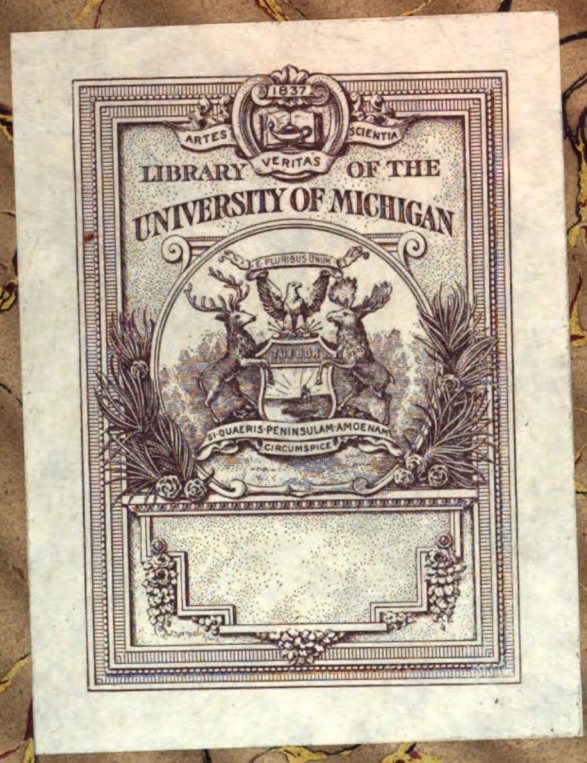
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Industries.

INDUSTRIES AND COMMERCE DURING 1890.

ALTHOUGH the prospects that appear to be in the immediate future are not, perhaps, quite so roseate as those of a year ago, yet it is hardly possible to claim that the trade of the year 1890 has been unsatisfactory. The amount of business done during last year by manufacturers and merchants has probably been fully equal to that done in any previous year, and has been much more satisfactory than that done in any recent year if we except the year 1889. The condition of trade has not, however, been so steady, nor has the prosperity of its different branches been so uniform, as in that year. Some departments have been enjoying an almost bounding prosperity, while others have been more or less depressed; but the great index to the actual average of the whole—the Board of Trade returns of exports—show that for the first eleven months of 1890—which is the period uniformly dealt with throughout this review, inasmuch as the full returns for the year are not available at the date of writing—there was an increased business to the extent of over fourteen millions sterling, as compared with the corresponding period of the previous year. While this is satisfactory, as far as it goes, it is not so to find that in the month of November our exports declined to the extent of nearly a million and a quarter; nor is it in some respects a matter for satisfaction that our imports have decreased to the extent of over eight millions sterling in the eleven months. It is, of course, possible that this has been a decline of prices rather than of volume, and if this were so it would be a matter for sincere congratulation. It is, however, all but impossible to estimate the volume of our imports, apart from their value, as they are expressed in terms that do not admit of comparison. Similarly, it is possible that the increase shown in the value of our exports is an increase of price rather than of volume, in which case the amount of work turned out, and consequently the amount of labour provided, would not be so great as the figures on the first inspection would suggest.

AGRICULTURAL INDUSTRY.

The condition of the agricultural interests of Great Britain appears to have considerably improved during the last two years, due partly to the better harvests, partly to the changes in the system of cropping (and especially the growing on a larger scale of vegetables, fruits, &c.), and partly to the increased demand for British produce at higher prices, rather than for foreign produce at lower ones. This last-named fact is, of course, only another way of stating that the purchasing power of the general community has been improved, so that they have been able more largely to buy British beef and mutton, where they had previously to buy foreign, and so with other articles in daily consumption.

The agricultural returns for the year 1890, which have recently been issued by the Agricultural Department, show that the total area of land under wheat crops in Great Britain in that year was 2,386,336, as compared with 2,449,000 acres in the previous year; of barley, the area under crops was 2,111,178, as compared with 2,121,530 in the previous year; and of oats the area was 2,902,998, as compared with 2,888,704 acres. The average yield per acre was for wheat, 30·74 bushels, against 29·89: of barley, 35·02, against 31·78; and of oats, 41·40, against 39·27 bushels. On the whole, therefore, the harvest has been a good one—considerably better than the average, as regards all three crops. There has, moreover, been a large increase in 1890 in the number of cattle and sheep in Great Britain. There is a diminished return in the statistics of the land under hop and beet crops, but there has been a larger area under small fruit, such as strawberries, currants, gooseberries, &c. It may be added that "the record of live stock in Great Britain in 1890 is the most satisfactory presented for many years."

So far as the second great branch of our agricultural industry is concerned—that of the distribution of imported foreign produce—the following table shows the quantities and the values of our imports for 1890, compared with the previous year:—

Imports of Agricultural Produce into the United Kingdom in 1889 and 1890.

	Imports. 1 = 1,000 Cwt. 1889.	1890.	Value. £1 = £1,000. 1889.	1890.	Average Value per Cwt. 1889. £ s. d.	1890. £ s. d.
Cereals:						
Wheat	53,623	55,185	20,629	21,274	0 7 8¼	0 7 8½
Wheat meal and flour	13,143	14,318	7,652	8,202	0 11 7½	0 11 5½
Barley	15,955	14,807	4,533	4,407	0 5 8¾	0 5 11½
Oats	14,690	11,114	4,063	3,419	0 5 6¼	0 6 1¾
Peas	1,517	1,571	494	514	0 6 6	0 6 6½
Beans	3,300	2,947	1,037	873	0 6 3½	0 5 11
Indian corn	34,113	41,333	8,089	9,296	0 4 8¾	0 4 5¾
Indian corn meal	22	56	18	30	0 16 4¼	0 10 8½
Totals	136,363	141,331	46,515	48,015	—	—
Other Food:						
Bacon	3,147	3,453	6,623	6,406	2 2 1	1 17 1
Salted beef	236	250	330	346	1 7 11¼	1 7 8
Fresh beef	1,251	1,687	2,739	3,568	2 3 9½	2 2 3½
Hams	897	1,122	2,302	2,658	2 11 3¾	2 7 4½
Other meat	652	753	1,630	1,962	2 10 0	2 12 1
Fresh mutton	1,177	1,535	2,367	3,199	2 0 2½	2 1 8
Salted pork	240	223	364	298	1 10 4	1 6 8½
Fresh pork	112	35	273	86	2 8 9	2 9 1½
Butter	1,759	1,852	9,310	9,630	5 5 10	5 3 11
Cheese	1,776	1,967	4,155	4,558	2 6 8	2 6 3
Rabbits	105	119	274	331	2 12 2	2 16 6
Totals	11,352	12,996	30,367	33,042	—	—

Of the total quantities of articles of food consumption received during 1890, the following proportions were received from the United States:—

	1890. Quantity. 1=1,000 Cwt.	Value. £1=1,000.	1889. Quantity. 1=1,000 Cwt.	Value. £1=1,000.
Wheat	15,681	6,262	15,330	6,149
Flour	11,025	6,148	8,912	5,016
Bacon	2,632	4,392	2,245	4,270
Salted beef	239	325	226	312
Fresh beef	1,545	3,308	1,153	2,556
Hams	1,009	2,378	798	2,032
Other meat	15	29	19	41
Pork, salted	174	240	175	263
Butter	80	305	98	401
Cheese	834	1,888	770	1,757
Cured fish	203	565	247	752
Lard	1,085	1,792	1,021	1,870
Totals	34,522	27,632	30,994	25,419

On comparing the two preceding tables, it will be noted that while the imports of cereals have increased in 1890 by some 5 millions of cwt., and those of other foods by about 1½ million cwt., there has been an increase of only about a million and a half in our imports from the United States. This would appear to show that we are not now depending upon the United States so entirely as we formerly did.

IRON AND STEEL.

The year 1890 has, on the whole, been fairly favourable for the iron and steel industries. There has been a considerable increase in the production of pig iron, the make for the first half of the year having been 4,168,464 tons, or about 85,000 tons more than the production for the first half of the previous year. The most marked feature of the year's business has, however, been the reduction of stocks, which now stand at about 590,000 tons, as compared with 1,030,000 tons at the same period of 1888. The furnaces in blast in Scotland at the latter part of the year were reduced to six in consequence of the labour troubles that occurred about that time, so that it is estimated that between the 6th of October and the 20th of December there was a reduction of 200,000 tons in the make, causing makers' yards to be completely cleared of stocks, and a reduction of 47,000 tons in the public stores. The immediate effect of the strike was to cause the Scotch ironmasters to blow out seventy-two furnaces, so that during the last three months of the year the trade has been in anything but a satisfactory state. Indeed, the only good thing that can be said about it is that the action of the trade has caused a reduction of stocks that may keep prices steadier in the time to come. The shipments of pig iron from Scotland during the year have been more than those of either 1888 or 1889, notwithstanding the reduction of make, and it is not a little remarkable that in spite of the diminished production, the diminished stocks, and the increased shipments, the price of warrants for the last few weeks has been exceptionally low, varying from 46s. to 47s. per ton, as compared with 57s. to 62s. at the same period of 1889. It is not expected that the makers of pig iron in Scotland will substantially alter the present situation until they can see their way to cheaper labour and cheaper raw materials, as these have for some time past been too high to admit of pig being made at a profit.

Meanwhile the position of affairs in Scotland tends to improve the prospects of the iron trade in Cleveland. In that district the make of pig iron for the first six months of 1890 exceeded by 43,019 tons the make for the corresponding half of 1889, and it is probable that the make for the second half of the year will be on at least as large a scale. The number of furnaces blowing during the second half of the year was the same as in the second half of 1889, and at the 1st of December last the total stocks in the district had been reduced to about 236,000 tons. In other districts the condition of the trade is fairly satisfactory.

In the steel trade prices have not kept up so well as could be desired, but production continues large. The total make of Bessemer steel and Siemens steel ingots for the first half of the year 1890 compares as follows with 1889:—

	1890. Tons.	1889. Tons.
Bessemer steel	1,055,280	1,048,256
Open-hearth steel	753,572	750,721
Totals	1,808,852	1,793,977

The production of Bessemer steel rails in the first half of 1890 was 510,459 tons, being an increase of 42,134 tons on the quantity produced in the first half of 1889. The demand for steel for shipbuilding purposes continues large, although not so much so as formerly. The production of plates and angles of open-hearth steel for the first half of the year is stated at 289,272 tons. There are now at work in the United Kingdom 241 acid and 23 basic open-hearth furnaces, while in the second half of the year 12 acid and 8 basic open-hearth furnaces were under construction. Several new open-hearth steel works are being proceeded with in Scotland.

Exports.—The total exports of iron and steel from the United Kingdom during the year 1890 compared unfavourably as regards quantity, but favourably as regards prices, with those of 1889, as the figures in the table at the head of the next column show.

In the following table, the total exports of iron and steel in each half of the year 1890 has been set forth, the quantities exported for December being taken as for November, and the totals for the second half and for the whole year being, therefore, subject to rectification to that extent. The fact that December has one more day than November must not be overlooked, but on the other hand, business is usually slacker about Christmas.

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Total Exports of Iron and Steel from the United Kingdom during the First Eleven Months of 1890, *with total Official Value, and calculated Average Value per Ton, compared with* 1889. (1 = 1,000).

	Quantity.		Value.		Average Value per Ton in £'s and Decimals thereof.	
	1890. Tons.	1889. Tons.	1890. £	1889. £	1890. £	1889. £
Pig iron	1,089	1,116	3,335	2,729	3·0	2·4
Bar, angle, and rod	197	235	1,482	1,496	7·5	6·3
Railroad	980	998	5,651	4,827	5·7	4·8
Wire	56	51	988	750	17·6	14·7
Hoops, sheets, and plates	307	357	3,515	3,799	11·4	10·6
Unenumerated iron	420	424	5,525	4,940	13·1	11·6
Old iron for re-manufacture	139	134	466	392	3·3	2·9
Tinplates	388	401	5,875	5,585	15·1	13·9
Unwrought steel	138	137	1,758	1,539	12·7	11·2
Other steel and iron	24	19	715	586	29·7	30·8
Totals	3,788	3,873	29,313	26,645	—	—

Exports of Iron and Steel during each half of the Year 1890.

	First Half. 1 = 1,000 Tons.		Second Half. 1 = 1,000 Tons.		Increase (+) or Decrease (−) in Second Half.		Total for Year. 1 = 1,000.
Pig iron	590	...	574	...	− 16	...	1,164
Bar, angle, bolt, &c.	96	...	122	...	+ 26	...	218
Railroad iron	576	...	473	...	−103	...	1,049
Wire	28	...	34	...	+ 6	...	62
Hoops, sheets, &c.	148	...	192	...	+ 44	...	340
Tinplates	191	...	232	...	+ 41	...	423
Other iron unenumerated	243	...	211	...	− 32	...	454
Old iron for re-manufacture	61	...	88	...	+ 27	...	149
Unworked steel	72	...	79	...	+ 7	...	151
Sundry steel and iron	14	...	11	...	− 3	...	25
Totals	2,019	...	2,016	...	− 3	...	4,035

In order to complete the information contained in this table, the values of the iron and steel exported during each half of 1890 have been treated in the same way in the following table, with the result that the total value of such exports, including steam engines and machinery, comes out as £52,306,000, a larger total than has ever before been realised in the history of the trade. It is satisfactory to find also that the value for the second half is greater than that for the first half of the year.

Statement Showing the Value of the Exports of Iron and Steel from the United Kingdom in each half of the Year 1890, *including Machinery and Steam Engines.*

	1890. First Half. 1=1000.		Second Half. 1=1000.		Increase (+) or Decrease (−) in Second Half.	
Pig iron	£1,875	...	£1,684	...	−	£191
Bar, angle, bolt, &c.	773	...	858	...	+	85
Railroad	3,369	...	2,664	...	−	705
Wire	493	...	596	...	+	103
Hoops, sheets, &c.	1,787	...	2,114	...	+	327
Tinplates	2,907	...	2,510	...	−	397
Other iron unenumerated	3,146	...	2,849	...	−	297
Old iron for remanufacture	215	...	285	...	+	70
Unworked steel	972	...	945	...	−	27
Sundry steel and iron	394	...	393	...	−	1
Totals	15,931	...	14,898	...	−	1,033
Steam engines	2,178	...	3,240	...	+	1,062
Cutlery and tools	2,046	...	2,053	...	+	37
Machinery and millwork.	5,785	...	6,175	...	+	390
Grand total	25,940	...	26,366	...	+	426

During the year 1890 our principal customers have been:—For pig iron, Germany; for bar, angle, and bolt iron, India; for railroad iron, the Argentine; for wire, Australasia; for hoops, sheets, and plates, Australasia; for tinplates, the United States; and for other unenumerated iron, Australasia. It appears, therefore, that for three of the principal classes of exports Australasia has come prominently to the front. Canada makes a good second, having taken from us the following quantities as compared with Australasia and British India (1 = 1,000):—

	Canada.		Australasia.		India.		Total.
Pig iron	40	...	28	...	—	...	68
Bar and angle iron	9	...	33	...	46	...	88
Railroad iron	108	...	85	...	210	...	403
Hoops, sheets, &c.	15	...	61	...	54	...	130
Tinplates	15	...	6	...	—	...	21
Unenumerated iron	8	...	64	...	62	...	134
Unwrought steel	13	...	—	...	—	...	13
Totals	208	...	277	...	372	...	857

Although these figures are interesting, and probably complete, so far as they go, they are not intended to record the total exports of iron and steel to any of the three groups dealt with, the full details not being available until a much later date.

OTHER METALS THAN IRON AND STEEL.

The course of the copper trade during the year has been favourable. The quantity imported to the end of November was 3,912 tons less than the imports for the previous year, while the deliveries were 29,388 tons more. The price of copper has been tending steadily downwards for some time, and is now about £53 17s. 6d., as compared with £50 2s. 6d. at this time last year, and £85 three years ago. It is stated that as low grade copper ore escapes duty under the McKinley Act, the Rio Tinto Company have contracted to deliver over 200,000 tons of sulphur pyrites in the United States, from which, after the sulphur has been extracted for the manufacture of sulphuric acid, over 9,000 tons of fine copper will be obtained. This looks uncommonly like "carrying coals to Newcastle," considering that of the world's production of copper in 1889, amounting to over 350,000 tons, the United States produced about one-third. The stocks of copper in England and France at the end of November were estimated at 16,315 tons. The copper works at home and abroad are doing well at present prices, so that efforts are being made in many directions to obtain a larger output. The business done in wrought copper has not, however, been so large as that done in the more crude forms of the metal.

The following is a statement of the exports of other metals than iron and steel during each of the years 1890 and 1889:—

Metal.		Quantity Exported in 1890.	1889.		Value of Exports in 1890. £ = 1,000.	1889.
Lead	tons	50,851	49,292	...	742	714
Tin, unwrought	cwt.	93,368	100,196	...	459	481
Zinc or spelter	,,	149,829	124,659	...	147	95
Copper, unwrought	,,	805,141	562,345	...	2,337	1,327
,, wrought	,,	260,437	279,523	...	875	838
Mixed or yellow metal	,,	336,867	273,391	...	963	722
Brass	,,	96,635	96,797	...	457	437

It will be observed that in almost all of the metals tabulated there has been a better business done in 1890 than in the previous year. The principal exception is tin, of which the exports have diminished by nearly 7,000 cwt., but probably this is due to the maintenance of a comparatively high price as compared with that of the previous year. Lead, on the other hand, keeps pretty stationary, alike as regards the quantity exported and the prices received. The table that follows shows how average prices have varied during recent years:—

Average Prices of Exported Metals in Different Years.

Year.	Copper Ingots. Per Cwt.	Yellow Metal. Per Cwt.	Brass. Per Cwt.	Tin, Unworked. Per Cwt.	Zinc. Per Cwt.	Lead. Per Ton.
1875	£4·40	£3·91	£5·44	£4·57	23·82s.	£23·17
1880	3·41	3·02	4·24	4·52	16·77	17·41
1884	2·94	2·73	4·24	4·27	13·59	12·58
1888	3·88	3·30	4·90	5·81	15·68	14·99
1889	2·36	2·67	4·51	4·81	15·63	14·56
1890	2·90	2·86	4·73	4·92	19·60	14·55

TEXTILE INDUSTRIES.

The recent course of the cotton industry has been well epitomised in the statement that "our cotton spinners and manufacturers received a million and a quarter sterling less in money in 1889 than they did in 1885, although they gave in exchange for it an additional 37 million pounds of yarn and nearly a billion and a half of yards of cloth, and this, too, while the conditions of the competition with the foreigner necessitated the production of a finer and more expensive quality." It should be observed, on the other hand, that there has been a substantial decrease of the price of the raw material, the average import of which has fallen from £3·47 in 1873 to £2·94 in 1880 and £2·49 in 1886 (this being the minimum), while in 1889 the price rose again to £2·64, and in 1890 to £2·66 per cwt. The import of raw cotton into the United Kingdom in 1890 has been 13,657,000 cwt., as compared with 14,621,000 cwt. in 1889, and 12,810,000 in 1888. There has, therefore, been a less importation than in 1889, but a greater than in 1888. As shown above, the price paid for raw cotton in 1890 has been fractionally more than in 1889. On the other hand, the average export price of cotton yarn has been 11·5d. per pound, as compared with only 11·13d. in 1889, and 10·94d. in 1888.

During the last three months an interesting official return has been published, which throws a good deal of light on the recent condition of the cotton industry of the United Kingdom. The return, which has been compared with 1856, shows that between 1885, when the last similar return was published, and 1889, to which year the latest figures relate, there was a decrease of 276 in the number of cotton factories, but an increase of 578,000 in the number of spindles, of 49,000 in the number of looms, and of 50,000 in the total number of hands employed. As against this, the imports of raw cotton rose from 12,730,000 cwt. in 1885 to 17,299,000 cwt. in 1889, while the exports of cotton yarn rose from 246 million lb. to 252½ million lb., and the exports of cotton piece goods from 4,374½ millions to 5,001¼ millions of yards. Two facts are clearly established by these figures—the first, that there is a tendency to establish and work factories of larger dimensions than formerly; the second, that there has been a considerable increase in the quantity of work produced relatively to the number of looms, spindles, and hands employed. This is very satisfactory, as far as it goes, and proves that the cotton industry of the United Kingdom is as progressive as formerly, whatever may be the case as regards other countries.

WOOL AND WOOLLENS.

The total home consumption of wool in 1890 is stated at 665,000 bales, as compared with 701,000 bales for the corresponding month of 1889. The Continental consumption was 979,000 bales in 1890, and 927,000 bales in 1889, while the American consumption is estimated at 48,000 bales in 1890, and 67,000 bales in 1889. The net imports of wool into the London market for the five series of wool sales were equal to 1,178,000 bales, as compared with 1,236,000 bales for the corresponding series of 1889. There has been a diminished importation of wool from the Colonies and the River Plate States, but the Colonial supplies do not much differ from those of 1889.

The imports of sheep and lambs' wool in 1890 reached a total of 576 millions of lb., as compared with 655¾ millions of lb. in 1889, and 583⅓ millions of lb. in 1888. There was a diminished export of woollen yarns and tissues in 1890, the figures comparing as under with each of the two preceding years:—

Year.	Yarns. 1 = 1,000 lb.	Woollen Tissues. 1 = 1,000 yards.	Worsted Tissues. 1 = 1,000 yards.
1888	39,004	81,719	135,225
1889	41,700	68,279	156,767
1890	38,135	51,476	160,600

The diminution in the exportation of woollen tissues in 1890 is very noticeable, but over the same period there has been a marked improvement in the exportation of worsted tissues. The total value of our exports of woollen and worsted manufactures was—

In 1890	£18,926,600
In 1889	19,504,000
In 1888	18,369,000

So that while the general result was not so satisfactory as in 1889, it was more so than in 1888.

The recent return made under the Factories and Workshops Acts shows that in 1889 there were in the United Kingdom 1,793 woollen factories, which employed 3,107,209 spinning spindles, 299,793 doubling spindles, 61,831 power looms, and 147,729 persons of all ages and sexes. The proportions attributable to the three several divisions of the United Kingdom were as under—

	Factories.	Spinning Spindles.	Employés.
England and Wales	1,429	2,477,964	114,209
Scotland	282	566,146	31,077
Ireland	82	64,099	3,443

There were, besides, 753 worsted factories in operation in 1889, employing 2,402,922 spinning and 669,328 doubling spindles, with 67,391 looms, and 148,324 employés.

OTHER TEXTILES.

Besides cotton and woollen textiles, there are those of jute, flax, hemp, and silk. An idea of the absolute and relative importance of each is presented in the following summary from the return already referred to:—

	No. of Factories.	No. of Spindles Spinning.	No. of Looms.	No. of Employés.
Flax	357	1,135,000	48,714	107,583
Hemp	105	41,724	516	10,572
Jute	116	268,165	14,107	44,810
Hair	42	1,987	352	2,583
Silk	623	846,575	11,464	41,277
Lace	408	—	—	16,930
Hosiery	257	—	—	24,838

In the numbers and equipment of most of these there has been a considerable improvement during the last few years, but this is especially the case with jute. The exports of jute yarn have more than doubled since 1880, and in 1890 the exports have exceeded by about 250,000lb. those of the previous year. There has also been a considerable increase in the exports of jute piece goods, and in the exports of linen yarn and piece goods. Silk, again, shows a considerably increased export, although at lower prices for broad stuffs. The average export prices for textiles are appended for a period extending over fifteen years:—

Average Prices of Exported Textiles in Different Years.

Year.	Cotton Yarns. Per lb. d.	Linen Yarns. Per lb. d.	Jute Yarns. Per lb. d.	Linen Thread. Per lb. d.	Woollen Yarns. Per lb. d.
1875	14·66	15·95	3·40	30·77	38·58
1880	13·25	14·25	3·33	31·02	30·33
1884	12·24	13·95	2·79	29·11	23·78
1888	10·94	14·48	2·46	30·58	22·81
1889	11·13	14·62	2·88	31·29	22·97
1890	11·50	13·54	2·72	28·70	23·90

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The above table is important as showing that the tendency of prices has been in the direction of reduction over the whole period until 1888, and that, although there has been a partial recovery since that year, prices are not now nearly so good as they were ten years ago, when trade was understood to be on a less satisfactory basis. The fact is that lower prices for raw materials, and improvements and economies in production, have enabled manufacturers to make probably as much profit on their generally extended output as they did some years ago, when the nominal prices were considerably higher, but the conditions of production were by no means so satisfactory. At the same time textile manufacturers have had a somewhat anxious time over the whole period, and even in the best of cases the profits are not by any means excessive.

COAL.

In the coal trade the business of the year just closed would have been entirely satisfactory but for the fact that labour troubles have interfered to prevent both employers and employed from enjoying the full measure of the advantages that should result from a large demand and an exceptionally high range of prices. There has been no year since 1873 when the demand for coals was so steady and considerable. Colliery proprietors have been taxed to the utmost to meet the wants of their customers; railway companies have been importuned to provide more rolling stock, in order to secure the adequate transport of the mineral; railway lines have in some cases suffered from a congestion of coal traffic, now rather rare; and consumers have sometimes had a difficulty in procuring all the supplies they wanted. It is expected that the total output for 1890 will exceed 180 millions of tons. Prices have kept up well throughout the year. Household coal has been in very great demand, at prices that recall the coal famine days of 1873, and coke has been in some districts exceptionally scarce, the price at the ovens ranging from 15s. to 17s. 6d. The exports have been 27,729,000 tons, as compared with 26,737,000 tons in 1889. The average export price has been about 13s., as compared with a fraction over 10s. in 1889.

SALT.

The operations of the Salt Syndicate continue to be carried on apparently with a considerable amount of success. The quantity of salt produced in the United Kingdom during the year 1889 was 1,946,496 tons. The quantity produced in 1890 has not been ascertained, but as the exportation amounted to 690,911 tons, being 67,000 tons more than in 1889, it is reasonable to suppose that the output will be found to have been larger. The average price for 1889 given in the "Mineral Statistics" was about 8s., and the average price for 1890, as ascertained from the export returns, was about 18s. per ton. In spite, therefore, of a continued higher range of prices, the production of salt continues to keep up. In most of the chief countries of the world considerable duties are levied on imports of salt, which are, of course, mainly derived from England. France imposes a duty varying from 11¼d. to 1s. 4d. per cwt.; Germany, 6s. 1d. per cwt.; Holland, 10s. 2d. per cwt.; the United States, 4⅓d. to 6¾d. per cwt.; and Spain, 2¾d. per cwt.; while in Italy, Greece, Turkey, Roumania, and Russia (as regards the ports of the Black Sea and the Sea of Azov), the importation of salt is prohibited entirely. Sweden and Belgium, on the other hand, allow salt to be imported free, while Austria only allows it to be imported by special permission, subject to a licence duty of 9s. 6d. per cwt.

CHEMICALS.

One of the most notable events of the year has been the formation of a syndicate in the chemical or alkali trade, which embraces, it is said, all the principal manufacturers in the kingdom, with a view to the limitation of production within a certain figure, and the maintenance of prices. The alkali business is carried on mainly in Lancashire, on the Tyne, and on the Clyde. It is a growing and important industry, importing raw materials to the value of nearly two millions sterling a year, and exporting, in the form of bleaching powder and alkali alone, products of the value of about £1,200,000, not to speak of the quantities consumed in the United Kingdom in allied industries, which must be very large indeed. The necessity for such a combination does not, however, appear to be very apparent. The average export price of alkali in the first six months of the present year was 6s. 2d. per cwt., as compared with a fraction over 5s. per cwt. in the first half of 1888, so that prices had advanced of their own motion before the movement for a syndicate had taken definite form. It has been otherwise with bleaching powder, the average export price of which fell from about 7s. 6d. per cwt. in the first half of 1888 to about 5s. 8d. per cwt. in the first half of 1890. It is to be observed that the price of chemicals has been abnormally low for a number of years, and although some firms, such as Messrs. Brunner, Mond, & Co., have been earning excellent dividends, the majority have had to be content with very lean results.

MINOR INDUSTRIES.

The course followed by most of the minor industries of the United Kingdom in 1890 has been fairly satisfactory, taking one with another. There has been an active business done nearly all along the line, and although in some cases prices have been lower than in the year 1889, labour has been steadily employed, where it was not itself the means of disturbance, and both profits and wages have ruled above the average. The following figures indicate the course of the exports of certain specific industries in each of the last two years—(1 = 1,000):—

		Quantity. 1890.	1889.		Value. 1890.	1889.
Alkali	cwt.	5,853	5,570	...	£1,917	£1,452
Bleaching materials	,,	1,611	1,384	...	467	515
Chemical manures	tons	294	294	...	1,889	1,858
Bags and sacks	doz.	2,436	2,873	...	595	721
Candles	lb.	11,524	11,413	...	240	210
Cement	tons	589	584	...	1,205	1,137
Products of coal		—	—	...	1,268	991
Earthenware		—	—	...	1,899	1,936
Flint glass, &c.	cwt.	1,288	1,341	...	806	828
Plate glass	sq. ft.	2,906	3,524	...	179	222
Paper	cwt.	653	644	...	1,101	1,147
Leather	,,	141	130	...	1,280	1,197
Painters' colours, &c.		—	—	...	1,454	1,437
Oil and floor cloth	sq. yds.	15,236	15,856	...	724	754

The average prices of some of the above manufactures exported from the United Kingdom at different dates compare as under:—

Year.	Alkali. Per Cwt. s.	Bleaching Materials. Per Cwt. s.	Cement. Per Cwt. s.	Flint Glass. Per Cwt. s.	Leather (Tanned). Per Cwt. £	Salt. Per Ton. s.
1875	9·16	8·79	2·61	60·09	8·89	14·75
1880	6·96	6·04	2·50	44·34	7·84	11·49
1884	6·37	8·21	2·25	46·94	9·45	12·91
1888	5·17	7·68	1·90	44·02	8·76	10·81
1889	5·22	7·39	1·95	45·40	9·18	16·15
1890	6·72	5·80	2·05	46·15	9·08	17·85

The same general improvement in realised values that is shown in the above returns would be found all through the piece, with but few exceptions. The general result is reflected in the extraordinarily large increase of the value of our exports for 1890 as compared with the considerable decrease in the value of our imports. There have, of course, been fluctuations of prices during each of the years in the series dealt with which are not reflected in the above averages, but, in general, the export prices, while of little use as a guide to the immediate movements of prices, are of considerable value as showing what has been the average result of the year's business in a particular branch of commerce.

SHIPBUILDING.

The course of the shipbuilding industry has been pretty evenly maintained over the year. The following figures, compiled from Lloyd's returns, show the number of vessels, and their tonnage, that were under construction at different dates during the year:—

	Number of Vessels.	Tonnage.
31st March	543	863,678
30th June	464	739,914
30th September	406	652,248

These figures clearly prove that there has been a substantial falling off in the number of vessels being built at our shipbuilding centres as the year proceeded, and the difference is more accentuated when the figures are compared with those for the corresponding dates for 1889. At the 30th of September, 1889, there were 230,000 tons more under construction than at the corresponding date of 1890. During the third quarter of the year, however, there were 242,000 tons preparing for construction, as against 99,000 tons at the close of the previous quarter, so that, taking the vessels actually under construction and those being prepared, there was a total of 894,000 tons at the end of the September quarter, as against a total of 838,000 tons at the end of the June quarter, indicating that towards the close of the year additional contracts were being placed.

The tendency to build vessels of larger tonnage continues to be a marked characteristic of the trade. According to the Board of Trade returns, the total number of steam vessels built in the United Kingdom in 1887 was 322, having a total of 225,000 tons, which represents an average of only 699 tons per vessel. In 1889 the total number of steamships constructed was 582, having a total of 554,000 tons, so that the average was 952 tons per vessel, or 36 per cent. more. At the 30th September last the total number of steel steamships under construction was 270, and the gross tonnage was 555,000, so that the average was not less than 2,055, as compared with an average of 1,999 tons in the ships under construction at the 30th September, 1889. It must be borne in mind that the Board of Trade figures are given in net, and Lloyd's returns in gross tons, but, even so, the greater size of the more recent vessels comes out very strongly.

Another characteristic of the shipbuilding work of the year has been the continued displacement of iron by steel. At the end of September of 1889 and 1890, respectively, the tonnage being built in steel was as under:—

	1889. Gross Tonnage.		1890. Gross Tonnage.
Steamships	759,532	...	555,220
Sailing ships	73,417	...	74,825
Totals	832,949	...	630,045

While the total tonnage being built in iron at the same two dates was as under:—

	1889. Gross Tonnage.		1890. Gross Tonnage.
Steamships	36,951	...	14,696
Sailing ships	9,995	...	2,750
Totals	46,946	...	17,446

At the latter date, therefore, only a little over 2 per cent. of the total tonnage of iron and steel ships being built in the United Kingdom was of the former material.

The greatest falling off in the shipbuilding work being done at the 30th September, 1890, was on the Clyde, and the next largest decline was on the Mersey. The details for the principal ports are appended:—

Gross Tonnage under Construction at

	30th September, 1890.		30th September, 1889.
The Clyde	165,286	...	229,959
The Tyne	122,158	...	140,434
The Wear	90,609	...	135,799
The Tees	108,435	...	104,792
The Mersey	16,126	...	9,465
Belfast and Londonderry	61,601	...	78,853

Of the total tonnage of shipbuilding under construction at the 30th September last, 427,000 tons were being built for British owners, being 65 per cent. of the whole. Among our foreign customers for tonnage the most important were, at the same date—

Germany,	with	45,110 tons.
British Colonies,	,,	27,150 ,,
Norway,	,,	26,440 ,,
France,	,,	14,495 ,,

SHIPPING.

There has been in the shipping, as in the coal, iron, and other industries, a great amount of difficulty and disorganisation caused during the year by labour troubles. At Cardiff, Glasgow, Newcastle, and other provincial ports, as well as at London, there has been an almost continuous struggle between the shipping firms and the dock hands, which has resulted in the establishment of a federation of shippers and shipbuilders, pledged to stand by each other in resisting what are deemed to be the unreasonable demands of dock workmen. The shipping interest is by no means so prosperous as it was a year ago. Freights are lower nearly all round, and in some cases a good deal of tonnage is laid up. At the same time, the business done in 1890 does not compare unfavourably with the past.

The total entrances and clearances in the foreign trade during the first eleven months of 1890 were as under, compared with each of the two previous years (1 = 1,000 tons):—

	Entrances.		Clearances.		Total.
1890	26,549	...	31,355	...	57,904
1889	28,131	...	30,463	...	58,594
1888	24,763	...	29,055	...	53,818

The tonnage of shipping entered and cleared in 1890 was somewhat less than in the previous year, but considerably more than in 1888. The most important foreign customer of the United Kingdom in 1890 appears to have been the United States, whence 5,076,000 tons entered in the first eleven months, as compared with 4,710,000 tons in 1889 and 3,982,000 tons in 1888. The clearances of shipping for the United States also appear to have improved, amounting to 3,136,000 tons, as against 2,970,000 and 2,832,000 tons in each of the two previous years. In the case of both our foreign and our colonial trades, the entrances to our ports have not shown so large a tonnage as the clearances from our ports, although the United States are in this respect exceptional, as already shown.

In the coasting trade the entrances and clearances compare as under (1 = 1,000 tons):—

	Entrances.		Clearances.		Total.
1890	26,385	...	25,276	...	51,661
1889	26,482	...	25,355	...	51,837
1888	26,672	...	25,338	...	52,010

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THE FRENCH EXHIBITION AT MOSCOW, 1891.

(*For description see opposite page.*)

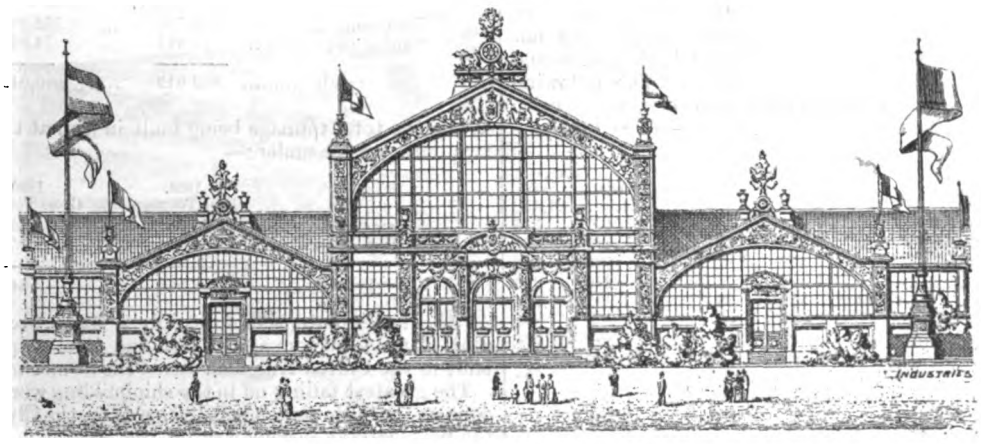


FIG. 1.—VIEW OE FRONT OF BUILDING.

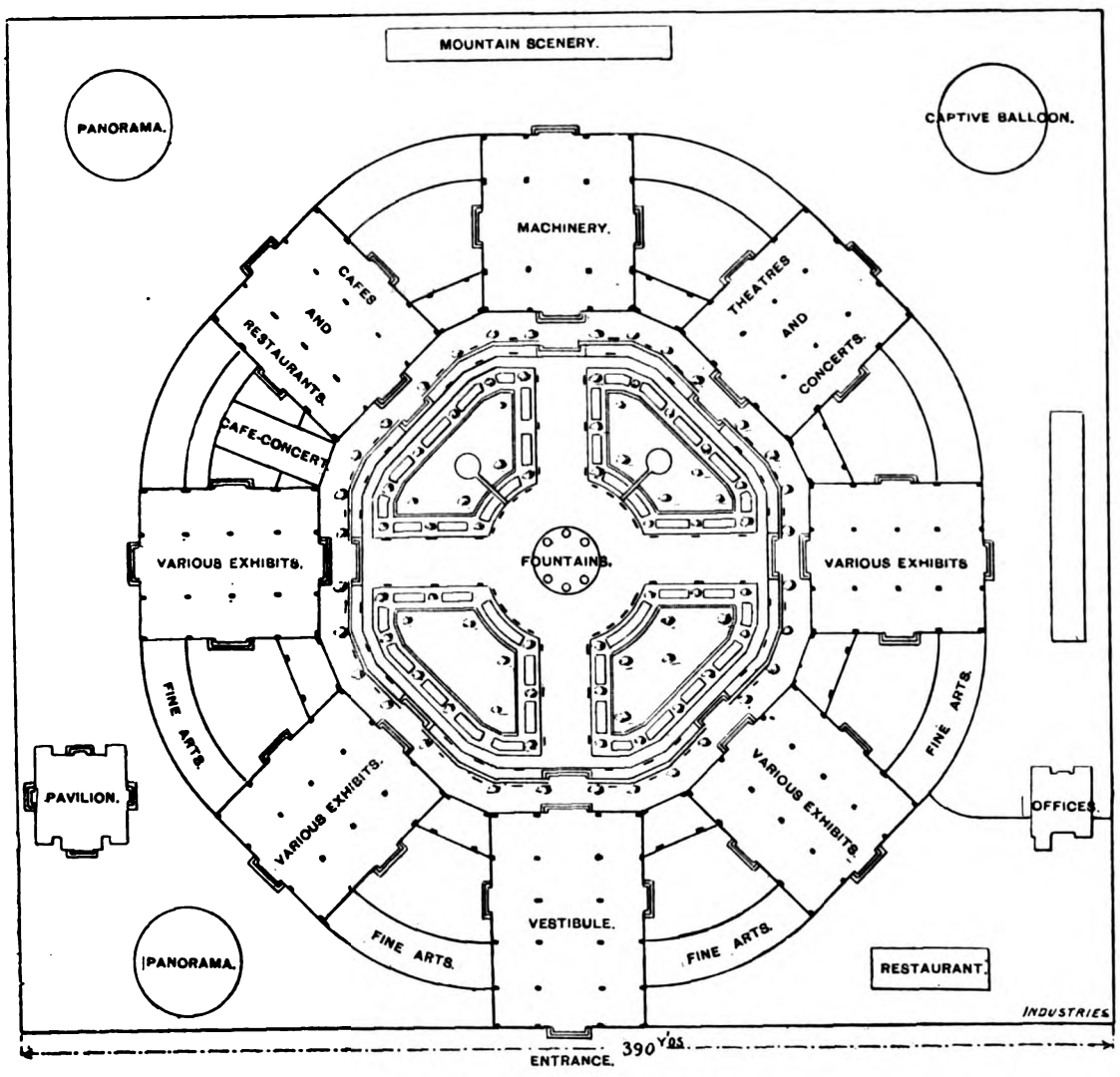


FIG. 2.—PLAN OF BUILDING.

The somewhat monotonous uniformity of the figures which illustrate the course of our coasting trade from year to year is a conspicuous fact, the entrances and clearances over the above period having varied to the extent of less than half a million tons, or less than one-hundredth part of the whole, in any of the years given.

RAILWAY RATES.

Another important event of the year from the point of view of trade and industry has been the close of the inquiry before the Board of Trade Commission relative to the maximum rates and charges, the classification, and the terminal and other arrangements to be made under the Railway and Canal Traffic Act of 1888. The inquiry was one of the longest, if not the longest, in the whole history of railway legislation. The Board of Trade have submitted proposals, alike as to maximum charges and classification, which are decidedly more favourable to the traders than those originally submitted by the railway companies. This, perhaps, was only what might have been expected, since it was an open secret that the railways did not expect to get all that they asked for under either head. But the Board of Trade proposals still leave something to be desired. They propose a terminal of sixpence per ton on coal, whereas the traders hold that a terminal of threepence is not only enough for the services rendered, but is also the sum allowed in certain principal Acts, including the main Act of the London and North-Western Railway. Then there is the question of the accommodation provided at private sidings, for which an indefinite charge may now be made, the question of what constitutes a train-load, and other minor details with reference to which negotiations continue to be carried on between the railway companies, the traders, and the Board of Trade, but on the whole the matter is in a fair way to be now speedily settled, and a Provisional Order will probably be applied for early next session.

TRADE AND FOREIGN TARIFFS.

Perhaps the greatest blow that has been threatened or aimed at British commerce and industry during the year 1890 has been the new American tariff, adopted and brought into operation in October last. This tariff had been under discussion for several months, so that neither merchants nor manufacturers in this country were unprepared for its adoption, and for the results that have both preceded and followed it. On the contrary, the utmost efforts were made by both, in view of the date when the tariff should take effect, to get all the merchandise possible into the United States, in order to discount its provisions, and as a consequence the Customs' warehouses and other centres of business activity in New York and other cities were congested with merchandise for a considerable time previously. The monetary crisis which subsequently occurred in New York has been attributed partly to this circumstance.

So much importance has been attached to the McKinley tariff, and to its probable effects on British trade, that it is interesting to refer to recent tariff history. Up to 1880 people who introduced tariff discussions were by common consent voted as bores, and it was seldom that the matter came up for public consideration. But the attempt made by the Democratic party to make the tariff a party affair, and to inaugurate a policy founded on lower duties, set the Republicans by the ears, and led to the adoption of a retaliatory policy. The tariff of 1883, the last important measure of the kind, found the average rate of duty on all imported commodities in that year 42·4 per cent. In the following year this was reduced to 41·6 per cent., and was followed in 1885 by an average of 45·8 per cent., and two years later by an average of 47·1 per cent. The Free Trade message delivered by President Cleveland in December, 1887, at the Fiftieth Congress, threw down a challenge which the Republicans were not slow to take up. The result was disastrous to the Democrats. Their opponents secured a substantial majority, and they did so upon the understanding, tacit, if not fully expressed, that the tariff, if interfered with at all, should be altered in the direction of increased duties rather than in that of lower rates. The McKinley Act is the result of this understanding, and it is admitted on all hands to be the most Protectionist tariff that the United States has hitherto produced. It is impossible at this date to say what average rate of duty it will impose on the imports into the country, but it is likely to be higher even than the high average of the years 1867–70, when the exigencies of war expenditure demanded an abnormally high range of duties, founded not so much upon protection to native industry as upon the actual needs of the revenue.

The *raison d'être* of the new tariff is to make provision in the United States for the establishment of industries that have hitherto been only imperfectly developed, or perhaps hardly established at all in that country. Of these undoubtedly the most important is the tinplate industry, which is peculiar in this respect, that it has up to the present time been carried on almost exclusively in South Wales, whence upwards of 300,000 tons of tinplates, valued at over 21 millions of dollars, were imported in 1889. The new tariff substituted a duty of $2\frac{2}{10}$c. a pound on imported tinplates, for the former duty of 1c., so that the amount to be paid in future will be over £10 per ton, or nearly as much as the whole value of the article at the place of production. With this protection it is believed and claimed that the United States will in the near future produce the whole of the tinplates required for their own consumption. The new duty will not come into effect until July, 1891, and it is to continue in force until October, 1897. Nine months are therefore given to the people of the United States to provide themselves with the means of producing their own tinplates, and they will have six years given to them to produce in any one fiscal year as much as one-third of all the tinplates imported for consumption in any year after October, 1890. If this result should not be attained within the period named, then tinplates of lighter weight than 63lb. per 100 square feet shall be admitted free of duty. But there is little reason for doubting that the sharp Yankees will find it possible to comply with this not very onerous condition. Already some Welsh tinplate makers, alarmed at the prospect of having their works stopped at home, are said to be

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arranging for suitable locations in order to establish works in America, and appear to be thus playing directly into the hands of those who have been seeking to ruin our home trade, on the principle, apparently, of throwing a big sop to Cerberus. The farmers will, meanwhile, have to grin and bear with the prospect of having to pay fully $1\frac{3}{10}$c. per lb. more for the tinplates used in their general tinned-meat industries than they have hitherto paid. The money, in point of fact, will be taken direct from the pockets of the agricultural interest, and transferred to those of those manufacturers who are henceforth to carry on the business of tinplate makers in America.

It is probable that this fact would have raised a considerable revolt on the part of the agriculturists, but for some considerations that have been thrown to them in other directions. Hitherto there has been a considerable importation of both raw and manufactured wool into the United States. In 1889 the value of such imports amounted to about 18 millions of dollars for raw, and to $52\frac{1}{3}$ millions for manufactured wool, in spite of a duty already deemed to be abnormally heavy by importers. Under the new tariff, however, the duty on wool and woollen goods has been generally increased, and this appears to have gratified the farming interest, who look forward to obtaining higher prices for their fleeces. So far, indeed, has this gone, that in Texas, which has heretofore been a distinctly pronounced Free Trade State (and has been represented by Mr. Mills, whose attempts to pass low tariff measures are well known), there has been an almost wholesale conversion to Protection in localities where wool is largely grown. It will, of course, be obvious that this will not affect the farmers of Minnesota and other important wheat-growing States. But there are two things to be said for these—the first, that every farmer in the United States looks forward to seeing his property opened up by the railroad, and industries thereupon established whereby he can not only sell his land at a profit, but his produce at an enhanced price; the next, that the farmers are very largely Republicans, and support the tariff because it is anti-Democratic. The duty on linen and linen goods has been increased, and this will be likely to give an impetus to the linen industry of the United States. In such a case we may probably find that the flax fibre produced by the farmers of the United States will come into requisition for the production of linen goods, instead of being a merely waste product, as at present. This would be a real gain to the flax-growing farmer, who can now utilise only the flax seed in the manufacture of oil-cake, and whose flax crop would thus become of much greater value. The agricultural interests, apart from wool and flax, are not likely to be affected directly by the new Act, and it need not be added that there is no likelihood of the ordinary agricultural produce of the country—cereals, potatoes, and so on—being influenced for the better.

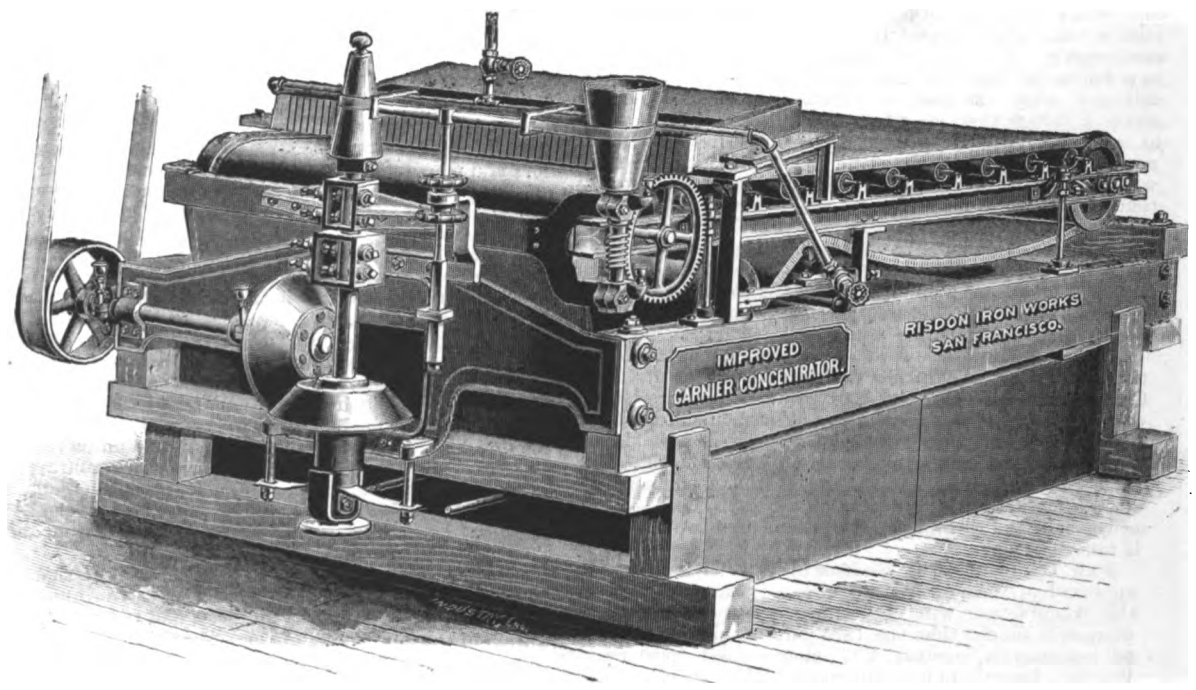
No other tariff matter has claimed much attention during the past year, unless it be the proposed new French tariff. This tariff, as ultimately adopted, will come into force on the expiry of the existing Treaties of Commerce, which is not very far ahead. So far as they have proceeded, the changes proposed in the present tariff do not appear to be favourable to British trade. The matter is, however, being well looked after. The Tariffs and Treaties Committee of the Board of Trade have directed the attention of the various Chambers of Commerce and other commercial bodies to the whole question, and evidence will shortly be taken by that committee as to the effect of the proposed duties on different industries.

RAILWAY TRAFFIC IN 1890.

The railway traffic returns for 1890 tell a very satisfactory tale. It appears that the total traffic receipts of the principal railways showed an increase in 1890 over the eleven months of the previous year of £2,595,000, and an increase over the corresponding period of 1888 to the extent of £6,329,000. This increase has been as marked during the later as during the earlier period of the past year, and it has been equally apparent in goods and in passenger traffic receipts. As regards the former, the total increase for 1890 over 1889 was £1,276,000, and over 1888 it amounted to £3,263,000. Now, the average receipts from goods and mineral traffic per ton carried in 1889 was 2s. 6d., and if this figure is divided into the excess receipts from the same description of traffic in 1890 it would follow that the tonnage carried by the railways in the latter year was about 25 million tons more than in 1888. This is a very problematical figure, however, inasmuch as the railways may have either raised or reduced their rates during 1890, and the result would be affected accordingly. The cost of working the railways of the United Kingdom in 1890 has been considerably more than in the previous year, or in any of the years going back to 1880, owing to the higher cost of labour and materials. Locomotive coal has cost from 2s. to 3s. per ton more, and so with rails, chairs, locomotives, and waggons. It does not, therefore, follow that the net profits of the companies have been higher because there has been so considerable an increase of gross profits. Indeed, it is believed in well-informed quarters that the net results will not be appreciably better than they have been on the average of the last five years.

THE "GARNIER" ORE CONCENTRATOR.

CONSTRUCTED BY THE RISDON IRON WORKS, SAN FRANCISCO, U.S.A.



GENERAL VIEW.

THE "GARNIER" ORE CONCENTRATOR.

THE above engraving represents an improved ore concentrator made at the Risdon Iron Works, San Francisco, U.S.A. These machines have undergone considerable modification during several years, retaining, however, in nearly all cases, the element of an endless apron or band, with some kind of movement to produce agitation of the sand or pulp as it passes from the feed end to the rear one. There are in some machines an "end shake," in some a "side shake," and also, in other cases, a shock or blow.

The present machine differs from all these. The table has a peculiar movement; the vertical shaft seen in front is connected to the apron, or table, by an eccentric bearing at the top, which gives a rotary movement to the apron and its frame at that point. The table is supported at the rear end, partially on the pivot studs seen at the side, and also by a fore and aft sliding bearing in the centre behind, which, permitting a forward and backward movement equal to the throw of the eccentric in front, but no movement sidewise at the rear end, so the sand on the table is first subjected to a kind of mixed circular movement, which is gradually changed to a reciprocating one, as the material moves back from the feeding end. The material is fed on from the hopper boxes seen on top, and the "concentrates" caught below in the usual manner.

The machine is started and stopped without shock by means of the bevel friction wheels seen in front, the horizontal shaft running continuously. The rotary movement of the table is derived from the vertical shaft in front by means of the cone pulleys and a band, as shown. This band is adjusted up or down, while the machine is in motion, so as to regulate at pleasure the movement of the apron over the rollers on which it is supported. The double shipper is adjusted and held by the two small hand wheels seen on the screw stem in front, and every working part of the machine is in plain view and accessible.

On the grounds of simplicity and absence of detail, this concentrator seems to have a good many points in its favour, and supposing its functions, due to the peculiar movement before explained, to have the advantages claimed, the machine will, no doubt, meet with success, especially as the process of fine concentration is increasing in favour, and also in adaptation to the requirements of present gold mining industry in California.

THE FRENCH EXHIBITION AT MOSCOW, 1891.

AN Exhibition is to be held this year at Moscow which will be open for a period of six months—from May to October. This Exhibition will be exclusively devoted to the productions of the French nation, a concession having been obtained by a committee of French merchants and manufacturers from the Czar for that purpose.

The Exhibition will be divided into the following nine sections, as follow:—

1. Fine Arts.
2. Education. Liberal Arts.
3. Furniture and Accessories.
4. Textiles.
5. Raw Products.
6. Machinery. Electricity.
7. Food Stuffs.
8. Agriculture. Vine Culture.
9. Horticulture.

The Exhibition will be held in the building which was erected for the Russian Exhibition of 1882. We give in Figs. 1 and 2 on the previous page an elevation and plan of the building. The building is of an octagonal form, and consists of eight large pavilions connected together by galleries. Each of the eight pavilions has a length of $60\frac{1}{3}$ metres, and a breadth of $51\frac{1}{2}$ metres. The total amount of space under cover is about 35,000 square metres. The space in the centre is laid out as a garden, in which fairy fountains are being erected, such as were used at the late Paris, Manchester, and Glasgow Exhibitions.

The Exhibition will be lighted throughout with the electric light, which is in the hands of one of the principal Paris companies.

Every facility is being given to induce the French manufacturers, &c., to send exhibits, and already a large number of applications have been made for space. The French, therefore, are not likely to let slip such a good opportunity of making the productions of France better known to the Russian people. We are indebted to the *Société des Ingénieurs Civils*, of Paris, for our illustrations.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 30th December, 1890.

Iron.—Business is this week practically at a standstill in the iron markets; but enough has been done to show a distinctly marked downward tendency in prices. The year ends with a weak market for bars at 132s., and for joists at 136s. a ton. The prospect for the new year is, however, encouraging. The fact that consumers are willing to pay 4s. a ton more than the rates now current for iron to be delivered after the end of February is evidence of a state of things that must bring about a recovery as soon as we have fairly entered on the year 1891. The latest news from the provinces is of the same character—present weakness with a prospect of speedy recovery. The situation is at its worst in the Nord. The Customs' returns for the first eleven months of the current year show the following changes relatively to the corresponding period of 1889:—Imports: Pig iron, 129,142 (110,692) tons; finished iron, 28,860 (25,453) tons; steel, 7,918 (8,752) tons. Exports: Pig iron, 158,827 (91,690) tons; finished iron, 63,530 (5,912) tons; steel, 38,912 (29,759) tons.

Metals.—The downward movement in metals continues. Copper has further declined several points, best Chili bars being offered at £58. Buyers hesitate, however, to deal at that price. The recent financial crisis in London seems to have crippled the group of speculators who have for so long a time controlled the market. The same cause probably has led to a further decline in the spelter market. Tin has also given way. Lead has receded a little in sympathy, but the market for this metal is fairly strong.

New Carbine.—The Minister of War having formally approved of the new pattern of cavalry carbine proposed, the manufacture will be commenced forthwith. This weapon is shorter than the 1874 pattern, hitherto in use—96 centimetres, against 1·17 metres—and considerably lighter. Its calibre is 8 millimetres. The effective range is said to be 2,000 metres. It is a repeater, the magazine containing three cartridges. The small arms factory at St. Etienne is under contract to supply 30,000 carbines in the first three quarters of 1891.

BERLIN, 29th December, 1890.

Iron.—Business in the iron market is, on account of the holidays, almost at a standstill. Nevertheless it is possible to perceive a further improvement in the situation. The tone of affairs generally is stronger. In Upper Silesia the stocks of pig in the hands of the blast furnace owners, never very large, have been perceptibly reduced in the course of the last three weeks. The manufacturers of finished iron and steel have orders enough in hand to enable them to begin the new year free from great anxiety, to say the least. Favourable reports, too, have been received from the Rhenish-Westphalian districts, where pig iron has become very firm in price, with a distinctly upward tendency in some sorts. The total production of pig iron in Germany, including Luxemburg, in the month of November amounted to 361,384 tons, against 373,090 tons in the previous month and 389,116 tons in November of last year. This brings up the total for the first eleven months of the current year to 4,200,465 tons, against 3,995,981 tons in the corresponding period of 1889.

The Silesian Nickel Deposits.—The newly discovered deposits of nickel and chrome ores near Frankenstein, in Silesia, are turning out to be very rich. Herr Krupp has ordered the immediate delivery of 100 tons of nickel ore, 20 tons of which have already been despatched from the mine. Herr Krupp has, it is said, offered 1,500,000 marks for these mines. The discovery of these deposits is an important event in the history of the German iron and steel industry.

Smokeless Powder Manufacture.—Hitherto the posts of superintendents and managers of the powder factories at Spandau have been filled by artillery officers. These are now to be replaced by civil engineers and chemists, it having been found necessary to employ men possessing special knowledge and training in the manufacture of the new smokeless powder. The production of this powder involves operations demanding high scientific attainments on the part of those whose duty it is to direct them.

Navigation on the Rhine.—According to the latest edition of the navigation register 6,502 crafts ply on the Rhine, amongst which are 661 steamers. Of the wooden ships 2,637 go under the Dutch, 568 under Prussian, 450 under Belgian, and 828 under other flags; of the iron boats, 566 under Dutch, 511 under Prussian, 104 under Belgian, and 177 under other flags; of the paddle-steamers, 105 under Prussian, 32 under Dutch, 14 under Hessian, and 16 under other flags; of the screw-steamers, 229 under Dutch, 141 under Prussian, 58 under Belgian, and 66 under other flags. Messrs. J. P. Lanz have established a regular goods service between Mannheim and Antwerp.

Firearms.—A Bill has been brought into the Reichstag to render it obligatory on all manufacturers of firearms to submit the barrels and breech mechanism to certain tests about to be imposed. These tests will be similar to those of the London and Birmingham proof-houses. Any manufacturers offering firearms for sale not bearing the proof-house mark are to be made liable to heavy fines and imprisonment. It is surprising that this measure was not taken years ago. A similar law to that now proposed has long been in force in Belgium, France, and England. The large export trade in German guns makes this question of proof one of wide interest. The declared value of sporting guns and parts thereof (chiefly barrels) amounted in 1885 to 1,385,000 marks, in 1886 to 1,076,000 marks, in 1887 to 944,000 marks, in 1888 to 1,174,000 marks, and in 1889 to 2,155,000 marks. In 1882 there were in Germany 1,686 gunmaking firms, only six of which are classed as employing over 200 and less than 1,000 hands. The total number of persons employed in these works in that year was 6,647.

VIENNA, 29th December, 1890.

The Iron Market.—At a recent meeting of owners of mines and manufacturers of iron and machinery, under the presidency of Count Larisch-Moenich, an authoritative report on the mining industry for the past year was presented. After reference had been made to the late Prince Salin, who was formerly president of the society, the following report was submitted to the meeting:—There has been a steady business during the past year, both in the coal mining industry and in the production of coke, the consumption being regular. The traffic arrangements have been good throughout the year, and the results of last year's trade may be regarded with satisfaction. The condition of the pig iron industry and of the production of medium and refined qualities was very favourable during the first half of the year, and prices showed an increase as compared with those of the previous year. During the summer the speculation of foreign markets caused an unnatural rise in prices, which had its effect on the home market. In consequence of increased production, and a decrease in the demand, producers were obliged to make concessions, and prices are now generally lower than they were in the first half of the year. There is now no excess of production in the iron industry, and the present condition of the market is sound. There is a good prospect for next year, if the agreement with the German Empire should not have the effect of allowing foreign goods to enter our market through a reduction of the customs duties.

Copper, Zinc, and Tin.—The tin, zinc, copper, and mercury industries have done a steady business during the past year. There was no important fluctuation in prices, and the decrease which was caused by a fall in the exchange was compensated by a rise of prices in foreign markets. No change in the favourable condition of business is to be feared, since important contracts have already been concluded at the existing high prices, and larger supplies are wanting. Under these circumstances our mining and iron industries expect that their interests will not suffer by reason of the negotiations now being carried on with other districts. The St. Egydier iron works made similar announcements on the occasion of their general meeting, which would indicate a higher dividend than that of the previous year. Owing to the holidays, business is now entirely suspended.

Electrical Railway from Vienna to Budapest.—A movement is being started in Vienna and Budapest to obtain a concession for the carrying out of preliminary works for an electrical railway between Vienna and Budapest. A speed of 100 kilometres per hour is to be attained, and the distance is to be accomplished in about three hours. In the technical departments of the Ministry of Trade the project is looked at very sceptically, and is considered premature in view of the present condition of transmission of power from a distance. No decision has yet been given in the matter.

BRUSSELS, 30th December, 1890.

Iron.—The general aspect and tone of the iron markets is unsatisfactory. The produce of the blast furnaces is disposed of with difficulty, and prices are weak and drooping. The Cockerill Company have blown out two of their seven furnaces. Production everywhere is being reduced, yet stocks continue to accumulate. Matters are but little better in the rolling mills. The home demand has dwindled away to nearly nothing, and export orders are secured only by making such concession in prices as leave a loss on the transaction. The Customs' returns for the first ten months of the year show a falling off relatively to the corresponding period of 1889. Thus the year 1889 ends in depressing circumstances, unrelieved by any promise of better things in the near future. The difficulties of the situation, already very great, seem likely to be yet further increased by dearer fuel, the attitude of the colliers being such as to destroy all confidence in the stability of the coal markets.

Glass.—Business in the glass market is very slack, largely on account of the holiday season, but partly also by reason of the weak tendency of prices, which leads consumers to defer their purchases. The time is not far distant when the prices of German plate glass will have to be reduced, and a change of that sort must operate unfavourably upon Belgian trade, which already suffers keenly from German competition. The export trade to England continues moderately active, but is considerably below that of last year at the same season. The recent rise in soda sulphate has made the situation critical.

New Small Arms Factory.—The erection of the small arms factory at Liège for the manufacture of the new rifle for the Belgian army proceeds apace. The buildings will cover some 8 hectares. One of these will enclose 10,000 square metres, the roof of which will be supported on 400 cast-iron columns. When completed this factory will be one of the largest and most perfectly equipped in the world. The newest designs of machinery will be employed. Some of the machines have been purchased in Germany; the rest, for the most part, in the United States. The works, which will cost about 4,000,000fr., will be capable of turning out 250 finished rifles daily.

DÜSSELDORF, 30th December, 1890.

Iron.—Though there is but little business doing in this holiday season, it is easy to discern an improving tendency in the state of the iron markets. Prices have become very firm. At the last meeting of the Rhenish-Westphalian Pig Iron Makers' Association, held on the 22nd inst., it was decided to make no change in the minimum. A circular issued by the Joint Manufacturers' Union directs attention to the underselling which has been going on among merchants, and informs customers that no reduction will be made by the manufacturers, and that therefore this "bearing" speculation must fail. The prospects of the pig iron market have greatly improved of late. According to present indications, a moderately brisk demand, likely to grow as spring approaches, may be expected in the second half of January. The willingness with which the recent rise in the price of bars is paid by consumers is a hopeful sign. The situation of the finished iron and steel markets is, on the whole, strong and full of promise for next year's trade. The export business is still very slack; but though slowly, it is steadily and constantly reviving.

Coal.—The demand for coal is unprecedented in this district, and the mines are being worked to the utmost of their capacity. The output now reaches 120,000 tons a day, the railways being taxed to the utmost of their powers to keep the pit banks clear. This extraordinary demand, coupled with the formation of syndicates to control and regulate the markets for all sorts of coal and coke, renders it certain that no reduction of prices will take place this winter, and probable that the present level of prices will be maintained for many months to come.

Founders' Prices.—The Hesse-Nassau group of the Association of German Ironfounders held a meeting at Frankfort the other day, at which the influences now operating to increase the cost of production were discussed. The general conclusion arrived at was that, in view of the present state of the labour market and the certainty of the prices of coal and coke being maintained for a long time to come, it was undesirable to reduce the prices of castings. It was further agreed to restrict production to the current needs of consumers.

LILLE, 30th December, 1890.

Iron.—There is no sign of speedy improvement in the iron market of this district. Bars and joists are pressed for sale, not only by merchants, but by manufacturers, so that the price is weak at 112s. a ton. Very little business is being done even at this price. The calm is in large part due to the holidays and the stocktaking season; but, apart from this, the situation is weak. Great changes must take place before there can be anything like a return of activity. Thus the year 1890 ends in unfavourable circumstances in so far as the iron industry of this locality is concerned, and the prospect for 1891 is depressing.

Textile Manufactures.—Very little business has been done in linen goods in the course of the last week. The holiday season is now in full swing, and no resumption of business is to be looked for till near the middle of January. The tone of the market is good, and there are indications of a brisk spring trade. Prices remain unaltered. The year ends favourably for the Roubaix woollen goods trade. Manufacturers are busy on summer orders. It is yet too early to predict what patterns will "take," for the travellers are but just starting on their rounds with the new designs, but it is likely that the fashion will run on very light goods.

Flax and Yarns.—The situation has changed but little during the past week in so far as flax is concerned. The holidays have brought business almost to a standstill, but enough has been done to show a weak tendency in prices. There has been a moderately brisk demand for fine linen yarns, and prices are higher than they were at the close of last week. This is the only direction in which there has been anything like activity. The calm may be expected to last till the end of the first week in the new year.

AMSTERDAM, 29th December, 1890.

Holland and the Crisis in the River Plate.—The economical crisis in the Argentine Republic has reacted most seriously upon the trade with Holland, which was, comparatively speaking, of recent growth. The Consul-General of the Netherlands at Buenos Ayres has sent repeated warnings against emigration to the River Plate under the present circumstances, and his latest communication to his Government upon this subject is more emphatic than ever. He writes—and his letter is printed in the *Official Gazette*—that the crisis is not by any means past, but rather goes on deepening, and seriously presses upon all trade, but particularly upon the artisan class. Agriculture, he maintains, is in a sorry plight, and peasant colonies are far from flourishing. Under such depressing

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circumstances the Dutch Consul-General once more deprecates emigration, especially of the artisan class, even where the passage money should be advanced. In connection with these repeated warnings, it should be noted that the Netherland-American Steamship Company has decided to discontinue its South American business for the present. Until further notice no steamers of this line will leave Rotterdam for the River Plate. The resolution was come to all the sooner by the directors because the South American branch of the business had not yielded brilliant results from the beginning, and freight was latterly at a very low ebb. For Rotterdam the stoppage of these steamers means a great loss. Latterly the imports of Brazil coffee by them had developed immensely, no less than 165,629 bags being landed there this year to the end of November.

THE WEATHER AND NAVIGATION.—As previously reported, the severe frost has seriously impeded navigation upon our rivers and canals. Upon the North Sea Canal, however, communication has been restored by the united efforts of two English steam vessels, the "European" and the "Seahorse," efforts stimulated by the offer of a premium of 5,000 guilders for the breaking up of the thick ice by a combination of interested merchants. Thirteen vessels immediately availed themselves of the opportunity to reach Amsterdam. Curious to say, the Government, to which the canal belongs, does not consider it a duty to keep the the waterway open under all circumstances. In 1881, under similar circumstances, the above-named "European" earned a gold medal for "forcing" the ice in the canal.

NEW LINE OF STEAMERS TO JAVA.—The Ocean Steamship Company (Holt Line), of Liverpool, will on the 15th February next inaugurate a new fortnightly service of steamers from Amsterdam to Singapore and Java. The first boat from Java will leave early in January. The same steamers had already, at irregular intervals, transported Sumatra tobacco to Amsterdam, where arrangements are completed for loading and discharging.

STOCKHOLM, 27TH DECEMBER, 1890.

NEW RAILWAY MATERIAL.—The Board of the Swedish State Railways have applied for a sum of 1,500,000kr., to be applied to the purchase of new rolling stock. The sum of 580,000kr. will be applied to the purchase of ten new locomotives, and the balance to the purchase of 230 covered carriages, of which thirty shall be passenger carriages. The Board have already ordered rolling stock to the extent of the funds available up to the end of 1891. When these orders are completed, the State railways will have 329 locomotives. Of these, 30 are, however, of such an old type that they are only used in cases of emergency. The express train locomotives have to do about 45,000 kilometres, and the goods train locomotives an average of 28,000 kilometres per annum. This heavy working entails considerably increased repairing expenses and too much wear and tear of the locomotives. The insufficiency in the number of locomotives makes it impossible to repair them soon enough, and the Board of the State Railways contemplate a further increase in the number of locomotives. The same remark applies to the carriages, of which about 1,000 goods carriages and 200 passenger carriages require repairs.

WOOD PULP.—The whole of 1891's production of that kind of wood pulp which is being treated with soda (soda pulp) has been bought by a London firm. It is consequently expected that this class of wood pulp will experience an advance, whilst all other kinds are dull.

ICE-BREAKING STEAMER FOR RUSSIA.—The new ice-breaking steamer "Ledohold," built at the Lindholmen shipyard, had a very satisfactory trial trip on the 15th inst. During the trial trip the "Ledohold" made 11¼ knots, against 10 knots as per contract. The engines are of the triple-expansion type, and the propeller is "Stone's patent." The entire material and the whole machinery are Swedish. The steamer's destination is Nicolajev, on the Black Sea.

LARGE RAILWAY BRIDGE.—A large bridge from the Bergsund Engineering Company has just been delivered and fixed over the Lögde River. The bridge has a length of 110 metres in three spans of 33·75 metres, 40·5 metres, and 33·75 metres respectively. It rests upon two high steel piers, and the road of the bridge lies about 28 metres above the level of the river. The cold during the fixing has reached as much as -32° C. The material is Domnarfort steel.

CHRISTIANIA, 27TH DECEMBER, 1890.

MORE NEW VESSELS.—A steamer, intended for fishing purposes, has recently been ordered at the Frederikstad Engineering Company by Captain T. Beck. The dimensions are as follow:—Length, 127ft.; breadth, 19ft.; and depth in hold, 13ft. The engine is to be triple-expansion, of 350 i.h.p.; boiler, 11½ft. in diameter and 10ft. long. It is to have a considerable speed, and to be used at the Lofoten fishery. At Christiansand a new syndicate has been formed for the building of a 2,500 ton steel vessel. What is probably the largest wooden vessel ever built in Norway was launched a few weeks ago at Hölen. She has been named Excelsior," and is built to the order of Consul Oppen. The tonnage is about 1,450 tons; length, 203ft.; breadth, 39ft.; and she is built exclusively of first-class materials. The bottom masts are of iron. The "Excelsior" will be fitted with steam winch and all other modern appliances, and is intended for the Australian trade.—The various Norwegian shipyards continue to be very busy.

FISH MEAL MANUFACTORY.—A fish meal manufactory has been started at Vordö by Professor Wange, who has himself superintended the erection of the works at this remote place.

VOLLÖ PAPER MANUFACTORY.—A large wall paper manufactory has been rebuilt at Vollö in lieu of the one burnt down last year. The production is expected to reach 3,000 rolls of paper, each 24ft. long, per diem. The works turn out wall paper of the most varied kinds. The principal market is Norway, Sweden, Finland, and Denmark.

SALVAGE STEAMER.—The want of an efficient salvage steamer on the Norwegian coast has been felt for a considerable time. The steamer built by Mr. Binz will be about the same size as the well-known Switzer Company's steamers, and is two or three times as large as any other Norwegian salvage steamer. Its dimensions are—length, 122ft.; breadth, 23ft.; depth, 13ft.—and it has a capacity of 198 registered tons. It has been specially constructed with a view to seaworthiness, and was constructed of the best timber at a shipyard close to Bergen. It is built to the highest class Veritas. The vessel will be fitted out so as to be used both as a life-saving and a salvage steamer.

NEW TEXTILE MANUFACTORY.—A new textile manufactory has been erected at Kongsberg, under the style of the "Konsberg Tricatoze Fabrik," and there seems altogether to be a good feeling in that locality for industrial enterprise.

COPENHAGEN, 27TH DECEMBER, 1890.

THE COPENHAGEN BREWERIES.—For about a year negotiations have been pending with the view of bringing about an amalgamation of all the Copenhagen breweries, with exception of the Tuborg, the Gamle Carlsberg, and the Ny Carlsberg breweries. The prospects of such an arrangement have fluctuated considerably, and more than once the scheme has been looked upon as virtually abandoned. The efforts of Mr. Tietgen have now been crowned with ultimate success. About a dozen breweries in Copenhagen and its immediate neighbourhood will now be amalgamated into one large brewery company, with a capital of about 12,000,000 kr. The plan was a difficult one to realise, for the breweries in question were paying widely different dividends on their capitals. One or two, in fact, showed very little profit. In addition to this cause, a natural opposition to the plan was shown by one or two of the breweries outside the arrangement, one of them having made a very good offer for one of the breweries in the ring. Their names are:—Kougens, Beyghus, Marstrands, Aldersro, Robeshove, Rahbeck's Allee, Svanholm, Toedes, and Frederiksberg.

MADRID, 29TH DECEMBER, 1890.

THE HUELVA FUMES.—The Royal decree, which prohibited the open-air roasting of pyrites, has at last been repealed. The present decree is only provisional, but a permanent measure will be introduced at the next sitting of the Cortes. It seems certain that the quantity of ore treated by the present method, which is so destructive to the surrounding country, will be lessened. The present decree gives the companies time for the adoption of a less harmful method of treating the ores.

THE NEW SCHOOL OF MINES.—Building operations have been suspended for some months, in consequence of a proposed change in the kind of material to be used, but will now be actively carried on. The building will be a fine one, and suitable for its purpose.

THE "GRAN CENTRAL ESPAÑOL" RAILWAY COMPANY.—Certain lines of railway are to be amalgamated under the above title, which has been given in imitation of the Midland Railway Company in England and the "Grand Central" in France. The lines do not seem well fitted for amalgamation, and the system is defective in consequence of its being connected with only one port, Pasages. The system will not be really connected with Lisbon and the Portuguese lines. In addition to these disadvantages, it does not pass through any coal district, and its only entrance into Madrid is over the Zaragoza line for a distance of at least 150 kilometres. The line from Madrid to Caceres, 429 kilometres in length, is to be amalgamated with the system, together with some other lines in process of construction. The scheme is intended to relieve the Royal Portuguese Railway Company from obligations entered into with the Caceres and Western lines, which entailed an annual loss of £120,000. According to this arrangement the loss will be reduced to a half of this amount, and the Portuguese Company, which is in a sound financial condition, will hand over 70,000 debentures of £20 each and receive the same amount of debentures from the Gran Central, thus exchanging a saleable security for what is at present unsaleable. When all the lines of the new company have been completed, the distance from the French frontier to Madrid and Lisbon will be shortened.

THE ELECTRIC LIGHT AT THE CONGRESS BUILDING.—It has now been decided that the building of the Congress de Dipitados (House of Commons) is to be lighted electrically. A commission has already been appointed to deal with the matter, which must be promptly carried out if the installation is to be ready before the opening of the Congress next spring.

EXPORT OF IRON ORES FROM BILBAO.—The exports for the past year are the largest on record, even including those for the year 1887, when, owing to low freights and prices, the shipments were in excess of the actual demand.

NEW YORK, 20TH DECEMBER, 1890.

RAILWAY ASSOCIATION.—The conference which was held in New York on the 15th inst. by officials of the Western railways for the purpose of forming a railway association promises to have a beneficial effect on Western business. The principal purposes of the association are to be the establishment and maintenance of public, reasonable, uniform, and stable rates, which shall be fair to the business public and yet leave a margin of net earnings to the railways; to secure to each railway in the association the due proportion of business to which it is naturally entitled; to prevent unnecessary and expensive diversions of traffic; and to introduce new methods in freight and passenger traffic, the aim being to accomplish these results by the introduction of economies in doing business without increasing the rates.

STRIKE IN THE RIBBON TRADE.—About one hundred ribbon weavers in the silk mill of Mr. C. E. Weding and fifty-six in Messrs. Francke & Duggan's mill, Paterson, N.J., struck recently in consequence of a proposed reduction of wages amounting to from 20 to 25 per cent. The reduction applies to wages after the present ones are run out. The manufacturers say they are forced to take this course by the unprecedented dullness in the ribbon business, and that similar action will probably be taken by all the manufacturers. Unless the reduction is accepted by the weavers the owners say that the mills will be closed, as they have been running at a loss for some time. The strike is considered ill advised, for the prospects are not at all good for the silk business.

BARBED WIRE.—A largely attended meeting of representatives of the barbed wire manufacturers of the United States was held in Chicago a few days ago. Mr. J. W. Gates, representing the St. Louis Wire Works, called the meeting in a circular issued two weeks ago, requesting the attendance of representatives of all the makers, as the meeting was to be an important one. The intention of the manufacturers, as announced by Mr. Gates, is to raise the prices on barb wire 1c. per lb., and form a trust.

THE POUGHKEEPSIE BRIDGE.—A traffic agreement has been concluded between the Baltimore and Ohio Company and the Poughkeepsie Bridge Company, by means of which all the New England freight, which has hitherto been sent by way of New York, will hereafter go over the bridge. The business over the bridge is increasing so rapidly that the company finds considerable difficulty in providing sufficient motive power. In September, 1889, fifty-two loaded cars passed over the bridge, and in the following month the number was doubled. In May of the present year the business had increased to 800 cars, in October to 1,800, and in November to 2,400. The receipts are now sufficient to pay the fixed charges, as well as the working expenses, and it is expected that the company will soon be earning sufficient to pay the fixed charges and working expenses on the entire system.

PHILADELPHIA, 19TH DECEMBER, 1890.

THE COAL TRADE.—There has been little change in anthracite. Production is pretty heavy, and prices are lower than in the autumn. In consequence of the colder weather local trade has somewhat increased. The condition of trade has not been favourable during the past two years, and an improvement is hoped for. The stocks of coal in the hands of retailers are not very large, and as a number of mines are reducing their output a better trade is expected.

SUSPENSION OF AN IRON FIRM.—The directors of the Bessemer Rolling Mill Company, of Birmingham, Ala., have decided to place their affairs in the hands of a receiver. The company lost $30,000 by the recent failure of the United States Rolling Stock Company, of Chicago, which was the direct cause of the suspension. The company's mill has been in operation two years, and 600 men were employed. The receivers will try to keep the mill running, and it is thought that all the debts of the company will ultimately be paid.

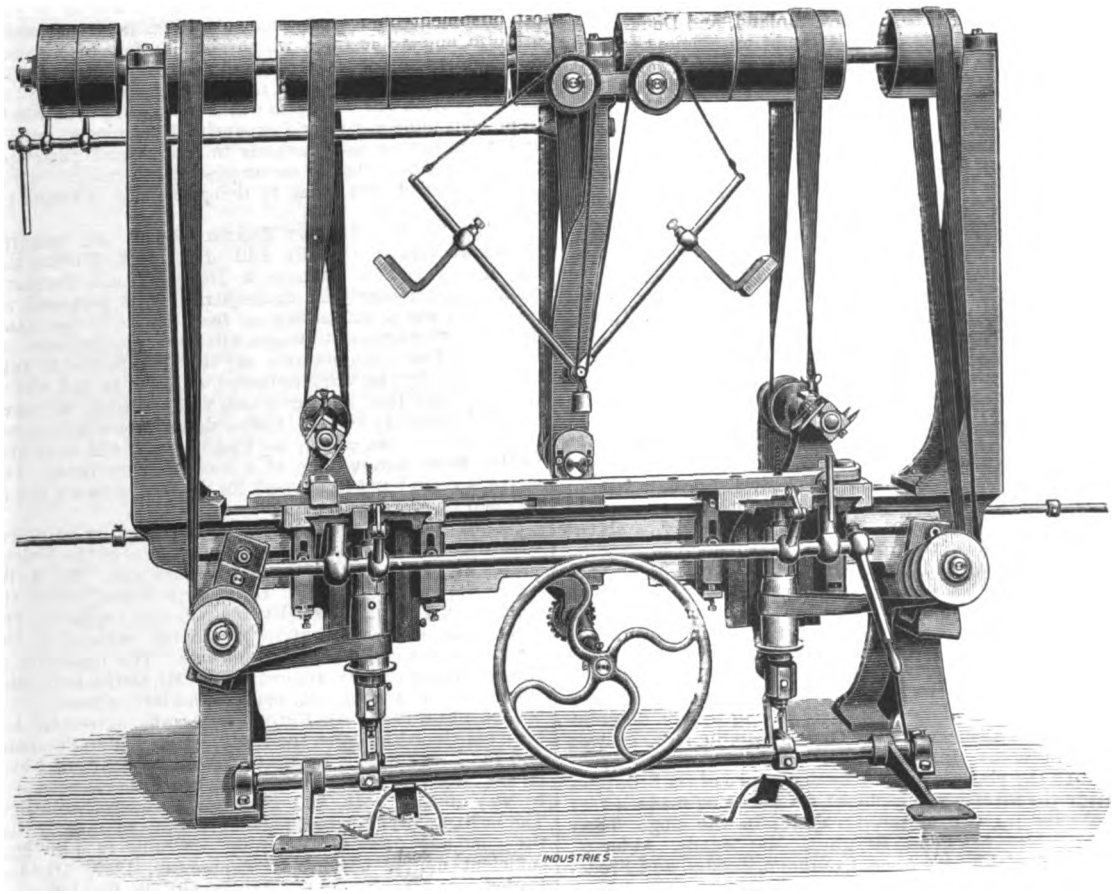
THE GLASS TRADE.—At a meeting of the Western Flint Glass Association on the 10th inst. reports were received which showed that the pressed ware business was in a bad condition. Nine houses, in which pressed glass ware was manufactured, have partly or entirely closed down recently, and several others were likely to do so in the near future. The depression is attributed to the Bill recently passed by Congress, which, to a great extent, stopped the advertisement of firms offering table ware as an inducement to their patrons. Other branches of the trade are prospering, the makers of chimneys and bottles reporting their business to be in first-class condition.

PAPER MILL ASSOCIATION.—A meeting of the Western Wrapping Paper Mill Association was held in Chicago a few days ago. This association controls the entire wrapping paper business in the West. Hereafter the entire product of the mills in the association is to be sold by the agents of the organisation instead of by the salesmen of the individual mills. Arrangements were made for keeping the standing committee of the organisation informed of the operations of every mill.

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MACHINE FOR SHAPING AND BORING TELEGRAPH POST ARMS.

CONSTRUCTED BY MESSRS. JOHN PICKLES & SON, ENGINEERS, HEBDEN BRIDGE.



FRONT VIEW OF MACHINE.

MACHINE FOR SHAPING AND BORING TELEGRAPH POST ARMS.

THE above illustration represents an ingenious machine which has been lately made by Messrs. John Pickles & Son, Hebden Bridge, *viâ* Manchester, for preparing telegraph post arms. These arms are usually made from the best selected English oak, and vary in length from 2ft. to 4ft. They are in the first case planed on the four sides by means of a special planing machine made by the above-named firm. They are then sawn to the exact length required by means of a double cross-cut sawing machine made specially for the purpose. The arms are then passed along to the machine we now illustrate. This machine is provided with a fence bar, in which the arms are held fast by a novel screw clamp. By means of the hand lever shown to the right the arm is carried, by the slides, between cutters revolving at a high speed. These cutters complete the end chamfering, and at the same time the central hole is bored by a revolving boring bit. After this the slide carrying the arm is moved up against an adjustable stop, and the operator turns the large hand wheel. This is connected by bevel and other gearing to the cutter headstocks, and causes the latter to move towards each other up to a given point in accordance with the length of chamfer required, which may be from 7in. to 17in. in length. The cutters revolving at a great speed take off the chamfer on both sides of the arm and also at both ends at the same time. The bars shown at the ends of machine have gauge stops fitted for giving the length of traverse required. The headstocks are after this rapidly wound back to their first position and are ready for the next operation. The operator then places his foot on the foot lever, which causes the two heads carrying revolving boring bits to rise and bore the holes at each end required for fixing the insulators. The pads connected with cords and levers on the central standard are intended to prevent the boring bits splintering the wood when coming through the top side.

It will be seen that the machine is quite self-contained, and has the driving shaft placed overhead and supported upon standards fixed to the main bed. The arrangements for dealing with the various lengths of arms have been carefully thought out. At the official test of the machine in the presence of the purchasers the wooden arms were finished at the rate of three per minute. This result reflects credit on the makers of this special machine, and speaks well for its efficiency.

THE BOILER EXPLOSION AT THE HAYBRIDGE IRON WORKS.

ABOUT midnight on the 10th November last a boiler explosion, which fatally scalded one man and injured three others, occurred at Haybridge Iron Works, near Wellington, Salop. An inquest was held on the body of Ralph Owen (the man fatally injured) on the 12th November, at which some preliminary evidence was taken, and it was then decided to adjourn until the 28th November. On that date the inquest was resumed. Mr. Littlewood watched the case on behalf of the Haybridge Company. After a puddler and two of the injured men had been examined, Mr. John Mills, engineer for the southern district of the Scottish Boiler Insurance Company (in which company the boiler was insured) gave evidence to show that "the explosion was caused by sediment mixed with the grease from the engine becoming deposited on the plate, and preventing the free activity of water passing through the plates, which, in consequence, became overheated and crushed in by the ordinary working pressure of the boiler." The jury, after considering the matter, returned a verdict of "Accidental Death," to which they added a rider "that in their opinion the practice of allowing grease to enter the boilers at Haybridge Iron Works is dangerous, and should be discontinued, and that the coroner be requested to convey this opinion to the Haybridge Iron Company."

On the 18th ult. the Commissioners of the Board of Trade, Mr. Howard Smith and Mr. W. C. Lang, held a formal investigation as to the cause of this explosion, there being present Mr. Clement Groom, of the Haybridge Iron Company; Mr. Littlewood, representing the company; Mr. J. F. L. Crosland, chief engineer of the Boiler Insurance and Steam Power Company, Limited 67, King Street, Manchester; Mr. John Mills, engineer of the Scottish Boiler Insurance Company, Limited; and Mr. James Aston, inspector for the same company. After hearing evidence from all the persons who had been connected with the examination and working of the boiler, the Commissioners came to the conclusion that, "so far from being an accident, it was almost a certainty that the boiler could not have worked any great length of time without exploding." The whole of the facts of the case are contained in the very able summing up of the President of the Court, Mr. Howard Smith. We quote below his concluding remarks, as they will be of special interest to steam users. Speaking for his fellow Commissioner, as well as for himself, Mr. Smith said:—

"We are asked some questions as to the duties of insurance companies generally. We are further asked to say whether a company is justified in issuing a policy without examination. The answer to that I have already given. But if by 'justified' is meant whether there is any legal obligation to examine boilers before being insured, then I answer emphatically no. But we do think, in the interests of minimising these accidents and preserving human life, it would be better if insurance societies would examine before they insured boilers. As a matter of fact, I believe the Boiler Insurance and Steam Power Company do, unless it is satisfied of the newness of the boiler. I am bound to say that the companies try to get an examination as soon after insuring as they can.

"As far as Mr. Mills' inspector's report is concerned, his company seems to have employed, so far as they knew, competent men. But there is this to be said, that both in justice to his own company and in justice to the Haybridge Company (although I have very little sympathy with them), that when the report of Mr. Ashton was brought under his notice (the one on the 26th of December, pointing out that the flues of the boiler ought to have been renewed), and knowing what sort of boiler this was, he should have advised his company to discontinue the policy, which could have lapsed, I think, in May—at all events before the explosion—and in that respect we do think Mr. Mills is somewhat to blame.

"We are told that on this unfortunate man Owen, who was killed, the Coroner had an inquest, and the jury found that his death was '*caused by the accidental explosion of a boiler.*' Now in regard to that verdict, we do not know what evidence was before the jury, but we do know that the documents, the reports, and the policies which have been produced before us were not before them. No doubt on the evidence before them their verdict was quite a proper one. That, to me, shows the great importance of this investigation. It is gone forth to the world and to the public generally that this explosion was caused by an accident. It is only when the case comes to the consideration of the Board of Trade and when it comes to be decided by a court, half of which has scientific knowledge, that the question is really thoroughly examined, and we find that, so far from being an accident, it was almost a certainty that the boiler could not have been worked any great length of time without exploding, because the flue had lost its cylindrical shape. If that had been before the jury, the jury could not have said that this was an 'accidental explosion.' We think it important that all the facts should be laid before the Board of Trade, and also that steam users should be cognisant of them, as well as the public at large.

"We have to find Mr. Clement Groom very much to blame for the reasons which I have already stated. We are of opinion that the costs in this case must be a substantial sum. There is no evidence on which we can act before us that the people ever challenged the report of the Manchester Company by an examination, by any proper and competent men. Their attention having been called to the condition of the boiler, they should have either stopped it at once, unless they had an engineer who was of the same capability as the inspector. We think their conduct with regard to this particular boiler, and the general management of the works, has been disgraceful, and therefore we order them to pay to the solicitors of the Board of Trade the sum of £70 towards the costs and expenses of this investigation."

SHIPBUILDING NOTES.

ON the 13th ult. the Fairfield Shipbuilding and Engineering Company, Limited, launched the "Oldenburg," a steel screw steamer of 5,400 tons, built to the order of the North German Lloyd. The dimensions of the vessel are:—Length, 430ft. 10in.; breadth, 48ft.; depth, 33ft. The hull of the vessel is of Siemens-Martin steel, and the vessel has been built to the highest requirements of the German Lloyd. The engines are of inverted triple-expansion type, the cylinders being 31in., 52in., and 83in. diameter, the stroke being 4ft. 6in. The "Oldenburg" is exactly similar to the "Gera," which was successfully tried also on the 13th ult., when a mean speed of 13·8 knots was obtained, a speed exceeding the guaranteed speed by ¾ths of a knot.

ON the 13th ult. Messrs. R. Stephenson & Co., Limited, Newcastle-on-Tyne, launched from their yard at Hebburn the screw steamer "Cornhill," which they have built and engined for the Warworth Steamship Company, Limited. The vessel is of the improved well-deck type, the principal dimensions being:—Length, 203ft.; breadth, 31½ft.; depth, 14ft. 6in. The vessel has been designed to carry about 1,100 tons on a light draught of water. To the engine-room seven of Mason's patent skylights, and in the saloon skylight twelve of Mason's pivoted sidelights, have been fitted. The latter specialties have also been adopted elsewhere in the vessel. The engines are triple-expansion, indicating 700 h.p., and are fitted with all the latest improvements. The hull and machinery have been constructed

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under the supervision of Mr. Alex. Taylor, consulting engineer, Newcastle-on-Tyne.

On the 20th ult. the steel screw steamer "Macduff," built by Messrs. W. Gray & Co., Limited, to the order of Messrs. J. Warrack & Co., of Leith, had her trial trip in the bay, off Hartlepool. She is a three-decked vessel, having a steel main deck, an iron upper deck sheathed with wood, and she takes Lloyd's highest class. Her dimensions are:—Length over all, 330ft.; breadth, 40ft. 6in.; depth, 27ft. Fine triple-expansion engines have been supplied by the Central Marine Engine Works of Messrs. Wm. Gray & Co., Limited, the cylinders being 25in., 40in., and 65in. in diameter, and the stroke of the piston 42in. The boilers, two in number and built of steel, are of large size, and work at a pressure of 160lb. per square inch. The ship and machinery have been built under the superintendence of Captain M. J. Butcher and Mr. M. A. Hall respectively. After the trial the vessel proceeded to Middlesbrough, where she will take in part cargo, making up the full complement at Glasgow and Liverpool, from which latter port she proceeds, under the command of Captain W. H. Hood, for Chinese ports, having been designed for that trade. The vessel was manipulated on her trial trip by her Chinese crew.

On the 26th ult. Messrs. Craig, Taylor, & Co. launched from their Thornaby shipbuilding yard, Stockton-on-Tees, a handsomely modelled steel screw steamer, of the following dimensions:—Length, 292ft.; breadth, 37ft.; depth, 20ft. 3in. The vessel has been built with a long raised quarter-deck bridge extending to and including foremast and fore-winch, short well, and topgallant forecastle. She is built on the web-frame principle, and has double bottom for water ballast all fore and aft and in peaks for about 600 tons. She will be fitted with four steam winches and Pepper's steam steering gear by Robert Roger & Co., Stockton; patent windlass, by Emerson, Walker, & Thomson Brothers, Gateshead; light-houses, Hastie's screw gear aft, and all modern improvements, so as to admit of rapid loading and discharging. The engines, on the triple-expansion three-crank system, are being constructed by Messrs. Blair & Co., Stockton, and the diameters of the cylinders are—21in., 35in., and 57in., with 39in. stroke; also two large steel boilers, 160lb. pressure. The vessel has been built to the order of Messrs. Vagliano Brothers, of London, for Messrs. Couppa & Co., of Marseilles, for their Mediterranean trade, and has been superintended by Mr. William Law, consulting engineer, of Liverpool.

On the 26th ult. Messrs. Sir Raylton Dixon & Co. launched a very fine steamer (the "Kintuck") which has been built to the order of the China Shippers' Mutual Steam Navigation Company, Limited, of London, and is intended to form one of their line of steamers for the tea trade. This vessel is one of the largest steamers yet built on the Tees, and has been constructed with very fine lines and large power, so as to attain a speed of 14 knots per hour. Her dimensions are:—Length over all, 373ft. 6in.; breadth, 45ft.; depth, moulded, 30ft. 3in. Her gross registered tonnage is about 3,700, and she will carry about 5,000 tons of tea. The engines are by Messrs. T. Richardson & Sons, of Hartlepool, with cylinders 32in., 49in., and 77in., having a stroke of 4ft., and will be of nearly 3,000 i.h.p. She was the last ship launched by Messrs. Dixon last year, making a total tonnage of 43,665 gross register for the twelve months.

On the 27th ult. Messrs. Ropner & Son launched a steel screw steamer, the "Calcutta City," of the following dimensions:—Length over all, 324ft.; breadth, 40ft. 6in.; depth, moulded, 23ft. 7in. This steamer has been built under special survey to class 100 A1 at Lloyd's, to the order of Mr. Ch. Furness, of West Hartlepool. She has a short full poop, in which is fitted accommodation for captain and officers, a raised quarter-deck, long bridge, short well, and topgallant forecastle, cellular bottom for water ballast. She is built on the web-frame principle, and, having very large hatches, is well adapted for carrying heavy cargoes. She will have four steam winches, two donkey boilers, Davis's steam steering gear, Hastie's screw gear aft, Emerson, Walker, & Co.'s direct steam windlass, &c., and all the latest improvements for a first-class cargo steamer. The engines are by Messrs. Blair & Co., Limited, of 950 h.p., with two steel boilers working at 160lb. This is the fifth steamer built by Messrs. Ropner & Son for the same owner.

On the 29th ult. there was launched from the shipbuilding yard of Messrs. R. & W. Hawthorn, Leslie, & Co., Limited, Hebburn, the "Mossoro," a steel screw steamer, for foreign owners, of the following dimensions:—Length over all, 215ft.; breadth, 31ft.; and depth, 15ft. She is built to the highest class at Bureau Veritas, under special survey, of Siemens-Martin steel, and has been specially subdivided by a large number of transverse bulkheads, which will add greatly to her safety. The vessel will be supplied with triple-expansion engines having a working pressure of 160lb. The vessel is intended to carry a large cargo on a light draught of water, and is specially adapted for ascending shallow rivers. She will be schooner rigged with two pole masts, and the whole of her fittings will be of the latest and most approved style. This is the first of four vessels being built by the same firm for similar trade.

The s.s. "Llanthony Abbey," which was built by Messrs. Ropner & Son, of Stockton, for Messrs. Pyman, Watson, & Co., of Cardiff, has just had her trial trip. The vessel is 290ft. long, 29ft. broad, and 20ft. 9in. deep. She has been engined by Messrs. Blair & Co., Limited, of Stockton, on the triple-expansion principle, her cylinders being 22in., 36in., and 59in. in diameter, by 39in. stroke, and working at 160lb. pressure of steam. The trip was very successful, everything working satisfactorily.

Notices of Meetings.

THIS WEEK.

Geologists' Association.—Friday, January 2nd, at 8 p.m. Papers to be read: "On Some Recent Sections at Dulwich," by Mr. T. Leighton and Mr. J. B. Ogle; "The British Tertiary Echinoid Faunas and their Affinities," by Mr. J. W. Gregory.

Royal Institution.—Saturday, January 3rd, Tuesday, January 6th, and Thursday, January 8th, at 3 p.m. Lectures on "Frost and Fire" (adapted to a Juvenile Auditory), by Professor Dewar, F.R.S.

NEXT WEEK.

Society of Chemical Industry.—Monday, January 5th, at 8 p.m. Paper to be read: "The Basic Copper Process," by Mr. Percy Gilchrist.

PRICES CURRENT, 31st December, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 0 0	.....	6 10 0	f.o.t. wks.
" Angles	5 17 6	.....	6 7 6	"
" Plates	6 0 0	.....	6 10 0	"
Staffordshire Bars	7 0 0	.....	7 10 0	London.
" Angles	7 5 0	.....	7 15 0	"
Crown Sheets	7 7 6	.....	7 17 6	"
" Hoops	7 7 6	.....	7 17 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 2 6	"

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3.	42/3	Cash.
Scotch Warrants, m/n	46/3	"
Hematite Warrants, m/n	53/6	"

Stocks in Stores. Scotch	587,725	Tons.
Middlesbro'	114,849	"
Hematite	208,885	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	...	.....	...	f.o.b. Glasgow.	
Gartsherrie	...	.....	...	"	"
Langloan	70/-	.....	60/-	"	"
Summerlee	68/-	.....	58/-	"	"
Glengarnock	...	.....	...	"	"
G.M.B. ex Store	46/9	.....	46/6	"	"

METALS.

Spelter: Ordinary	£23	15	0	to	24	0	0
Copper: British Cakes and Ingots	59	10	0	,,	60	10	0
" Chili Bars, G.O.B.'s	52	10	0	,,	53	0	0
" Other sorts, G.M.B.'s (equal to Chili Bars)	52	10	0	,,	53	0	0
" Manufactured (strong)	66	0	0	,,	67	0	0
Lead: Common Pig	13	15	0	,,	13	17	6
" English Sheet	14	10	0	,,	14	12	6
Tin: Straits	90	7	6	,,	90	17	6
" Australian	90	15	0	,,	91	5	0
" English Ingots	94	15	0			.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues quiet—very little business taking place during the holidays. Owing to the small demand, values of raw copper keep very low, Chili bars being quoted to-day £52 10s. to £53 cash, with moderate trade. Manufactured, £66 to £67 "Strong," with slack demand.

Tin: Lower, the amount of business being very limited.

Lead: Quiet; last week's quotations unchanged.

Spelter continues very flat and prices are receding accordingly. The least improvement in demand would stop the downward movement, as stocks are unusually small everywhere.

CHEMICALS.

	£ s. d.	£ s. d.
Acid: Carbolic Crystals lb.	..... —	.....
" " Liquid gal.	..... —	.....
" Citric lb.	0 1 4½ —	.....
" Oxalic "	0 0 3½ —	.....
" Sulphuric ton	..... —	.....
" Tartaric lb.	0 1 3 —	.....
Alum: Lump (powder 10/- ex.) ton	5 12 6 —	.....
Ammonia: Carbonate lb.	0 0 3½ —	.....
" Muriate (Grey) ton	25 0 0 —	.....
" " (White) "	..... —	.....
" Sulphate "	10 15 0 —	10 17 6
" Liquor lb.	..... —	.....
Antimony ton	..... —	.....
Bleaching Powder "	..... —	.....
Bisulphide of Carbon "	..... —	.....
Borax "	..... —	.....
Benzole (90 %) gal.	..... —	.....
" (50/90 %) "	..... —	.....
Copper Sulphate ton	..... —	.....
Copperas "	..... —	.....
Kieserit "	..... —	.....
Lead: Nitrate "	..... —	.....
" White Sugar "	..... —	.....
" Brown "	..... —	.....
Potash: Bichromate lb.	0 0 3¾ —	.....
" Caustic ton	..... —	.....
" Carbonate "	..... —	.....
" Chlorate lb.	0 0 5½ —	.....
" Prussiate (Yellow) "	0 0 9⅞ —	0 0 10
" Sulphate (Basis 90 %) ton	4 0 0 —	.....
Precipitate: Red lb.	0 3 9 —	.....
" White "	0 3 9 —	.....
Salts: Epsom { Bags ton	..... —	.....
Salts: Epsom { Casks "	..... —	.....
" Glauber "	..... —	.....
Sulphur: Sublimed Flowers "	..... —	.....
" Recovered "	..... —	.....
Soda: Ash deg.	0 0 1¾ —	.....
" Caustic (White 70%) ton	..... —	.....
" " { " 60%) "	..... —	.....
" " {Cream 60%) "	..... —	.....
" Crystals "	..... —	.....
" Bicarbonate "	..... —	.....
" Hyposulphite "	..... —	.....
Solvent Naphtha gal.	..... —	.....
Tartar, Cream of cwt.	4 13 0 —	.....
Zinc Sulphate ton	..... —	.....

OILS.

	£ s. d.
Cocoanut: Cochin per tun	33 10 0
" Ceylon "	29 0 0
Cottonseed "	18 5 0
Cod "	23 0 0
Lard "	34 0 0
Linseed "	21 10 0
Palm, Lagos "	26 0 0
Rapeseed: English "	28 5 0
Seal: Pale "	25 0 0
" Brown "	.....
Sperm "	47 10 0
Whale "	22 0 0
Turpentine per cwt.	1 9 6
Coal per gal.	.....
Petroleum (Refined) "	0 0 5
Spirit "	0 0 8

The "Mechanical World" Pocket Diary and Year Book for 1891.—This handy little work has now attained its fourth year, and will be found of considerable use to engineers and draughtsmen. The contents of the book are practically the same as in previous years, except that the collection of rules and notes has been somewhat enlarged.

Calvert's Mechanic's Almanack for 1891.—We have had sent us a copy of this popular almanack, which is now in its eighteenth year of publication, and which is too well known amongst engineers and handicraftsmen to require any description on our part. We may, however, state that it appears to be generally up to date, and contains very interesting information.

The "Practical Engineer" Pocket Book and Diary for 1891.—We have received a copy of this useful annual, which combines a great amount of useful information for engineers and machinists, with a diary for the present year. In addition to the matter contained in last year's issue, we notice working drawings of various types of steam boilers, detail sketches of gas and steam engines, with their indicator diagrams. The little book is neatly bound, and will be found very useful.

We have received from the offices of the *Chronique Industrielle* a copy of the first part of a work by Ch. Casalonga, member of the Society of Civil Engineers of France, entitled "Mécanique Professionnelle," which is to be completed in ten parts. The book is replete with illustrations, and useful tables for giving the proportion of tools such as spanners, screw taps, and dyes, &c. It also deals at some length with the various metals employed in machine construction, their treatment in the foundry and forge, and with the various tools used in their conversion intomechanical appliances.

We have received a well-illustrated and complete catalogue of the engines, boilers, &c., made by Mr. R. Wolf, of Magdeburg-Buckau, Germany. Mr. Wolf has devoted particular attention to improvements in portable and semi-portable engines of modern construction, and, judging from the illustrations and tables given in the catalogue, has achieved excellent results. The works, we are informed, are provided throughout with the most modern type of machinery, and are lighted with the electric light from electrical machinery erected in the works.

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HOME INDUSTRIES.

LONDON, 1st January, 1891.

The Money Market.—The demands incidental to the close of the year have made loans fairly dear this week, the more so as a large sum has been temporarily taken off the market to enable the India Council to pay for the acquisition of the South Indian Railway from the shareholders. Discount rates have remained steady at a fraction over 4 per cent. The holiday influence is still strong in the Stock Exchange, which is closed again to-day (Thursday). But though business has been on a very restricted scale, the tone of the markets has been firm and improving. The signs of a cessation of the Scottish railway strike gave rise to a considerable recovery in the stocks, and home railways generally rose after a few days' freedom from snowfall. Silver securities have been in request, largely on Continental account, Paris being anxious to sustain all markets to ensure the successful floating of the new French loan. Thus not only "International" stocks, but Argentines and silver securities have been supported with that view. Americans have been irregular, but with a steady undertone, and Canadian railway stocks have been in some favour. Mexican rails have undergone another sharp recovery, both on good traffic receipts and in consequence of the steadiness of silver. Miscellaneous securities were depressed by the failure in Dublin of a large operator interested in many of the more speculative of the newer industrial companies, and brewery shares also suffered through his delinquencies.

The Institution of Civil Engineers.—The seventy-third anniversary of the establishment of the Institution occurs to-morrow, the first formal meeting having been held at the Kendal Coffee House, in Fleet Street, on the 2nd January, 1818. The honour of having originated the Institution is often assigned to Smeaton, or to Telford, but the idea is erroneous in both cases. Smeaton died many years before it was thought of. Smeaton founded the Society of Engineers in 1771, but this Society, which still exists, and includes many of the most eminent members of the profession, has no connection with the Institution. The real founders of the Institution were William Maudslay, Joshua Field, Henry Robinson Palmer, James Jones, Charles Collinge, and James Ashwell, who had then just entered the profession. Telford became its President in the year 1820, and the Charter of Incorporation was granted on the 3rd June, 1828. Its membership now includes 5,953 persons of all classes, distributed throughout all parts of the Empire.

The Institute of Marine Engineers.—A meeting of this Institute was held on the 20th ult., Mr. F. W. Wymer, Vice-President, being in the chair, when an interesting paper on the "Efficiency of Air Compressors" was read by Mr. Joseph Williams, in the course of which he referred to the installations of pneumatic power distribution as being cleaner and safer than those where steam is the motive power. The author said that the fundamental principles of thermo-dynamics, as reasoned out by Professor Rankine and others, were true and accepted, but the practical working out of details based upon them was sometimes at fault, and to these he took exception. Papers read by Professor Kennedy, Messrs. T. B. Lightfoot, Coleman, Shone, and Donaldson were referred to in the course of the paper. The meeting closed with a vote of thanks to the author of the paper.

"Work" Exhibition.—On the 29th ult. an exhibition of various kinds of work was opened at the Polytechnic Institute, Regent Street, by Sir John Lubbock, M.P., Chairman of the London County Council. Many of the exhibits are made from designs published in *Work*, a journal issued by Messrs. Cassell. The jurors, who were appointed by the London Trades Council, awarded a gold medal to Mr. T. Coates for a working model of a steam fire-engine.

The "Electrical Review."—The offices of our American contemporary, of which Mr. Charles Ffrench is the London editor and manager, have been removed from Bridge House, 181, Queen Victoria Street, E.C., to Northumberland Avenue, Charing Cross, W.C.

German Wire Industry.—The Eschweiler Wire Industry Company, Limited (Germany), manufacturers of wire rods, rolled and drawn wire, wire nails, &c., have appointed Messrs. Künster & Co., 11, Queen Victoria Street, E.C., their sole agents in this country.

Business Announcement.—Mr. Thomas Tyrer, late partner in the firm of Messrs. May & Baker, manufacturing chemists, Battersea, has bought the goodwill and business of Messrs. Dunn & Co., manufacturing chemists, Stirling Chemical Works, Abbey Lane, Stratford, London, E. We are pleased to note that on the 5th inst., at 5 p.m., in the Lecture Theatre of the Chemical Society, Burlington House, a testimonial will be presented to Mr. Tyrer by his brother chemists, in recognition of his valuable services in the advancement of industrial chemistry.

Messrs. Broadwood & Sons.—At an entertainment given on the 27th ult. at the Westminster Town Hall by this firm to the children of their staff of employés, the electrical lighting was carried out by Messrs. Girdlestone, Tatham, & Co., of Davies Street, Berkeley Square, the current being gratuitously supplied by the Westminster Supply Company.

The Junior Engineering Society.—At a meeting of this Society, held on the 19th ult., a paper on "Artesian Wells" was read by Mr. P. G. Bowen. The difference oetween artesian and ordinary wells was first pointed out as consisting of the supply in the former case being obtained from a stratum below impervious beds instead of from surface waters as in the latter. The three principal modes of digging artesian wells by ordinary underpinning, by steining underpinning, and by drum curb sinking were then described. The wells were very seldom left unlined; bricks, dressed stones, and cast-iron segmental cylinders being the materials generally employed for their lining. The boring of wells was practised more on the Continent than in this country, but in 1885 two bored wells, each 6ft. diameter and 72ft. deep, were executed for the Southampton Water Works, the first taking 33 days, and the second 14 days in boring. The paper included an account of the difficulties encountered in artesian well work; of the systems adopted for increasing the water supply; the details of finishing off; the cost of boring; pumps; the comparison of deep well water with other waters; and the testing and softening processes.

MANCHESTER, 1st January, 1891.

The Iron Trade.—The present being practically observed as a holiday week, there is very little being done in this district in the iron market. Such transactions as are being effected are small in amount, and the prevailing weak tone throughout the main producing districts is having its effect on buyers here. Iron is being largely used, and consumers must come into the market sooner or later, but there is little disposition to buy so long as the prevalent depression exists. Purchases are mostly of small amounts, and prices are not fairly tested. Bar iron is also slowly bought, and there is a marked difference in the tone of this industry as compared with the corresponding period of last year. Still, there is a steady business doing, but the orders given are not large, and prices tend to weaken. Steel plates are steady, fair quantities being made and used. The general metal market is not so lively as it was, but both copper and brass are being well sold in sheets, tubes, and wire.

The Linen and Jute Trades.—There has not been any change of importance lately. The Scotch strike has affected business somewhat, the railway companies having declined to accept goods for points north of the Tweed without reservations in order to protect themselves against injury arising from delay. As far as consignments of linen goods from Scotland are concerned, the fact that such centres as Dundee and Kirkcaldy are on the coast enables manufacturers to counteract the effect of any possible stoppage in the system of inland transport. Many firms have already made use of the facilities thus placed at their disposal, and there has been a greater demand for tonnage from Liverpool in consequence. There is not much doing in the home trade, however, at this season, so that distributors are not inconvenienced as much as would have been the case had the strike set in a few months later. There is no change in quotations of piece goods, although yarns keep dear and manufacturers complain accordingly. Stocks in the hands of local merchants are not extensive, and this fact gives grounds for expecting an improvement in trade. Producers will thus be able to replace the orders which are now lapsing. Jute goods are quiet. The report current here to the effect that two of the largest firms in the linen thread trade are about to amalgamate is now denied, but as branch managers are not likely in any case to be taken into the confidence of the officials at the mills too soon there may be some truth in the rumour.

Technical Instruction.—The special committee appointed by the City Council to consider this subject has reported and recommended that the share of the city of Manchester of the grant in aid of the local rates, amounting to £11,500 for the current year, shall be applied to the purposes of technical education. It is pointed out that Mr. Goschen had expressed himself as of opinion that such an application would probably be approved by subsequent Governments. The grant would thus become practically perpetual, and in order to ensure this desirable end the recommendation of the committee has been made.

GLASGOW, 1st January, 1891.

The Coal Market.—The shipments of coals from Scottish ports, which were 112,785 tons in the week from 15th to 20th December, the week before the strike, and which were of about the same amount in the week from the 22nd to the 27th December, 1889, were only 68,082 tons in the past week. This falling off in shipments, amounting to upwards of 44,000 tons, has been due wholly to the railway strike. The prices of Newcastle coal have gone up considerably, owing to the transference of orders from Scotland.

The Railway Strike.—The serious block caused by the strike of the 21st ult. still continues. There is as yet no prospect of a decisive settlement. Spasmodic efforts at conciliation have been made at Edinburgh and Glasgow without result. The only important change in the situation is that a number of the employés of the Glasgow and South-Western Railway have gone back to work. The North British Railway traffic continues to be almost at a standstill as regards the goods traffic, and also to a large extent as regards the passenger traffic. The Caledonian Railway still finds serious difficulty with its goods traffic. The contest, however, has practically resolved itself into a struggle between the North British Railway Company and their men. It is impossible to predict what may be the course of events during the next few days. The men may gradually return to their work in small numbers, and so weaken the position of the strikers, or they may make up their minds to concentrate their attack upon a single railway company rather than divide their forces. The whole situation is fraught with much peril and annoyance to the travelling public, and, although occurring at a holiday time, with serious injury to industry.

Minerals.—The want of coal, in consequence of the suspension of goods and mineral traffic on account of the strike, has led to the premature closing of several public works for the holidays. It is calculated that not fewer than from 50,000 to 100,000 men are rendered idle for this reason for a longer period than would otherwise be the case. The pig iron market closed on the 31st ult. after the forenoon meeting, and will not reopen till the 5th inst. Business for the two days and a half of this week has been very quiet, though there is no falling off in price. The stock of pig iron in Connal's stores has now fallen to 587,652 tons, the decrease for last week having been 1,368 tons. Warrants were fairly firm in the beginning of the week, though even yet quotations are purely nominal, there being very little actual business done.

Rival Steamship Companies.—The Islay Steam Packet Company, which had been projected for the purpose of providing a steamer to ply between West Loch Tarbert and the island of Islay, will not now be formed, Mr David MacBrayne having undertaken to place a new steamer on the route.

(From our own Correspondents.)

LIVERPOOL, 31st December, 1890.

The Liverpool Water Supply.—"In consequence of the excessive consumption of water caused by the frost," the supply of water to the city and Bootle has had to be restricted, and it is cut off every evening until 6 or 7 o'clock the following morning. This has caused considerable inconvenience and consequent annoyance, especially as it is not evident why there should be an excessive consumption during the frost, as stated in the Town Clerk's notice. It is also a source of danger, for with the intermittent supply there is much more danger of the various pipes being frozen, thus preventing the escape of generated steam in domestic boilers. There have been several serious and fatal explosions of household boilers during the past week, and this action of the water committee is not conducive to safety. The supply of water to the city is from the old reservoirs and wells, the Vyrnwy water being still on the wrong side of the Mersey. The work at the tunnel is progressing slowly, and there are many complaints about the delay. Fresh arrangements have had to be made with the engineers, and instead of there being some return for the enormous outlay the expenditure keeps increasing.

LEEDS, 31st December, 1890.

Iron and Steel Trade.—Taken altogether the year 1890 has been a good one both for masters and employers, and, in fact, there has hardly ever been a year when all classes of workpeople have been more fully employed or better remunerated. It would, perhaps, be unwise to entertain the belief that the same amount of prosperity will be seen in the coming year, but some encouragement may be gathered from the opinion of Sir James Kitson, Bart. Speaking the other day in Leeds, Sir James said that notwithstanding the trouble in financial circles in London there is no reason to be despondent or to take a gloomy view of the future of manufactures in Leeds. In the year there has been a decline in prices, and at the present time the iron trade is very quiet, though a revival is expected before long. The steel trade has been busy during the year, and it may be noted that at the Leeds steelworks considerable extensions to the plant have been made. The briskness which has marked the engineering trade in 1890 continues, but most of the work is on account of old orders. There is again quietness in the agricultural machinery branch, and the cut steel and iron trade is not so good as it was.

The Coal Trade. — The revival which began in January has been maintained during the year, and now the prices quoted for the larger classes of coal are about what they were eleven months ago. A falling off in the demand for manufacturing coal is noticeable. The export trade has been steady throughout the year, and, excepting two months, there has been no difficulty in meeting the demand. The demand for gas coal has been uniformly good, and is now very brisk. During the year the miners have received an advance of 20 per cent. in their wages.

SHEFFIELD, 31st December, 1890.

Iron and Steel.—Business has been slack during the week here, although many firms are endeavouring to keep their machinery going. A large number of contracts for various engineering works at home and abroad will be cleared out this week so as to make room for a fair start on new contracts with the opening of another year. Again the home railway companies have favoured Sheffield with some large orders for tyres and axles, together with springs and other general forgings. It is worth mentioning here, however, that Messrs. Krupp, of Essen, Germany, have secured an order from the "Indian Midland" for railway material. This should make Sheffield manufacturers more

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anxious than ever to turn out work of a quality superior to that of other manufacturers. Belgium also has secured a large portion of Sheffield work in an order for some wrought-iron buffer cases. These are welded up from ⅜in. plate to a cone with a narrow flange thrown off the base, the whole of the work being of a comparatively simple character. All the English tenders for this work were far above that of the Belgian firm who secured the order. Prices at present are as follows:—Laminated bearing springs, £10 to £12; volutes and other sections higher; waggon tyres, £10 to £11; locomotive tyres, £12 to £14; axles, £11 to £12, either Siemens or Bessemer, but the former is generally specified. No fixed price can be given for ordinary billets of steel, as these are sold to suit customers' requirements as to quality and temper. On the whole this has been a most prosperous year for Sheffield manufacturers. Prices have been low; indeed, far lower, in fact, than they should be, considering the enormous capital invested in the machinery and plant necessary to turn out the highest grades of work. As regards actual improvements in the method of producing steel, or in the reduction of cost, no progress has been made in the past year. Numerous extensions to works have been made, and the producing power has thus been vastly extended. The general prospects of trade for the new year are good.

COAL.—Colliery owners are endeavouring to get their men at work as soon as possible, as there is practically no fuel in stock, and most of the mines are now running. A vast amount of coal is being exported, and if the present output of iron continues fuel must increase in value again. House fire coal is in great demand, owing to the extremely cold weather. This winter has been one of the coldest known here, the thermometer having registered 22° F. below freezing.

THE NEW TRUNK LINE.—A number of surveyors have recently been engaged in the neighbourhood of Buxton in the interests of the promoters of the proposed East to West railway, and preparing the necessary maps, &c., to be deposited at Westminster. Should the work eventually be carried out it will be necessary to tunnel through the hill at Edgemoor to afford a direct route between Buxton and Macclesfield.

NORTH STAFFORDSHIRE, 31st DECEMBER, 1890.

THE IRON TRADE.—Work has been generally resumed at the mills and forges after the holidays. Prices show no signs of improvement, and the immediate outlook is not of an encouraging character. Pending the quarterly meetings but few inquiries or specifications are being received. The Chatterley Iron Company, in liquidation, last week paid its unsecured creditors off in full. It is understood that the company has made a good bargain with a North of England syndicate, having sold the whole of its property as a going concern, and that a company will shortly be floated with a capital of about £600,000 to work it.

THE POTTERY TRADE.—Mr. James, the arbitrator appointed by the manufacturers, objects to Mr. Mawdesley, the arbitrator appointed by the operatives, on the ground that, as an official of a working trades union, he would be naturally biassed and act more as a delegate than as an arbitrator. This appears a comparatively trivial objection, and one which should not be allowed to jeopardise a peaceable settlement of the wages question in the trade.

LEICESTER, 31st DECEMBER, 1890.

COAL MINING.—The collieries in this coalfield are all very busy, many of them being at work six days a week. The demand continues pressing, and as stocks are clear, there will of necessity be full employment in coal-getting. The coal owners have this week made a further advance in prices all round.

WOOL SPINNING AND YARN TRADES.—There was a quiet trade doing in the local wool trade just before Christmas, but the occurrence of the holidays has naturally much interfered with business. There is a very healthy tone pervading the market, and the prospects of trade in the new year are on all hands considered encouraging. Buyers are cautious, and there is no disposition to speculate. Stocks are small, and in few hands. Much more confidence prevails on all sides. Deep-stapled fleeces make 23s. to 24s. per tod; superior quality, 24s. 6d. to 25s. 6d. per tod; choice lots, with large proportion of Shropshire fleeces, 26s. to 27s. per tod. Spinners are mostly idle this week, and engaged in machinery repairs. There is a small amount of new business, and a fairly brisk time is anticipated after this week.

HOSIERY TRADE.—The cold weather gave a great impetus to this department, and a busy time was experienced right up to Christmas. The demand for heavy woollen underwear and gloves was very brisk, and has cleared the stocks in the warehouses. Business is being gradually resumed this week, and a very good time is anticipated in the opening weeks of the new year.

BOOT AND SHOE TRADE.—Some firms are making a long holiday in the factory department, and have not yet resumed business. The snow has cleared stocks of heavy goods, but its long continuance has somewhat retarded the placing of orders for spring goods. Still there will be rather more work to commence on next week than for some time past. Leather merchants are doing a small trade only.

SWANSEA, 31st DECEMBER, 1890.

TINPLATES.—It would seem as if the cycle of prosperity for this trade was measurable in decades, for, to find so successful a period as that through which we are passing, it is necessary to go back to 1880, and again to 1870. This, however, only refers to results of operations, and not to the magnitude of the trade itself, for this has been increasing at so large a rate that, whereas, in 1870, 100,000 tons of tinplates were exported, the amount was more than doubled in 1880, and this will again be more than doubled for 1890, as the exports for this year are sure to exceed 450,000 tons. Prices, which saw a low level from April to July of the year now closing, during which period IC cokes barely reached 13s. 9d. per ton, have, under the influence of the excitement caused by the McKinley Act, recovered the position they had attained at the commencement of the year, and are now at 16s. 6d. to 17s., with a hopeful outlook. Close upon 100,000 boxes were received into warehouses during the week preceding Christmas, a quantity which is the highest on record. The Caerleon Tinplate Company has been registered, with a capital of £5,000 in £5 shares.

THE COPPER WORKS.—Some twenty workmen have had to be discharged from the Morfa Copper Works owing to the scarcity of orders for yellow metal. It is stated that during the recent strike at these works the company had to refuse an order for 7,000 tons of yellow metal, which, had they been able to accept, would in all likelihood have made the present action unnecessary.—The strike at the Cape Copper Works, Neath, which affected upwards of a thousand men, was put an end to after six weeks' idleness, brought about by a dispute over the question of helpers engaged in wheeling the metal to and from the furnaces. Masters and men have met each other half way.

BARROW-IN-FURNESS, 31st DECEMBER, 1890.

HEMATITE.—There has been a want of activity in the hematite pig iron trade during the week, and sales have been checked by reason of the Christmas holidays. Prices are again easier, and warrants are at 53s. 7½d., and makers are asking 54s. 6d. for mixed numbers of hematite warrants, and 54s. for No. 3 forge. Stocks have again been reduced during the week to the extent of 980 tons, making a decrease of 169,474 tons up to the 29th inst., and leaving the stocks still in hand at 211,065 tons. An additional furnace has been put in blast at Askham, near Barrow, which makes the number in blast fifty, compared with fifty-six twelve months ago.

STEEL.—Although the prospects of the steel trade for 1891 are not such as will justify the belief that trade will be as brisk as in the year now closing, it is noteworthy that some fairly good orders have been received for rails at about £4 17s. 6d. per ton for heavy sections. The local and general demand for steel shipbuilding material is fairly brisk, the requirements of local shipbuilders being especially good. Plates are down at £6 7s. 6d. per ton, angles at £5 12s. 6d., and boiler plates at £7 10s.

SHIPPING.—The amount of pig iron and steel shipped from West Coast ports during the past year represents 1,042,429 tons. The amount shipped during 1889 was 1,064,511 tons, showing 22,082 tons decrease on the year.

SHIPBUILDING.—The shipbuilding works are almost closed, and a complete resumption of work will not take place until the 5th prox. Builders have a very big programme of work before them, and it is expected that a very large tonnage will be launched, and that the engines built for the ensuing year will show an enormous indicated horse-power.

MIDDLESBROUGH, 31st DECEMBER, 1890.

PIG IRON.—The market yesterday was very dull, and the attendance on 'Change was small. This dulness of trade is intensified by the holidays, and there are few people prepared to do business. There is little inquiry, and the policy of buyers is a waiting one, for they believe that prices will be worse instead of better in the new year. There is little done in speculative operations, for as prices continue to fall persistently there is nothing to be made out of transactions in warrants. Merchants would take 42s. 6d. per ton for prompt f.o.b. deliveries of No. 3 G.M.B. No business is done in warrants, but the prices nominally are 42s. 3d. cash buyers and 42s. sellers. In hematite iron East Coast brands are quoted at 55s. per ton for Nos. 1, 2, and 3 makers' iron. The stock in Connal's store here is going quite the opposite way from what was expected, for it has increased 4,442 tons since the 22nd inst. and 14,207 tons since the 30th ult., the quantity held on the evening of the 29th inst. being 104,336 tons.

SHIPMENTS OF PIG IRON.—The shipments of pig iron are very poor, and up to the 29th inst. reached only 56,996 tons, as against 75,849 tons during the corresponding period in November, but 16,673 tons more than up to the 29th of December last year. Altogether over the whole year shipments will have fallen off at least 160,000 tons, as compared with 1889. Of the pig iron shipped this month 31,116 tons have gone to Scotland, 5,717 tons to England and Wales, 5,717 tons to Germany and Holland, and 14,279 tons to other foreign countries. The chief falling off is in the shipments to Germany and Holland, who took 15,439 tons last month, and to Scotland, who had 36,119 tons.

MANUFACTURED IRON AND STEEL.—There is no change in these in the prices; indeed, very little business is being done. As a set off to the dulness of the trade it is comforting to note that Messrs. Bolckow, Vaughan, & Co., of the Cleveland Steel Works, have just got orders for steel rails—17,000 tons for the Indian State Railways and 10,000 tons for a German railway. The latter is rather remarkable, considering the influences which practically shut us out from the German market.

WAGES.—The Cleveland ironmasters having notified the blast furnace men that they cannot entertain an application for the eight hours system, and that they intend to ask the men to submit to a material reduction of wages, a joint meeting of the executive of the Cleveland Miners and the Cleveland Blast Furnace Men's Associations was held, when it was resolved:—"That, on the intimation from the iron-masters and mine-owners for a substantial reduction in wages, it will be greatly to the interest of both bodies of men that they act in unison to avoid such reduction, and that neither party will agree to accept such reduction without the consent of the other."

THE LATE MR. T. RICHARDSON.—Mr. Thomas Richardson, who was head of the well-known shipbuilding firm of Messrs. T. Richardson & Sons, of Hartlepool, died on the 29th ult. He had represented Hartlepool in Parliament for many years, having been first elected in the year 1874.

NEWCASTLE, 31st DECEMBER, 1890.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending the 27th inst. amounted to 81,177 tons, being a decrease as compared with the corresponding week last year of 206 tons.

THE HOLIDAYS.—The observance of the Christmas holidays has caused the whole of the works in the district to be laid idle during the latter half of last week, and in some instances the suspension of operations is intended to be continued over this week also. Many firms take advantage of this holiday period to carry out a thorough process of stocktaking, and to this circumstance is doubtless due the prolongation of the stoppage in the cases referred to.

RAILWAY MEN'S WAGES AND HOURS OF WORK.—The claim of the railway servants in the employ of the North Eastern Company in Newcastle, for a rearrangement of the working hours in some departments and an advance of wages in others, having been met in a conciliatory spirit by the directors, a conflict which would have been disastrous to the commercial interests of the district has been avoided. Wherever any reasonable grounds for a change in the existing conditions of work could be put forward concessions have been made, and as a settlement which appears to be satisfactory to all parties has been arrived at, it is to be hoped that such a sudden disruption of traffic arrangements will not again be threatened.

OVERTIME IN ENGINEERING SHOPS.—A committee representing different sections of engineering operatives have sent a notice to the employers intimating that from January 1st the working of overtime on new and old work shall be disallowed, excepting under conditions which involve a large increase in the rates of pay for the same. It is not as yet known what action the employers may take in reference to the matter.

ENGINEERING.—A new engineering specialty, which is likely to become popular, is being introduced in this district by Mr. W. F. Snowdon, 32, Side, Newcastle. This is the "Dodge patent wood split pulley," manufactured by the Dodge Manufacturing Company, Indiana, U.S.A., for whom Messrs. Isaac Braithwaite & Son, Kendal, are the principal English agents and importers. Several special advantages are claimed for this specialty, and the agents are so confident of its superiority that they offer a free trial before purchase.

SHIPBUILDING.—The total tonnage launched on the Tyne this year amounts to 235,062 tons, which, as compared with last year's output, shows a decrease of nearly 47,000 tons.

DUNDEE 31st DECEMBER, 1890.

FLAX AND JUTE TRADES.—The railway strike, which has now lasted ten days, has seriously interfered with business. At this season of the year there is generally very little business. Manufacturers are now taking stock of the trade for the last twelve months. The retrospect is not a bright one, but there is not, on the whole, much room for complaint. In some departments the extent of business has not been so great as could be wished, and prices are somewhat weak, but, on the other hand, the price of the raw material is lower than it was last December. Dundee has imported during the year 24,153 tons of flax, and 4,887 tons of tow and codilla. Last year the imports were—Flax, 26,396 tons, and tow, 4,789 tons. These figures, it may be remarked, were much below those of 1888. As to prices, the quotation for the best quality of flax shows little or no change, but tows, which were £25 and £27 last December, are £23 and £25. Flax yarns, which fetched 1s. 4d. last December, are now selling at 1s. 2½d., and 6lb. tow yarns have fallen from 2s. to 1s. 8½d. Flax canvas, which brought 9¾d. to 10d. twelve months ago, is now sold at 9d. to 9¼d., and merchant navy has declined from 7½d. to 7d. The jute import for the year shows an improvement—238,835 tons, against 222,710 tons. During the latter half of the year some qualities have declined in value as much as £5 per ton. Fine jute yarns show a considerable decline in price for the year. The closing price last December was from 1s. 7½d. to 1s. 8d.; the quotation to-day is 1s. 5d. to 1s. 6d. Hessian cloth 40in. 10½oz., which closed last year at 2d. to 2 1/16d., closes this year at 1⅝d. to 2⅛d.

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THE WEST HIGHLAND RAILWAY.

MESSRS. FORMANS & MACCALL, GLASGOW, ENGINEERS; MESSRS. LUCAS & AIRD, LONDON, CONTRACTORS.

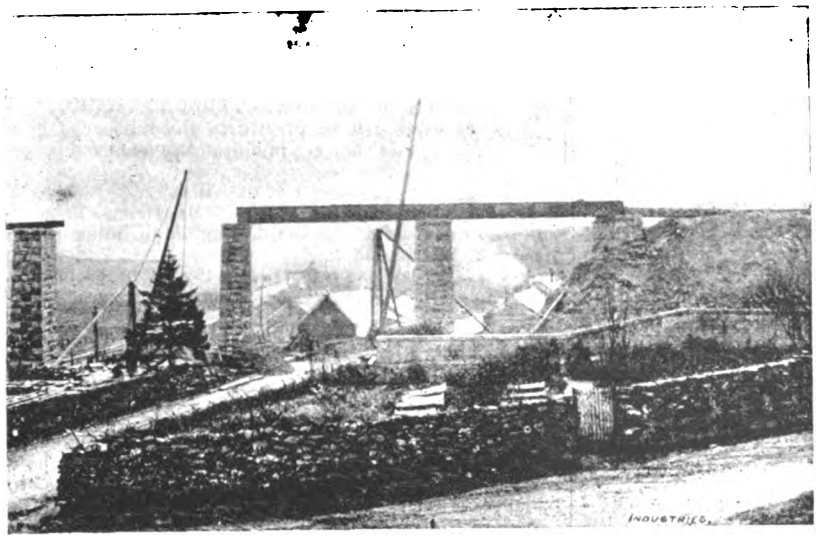


FIG. 1.—CRIANLARICH VIADUCT.



FIG. 2.—AUCHTERTYRE VIADUCT.



FIG. 3.—TYNDRUM VILLAGE AND CALLANDER AND OBAN RAILWAY STATION.

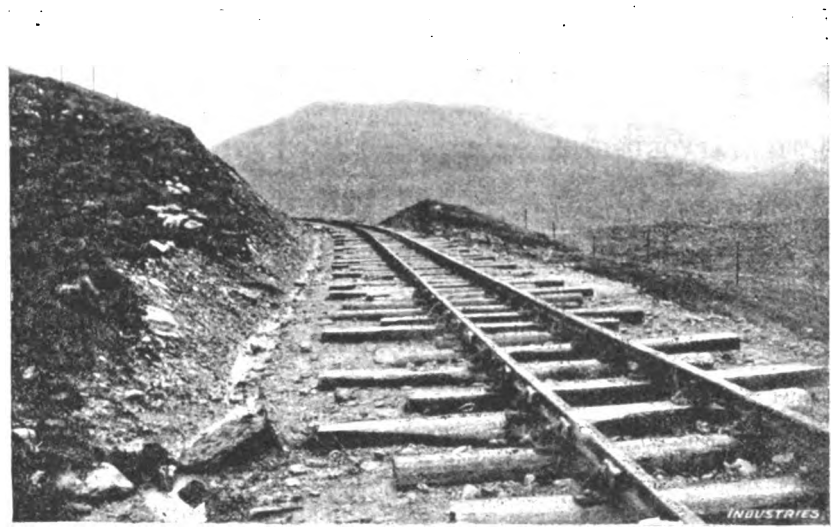


FIG. 4.—VIEW NEAR TYNDRUM. NARROW GAUGE TEMPORARY LINE.

THE WEST HIGHLAND RAILWAY.

I.

THE railway now being constructed from Helensburgh, on the Clyde, to Fort William, under the shadow of Ben Nevis, is one of the most considerable engineering enterprises in progress in this country at present. The line is 100 miles long, and is carried through a country of mountain and moorland, in parts of which there are even no roads for the transport of the material of construction. Passing as it does through a country famous for opportunities for fishing, shooting, and deer-stalking, the line must ultimately become very familiar to English sportsmen as well as to the ordinary tourist. Throughout its length the railway traverses scenery whose picturesqueness is not excelled in Scotland. Immediately on leaving Helensburgh the line plunges into the beautiful woodlands at the entrance to the Gareloch, and, following the north shore of that loch—whose still waters are famous among shipowners as the Clyde resort for the adjustment of compasses—it rises by a gradient of 1 in 60 to the "col" at the head of the loch, from which it drops again to Loch Long, and, winding along its eastern shore, reaches Arrochar, from which it crosses the isthmus separating Loch Long from Loch Lomond, and by Tarbet and Ardlui passes on by the unrivalled scenery of the queen of Scottish lakes to Crianlarich, where it crosses the existing Callander and Oban line by a fine viaduct. By the opposite side of the valley to the Oban line it follows the contour of the hills, sweeping round them in ample curves, and rising at an easy gradient until it reaches Bridge of Orchy, from which it crosses the western end of the moor of Rannoch, and so on to Fort William. While it has been thus necessary to indicate the general features of the line, we illustrate at present, in Figs. 1, 2, 3, and 4, only the section from Crianlarich to about four miles beyond Tyndrum, leaving the other sections for subsequent treatment. This section is fully twelve miles long, and, although the utmost ingenuity has been exercised by the engineers in availing themselves of the contours of the hills, several viaducts have been necessary. The largest of these is at Crianlarich, where, emerging from Glen Falloch, the line first crosses the Callander and Oban Railway, and then sweeps across Strath Fillan, until it again winds along the hillside. The Crianlarich viaduct, shown in our illustration (Fig. 1), consists of five spans of 35ft. each, and extends to a length of 200ft. At Crianlarich there is a short loop line which connects the West Highland with the Callander and Oban Railway. The next viaduct is at Inverhaggernie, where the line crosses a mountain stream. A deep and narrow gorge at Auchtertyre is crossed by another viaduct, now in course of construction, and shown in Fig. 2. This viaduct will consist of five spans, the centre span being 101ft., and the remainder 55ft. each. The height of the centre of the viaduct will be 80ft. The material out of which the piers are built is quarried from the bank of the stream over which the viaduct is built. The spans are constructed of lattice girders. The line from Auchtertyre to Tyndrum follows the contour of the hill very closely, and is made in the simplest manner, the material cut from the hill being in some places simply tipped over the shelf, only about half the width of the line having thus to be excavated from the hillside. Very ample provision is made for water-courses, which form the principal sources of danger to lines and roads in these Highland regions. The railway, indeed, as it follows the contour line, consists for the most part of short lengths of bank between small bridges, there being very few cuttings, and no tunnels whatever. The absence of tunnels is quite an unusual feature in a mountain line. When the line reaches the end of the range, near the upper end of Glen Lyon, the longest glen in Scotland, and opposite Beinn Doireann, a mountain over 3,500ft. high, confronting the head of Strath Fillan, it takes a sweep round the horseshoe-like configuration of the group of hills, of which Beinn Doireann is the highest and most north-westerly, and Beinn á Chaisteil is the central and most northerly. Two viaducts here enable the line to pass at the same level from the contour of one hill to another, and yet to another. This part of the line is not yet constructed, but the viaduct will be one of the most picturesque on the line. On the side of Beinn Doireann the railway is carried to Bridge of Orchy, where the section begins which stretches over Rannoch Moor, in regions where the conveyance of material is as difficult as in an uninhabited country. This, as well as the other sections, will form the subject of subsequent articles. The line is a single one throughout. The rails employed for the permanent way are 75lb. steel rails, and the girders used in the viaducts are being made and erected by Messrs. Finlay & Co., Motherwell.

The engineers of the line are Messrs. Formans & MacCall, Glasgow, and the contractors are Messrs. Lucas & Aird, of London. We have to express our acknowledgments to both firms, and to their representatives on the works, for the facilities generously given us for visiting and illustrating the railway.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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To Correspondents.

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Industries:

FRIDAY, 2ND JANUARY, 1891.

THE INDUSTRIAL OUTLOOK FOR 1891.

THERE is a not very easily formulated, but nevertheless wide-spread, impression that the prospects that lie in the future are by no means so satisfactory as the trade outlook at this time last year. This view is not, it must be admitted, without some, if not very adequate, justification. The usual tests of the immediate future of business are the export and import returns, the railway traffic returns, and the range of prices. The first of this series indicates the prospects of our foreign trade, the second the position and prospects of our business at home, and the third the character of the demand in relation to the supply. The foreign trade of 1890 was considerably better than in the year 1889. Imports have diminished, but there has been a more than corresponding expansion of our exports. The balance, on the whole, is favourable to the net result for the year. But the amount of business done during the second half of the year has fallen off in comparison with that of the previous year, and the fall was all the more marked as the year proceeded, until in November there was a falling off in our export trade of about a million and a half, and in our import trade of more than four millions sterling, as compared with the totals for the same month of 1889. If the same rate of decrease were continued over the twelve months, it would mean that the foreign trade would show a diminution of not less than 66 millions sterling at the end of the year, which would, of course, represent a shrinkage of the most serious character. There is probably no sufficient reason to believe that the total trade of the year will suffer to anything like this extent, but that there will be a reduced business in the immediate future appears to be placed beyond much doubt. So far as our internal trade is concerned, there are evidences of a decline in many directions. We have the falling off that is already apparent in our railway traffic. During the second half of the year there was an increase of only 2·7 per cent. in the receipts from this source, whereas, for the first six months of 1890, there was an increase of 4·2 per cent. It is true that up to the end of the year 1890 there has been an actual increase in the traffic carried, and in the receipts therefrom, as compared with the previous year; but the increase steadily diminished as the year advanced, until at the close of the year it had practically reached a vanishing point. There have, of course, been exceptional circumstances to account for this falling away, but the main reason has been that the general condition of trade had become less stable, and that in many industries profits had become more attenuated.

One of the most serious difficulties that appear to lie in the pathway of industry is the continued high price of the raw materials relatively to the prices realised for the finished articles. Throughout the year 1890 there has been a very large demand for nearly all descriptions of raw material. As a consequence, fuel, iron ores, and other raw materials have been selling at extraordinarily high prices. The average price of the imported iron ore, which, by the way, reached the exceptionally high figure, for the year, of about 4½ millions of tons, was about 16s., being several shillings above the average prices of the six years ending with 1888. It has been much the same with coal and coke, which have been selling at fully 60 per cent. more than the average prices of the same period. Labour, again, has advanced all round, so that the wages paid to-day are probably 35 to 50 per cent. more than the average wages of three or four years ago. The prices of the manufactured articles, such as pig iron, rails, shipbuilding tonnage, and other leading products, have failed to keep pace with the greater cost of raw materials, so that manufacturers, instead of being in a better, are in very many cases in a worse, position than they occupied a few years ago. The result is seen in the suspension of manufacturing operations in the pig iron trade of Scotland, in the increased development of syndicates designed to control prices and production, and in attempts to reduce the rate of wages all round. Another rock ahead is the labour question. The workmen have up to the present time participated fairly, as a rule, in the generally improved conditions of trade. They have, however, lost a great deal of the gain that would have come to them from this source by their frequent strikes, since the rise in prices caused by restricted production was only a temporary one. But they are generally earning much better wages to-day than they did a year or two ago. Should the prospects that appear to be imminent come to be fully realised, wages must fall, but it is seldom that they are allowed to fall without some sort of resistance on the part of the workmen. The Board of Trade has ascertained that during the year 1889 there were not less than 1,145 strikes of all kinds, most of them for higher rates of wages. This system of "killing the goose that lays the golden eggs" is not by any means new; but it is none the less unfortunate that the same experience is always repeated under similar conditions. The years 1889–90 have been years of plenty, and employers could not in many cases decline to give higher rates of wages. We are now, however, entering upon what appears likely to be relatively, if not absolutely, lean years, and it will be well if the working classes learn to adapt themselves thereto.

Apart from the influences which operate at home, and which, like the poor, we "have always with us," there are influences beyond our own control that threaten to interfere with the prospects of our commerce in the future. The most important of these is probably the tendency on the part of foreign countries to draw still closer the bonds that bind them to the Protectionist movement. The McKinley Tariff Act, so long as it lasts, will undoubtedly have an unfavourable effect on our trade relations with the United States. The annual value of our trade with that country is about 140 millions sterling, of which 44 millions represent exports from Great Britain. This sum is only 47 millions less than the value of our total annual trade with the colonial possessions of Great Britain, including India, so that it is a fairly important factor in our trade accounts. The new Tariff Act may not affect our imports very materially, but it has already affected, and is likely to affect still more in the future, the value of our exports. In Russia, France, and other countries, the general tariffs are now under revision, and the outlook from this point of view is far from reassuring. We may, indeed, be able by-and-bye to adapt ourselves to the altered tariff conditions of these countries, as

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we have done before, but the immediate effect is likely to be a certain dislocation of industrial affairs, involving both loss and trouble.

On the other hand, there is a brighter side to the somewhat sombre picture that we have so far painted. England has industrial worries and difficulties, but she does not stand alone. Most of the leading nations of the world are in much the same case, without possessing to the same extent that combination of skilled labour, English grit and steadiness, financial resources, and accumulated experience that have all along kept England in the forefront. In Continental countries there is a tendency to reduce the hours of labour and to raise the rate of wages. In the United States, the McKinley Tariff Act, by making imports dearer, will certainly not make labour cheaper. There is but little proof that we are likely to yield up our industrial supremacy to other nations. It is true that the United States now make more pig iron, steel, and some other productions than we do, but they make these almost exclusively for themselves. England continues to hold her own in neutral markets, and it is at least a consoling reflection with which to begin the new year, that we have just finished the best year's business that has ever been recorded in industrial history.

THE SCOTTISH RAILWAY STRIKE.

The Christmas holidays in Scotland have been marked by a strike of railway servants so extensive as to cause an almost complete stoppage of goods traffic and a very considerable derangement of the passenger service. Indeed, the Scottish railway system has been almost paralysed from the morning of Monday, the 22nd ult. The leading ground of the complaint made by the men is the duration of the working day. They do not, they say, object so much to the average number of hours of work, as to the length of the spells of it, and they allege that they have placed their grievances again and again before the companies without effect. The managers of the companies state, on the other hand, that they have never indicated any indisposition to deal with specific complaints. The meaning of this is, of course, that the railway managers refuse to recognise the Railway Servants' Association, or to treat with its executive as the ostensible representatives of the men. However, on the morning of the 22nd ult. upwards of 3,000 men came out, and by the 27th ult. at least 8,000 were out, although the figures as stated by the different parties vary considerably. The railway companies were completely taken by surprise. They had not made—perhaps they could not have made—provision for carrying on their traffic without the services of the strikers, and the result, for a time, was complete chaos. Signalmen and engine-drivers cannot be produced in numbers at a day's notice, and thus those who remained in the service of the companies were compelled, it is said, to work, practically, from Monday morning to Saturday night, with the briefest intervals snatched for sleep. The wonder is that, in spite of the reduction in the train service, some deplorable calamity has not occurred.

The demands of the men are formulated in the following terms:—

"1. That a universal ten-hours day be the maximum day's work for all grades of the service.

"2. That the custom of reckoning hours of labour by an aggregate fortnight's work be dispensed with, and that each day stand for itself.

"3. Time-and-a-quarter pay for overtime.

"4. Time-and-a-half pay for Sunday duty; such to be reckoned from 12 p.m. on Saturday to 12 p.m. on Sunday.

"5. That eight hours be the maximum for yardsmen, shunters, ground pointsmen, and locomotive men, and others engaged in busy shunting yards.

"6. That more cabins at present working on the twelve-hours system be placed on the eight hours per day system.

"7. That a universal agreement for regular annual holidays be put into practice.

"8. That the running of trains on the "trip" or contract system be abolished.

"9. That a mileage system be arranged for passenger and goods trains.

"10. Owing to the whole time of all grades being at the disposal of the companies, it be a condition of service that men be guaranteed a week's work, and when sent out for duty at any time, or waiting orders by instruction, a full day's pay be paid, and the custom of booking men off duty for periods during the running of their maximum day's work be abolished."

The shipping delays on account of the strike have already caused immense loss. In the case of some valuable goods, these have been carted into Glasgow for distances of over twenty miles in order that they might be shipped. It is perhaps too soon, however, to estimate the extremely serious issues opened up by the strike. There are some disputes which the public may regard with indifference, because its interests are not seriously menaced, or because the combatants are so nearly equally matched in strength that they may be left to fight out their own quarrel in their own way. But a railway strike is not a strike of this kind. The position which a great railway company occupies nowadays is that of practical monopolist of public transit. So far as the legislature is concerned, every facility has been given to the development of our railway system. The result of all this has been that the railway companies have become endowed with most extensive and progressively valuable privileges. The claim, therefore, that the public may, on occasion, intervene in the affairs of a railway company seems fairly clear. Not only this, but, since the irregularity or otherwise of the way in which the companies exercise the function of public carriers is a matter of supreme public moment, it may become an absolute duty for the public to interfere, apart altogether from any special legislative enactments, by using the weight of its opinion. Yet it is difficult for the public to do this effectively. A railway company is a delicately organised machine, depending not upon the strongest, but upon the weakest of its integral parts. The growth of the railway system has thus been at once a growth in size and in close interdependence in organisation. When from any cause any part goes quite out of gear, the whole machinery stops or becomes a ruin. The occurrence of this strike, and the by no means remote probability of a repetition of it ere long, shows how tremendously potent for evil a railway strike may become. It is futile to expect the companies to surrender to demands that they have already repeatedly rejected; it is equally futile pathetically to beseech the men to return to their work. The plain course is, since they cannot agree, and since their disagreement is a public peril, to mutually refer their differences to a neutral arbiter. The higher the standing of this arbiter the better. It is out of no sentimental idea that "peace is better than war" that we have persistently pressed this remedy for industrial disputes, but because it is becoming increasingly plain to every one who looks even a little way ahead, that the policy of leaving two brute forces to fight it out between them is fatally wrong economically. The more highly developed our industrial system becomes, the more dependent do we become upon labour. Thus, if it be partially true that the forces of capital are becoming concentrated, it is even more true that the forces of labour are becoming concentrated. On one side we have massed a more or less cohesive group of labourers, and on the other a more or less cohesive group of capitalists. These together carry on production, national or international. The great mass of the public, so far as these groups taken separately are concerned, have interests distinct from them, and thus, unless the public is perpetually to be buffeted by these contending factions, some means must be devised to prevent the frequency of this appeal to brute force.

Two methods at once suggest themselves—that of legislation, and that of voluntary regulation. Legislation may be in one of two directions: it may be in the direction of re-enacting the abandoned anti-combination laws, or it may be in the direction of compelling reference to the Courts of Justice in all cases of disputes about wages, hours, or terms of service. It is reported that the railway companies contemplate making some attempt in the first-mentioned direction. It is, however, rather unlikely that Parliament will reverse the legislation of the past twenty years. The other direction—viz., that of compelling in certain events appeal to the Law Courts—might, perhaps, be attempted with success; but the practical difficulties in the way of devising a measure which would be just to every interest are very great. The method of voluntary regulation remains as by far the best and most elastic. It must not be supposed that we would countenance happy-go-lucky interference and gratuitous advice by people who have no means of forming any reliable judgment on intricate details of administration. The haphazard method just now current, where obstinacy and eagerness to cultivate the goodwill of the public go hand in hand, is responsible for the existence of these irresponsible advisers. What we mean is a formal arbitration by some arbiter of undoubted standing, who should have before him both pleadings and evidence.

Even if this strike fail altogether in its specific aim, it has shown what a dangerous power the railway servants have when they choose to use it. We would not defend for a moment the action of the men in leaving their employment without notice, nor would we pronounce offhand an opinion as to the severity of their work, but the fact of the strike is enough to show that their grievances should be made the subject of careful inquiry, and that any settlement that does not take these into account cannot be otherwise than merely temporary.

THE COTTON INDUSTRY.

A well-known politician is reported to have said a few days ago that millowners are firmly convinced that it is only a question of a very few years before Manchester will lose the India and China markets. If this opinion be correct, it is a sufficiently serious matter for Manchester, and, indeed, for Lancashire generally, to demand the most careful attention of all concerned, so that if the state of affairs indicated cannot be averted it may at least be brought about so gradually that those who are mainly affected may have had time to have fitted themselves to the altered conditions. It must be admitted that the circumstances are very threatening, especially as regards India, for even at present the Bombay spinners of cotton yarns have virtually driven Lancashire out of India, Japan, and China for the coarser yarns, and efforts are constantly being made to produce finer numbers, and every year shows fresh encroachments on Lancashire. Twenty years ago there were only 400,000 spindles in all India. During the last half-dozen years, however, the rate of increase has been very great. In 1885 the number of people employed in the cotton industry in India was 67,000, while at present there are about 102,000. In 1887 there were 103 cotton mills in the country, with about 2¼ million spindles, consuming 2½ million cwt. of cotton. Now there are 137 mills, with 3,274,196 spindles, consuming 3½ million cwt. of cotton, and the majority of these mills are paying good, and in some cases very good, dividends. The number of power looms in India in 1887 was 18,536, now there are 23,412. During the five years 1880–84 the total exports of twist and yarn from India were valued at £7,800,000; during the following five years 1885–89 they mounted to a total of £18,230,000, or an increase of about 230 per cent. There has been a substantial increase in manufactured cotton goods over the same periods, viz., from £9,700,000 to £12,440,000.

These figures are sufficient to cause serious thought to our Lancashire manufacturers, and make them inquire into all the circumstances connected with the progress of the cotton industry at home and abroad. They know perfectly well that they cannot expect India to be kept as a preserve for their special benefit, but they have a right to expect that the conditions of competition shall be fair, and this cannot at present be said to be the case. By our Factory Acts our cotton mills can only work fifty-six hours per week. In India, on the other hand, much greater freedom is allowed to the manufacturers, and the cotton industry there seems to be passing through the same stages as it did in its early days in this country. Of course, the competition with Lancashire prevents the immense profits being made which were made in Britain early in this century, but the longer hours and the cheap labour, which is to a very large extent that of women, children, and young persons, enable the manufacturers not only to withstand competition, but also to realise what in these days are considered very fair profits. We cannot interfere directly with the conditions of labour in foreign countries, nor can we attempt to make our colonies and dependencies mere appendages to our manufacturing concerns, but it is only reasonable that conditions should be equalised as nearly as possible, and this, not merely as an act of justice to our manufacturers, but also in the interests of humanity and of the natives of India. We may rest assured that a reaction will come, and that it will be impossible for us to govern the vast population of India unless the great mass of the people of that country are satisfied that we are acting in their interests, and not in the interests of foreign capitalists, who are extracting from the great mass of the people great gains by keeping them in a state of abject poverty and unremitting toil.

The workpeople in India are beginning to combine and to demand reasonable hours, and the same conditions as the workers in this country. The Bombay Mill-hands' Association recently presented a petition to the Viceroy setting forth their grievances, and asked that it be forwarded by him through the regular channel. The authorities will have their hands full with this matter during the coming session, and it will be their duty to weigh carefully all sides of the question. Our manufacturers should take care that their opinions are heard and considered. It may be urged that the transit charges of the raw cotton to England, and of the yarn and manufactured goods to India, are sufficient to account for the advantages of the Indian mills, but those

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who have examined carefully the details of the problem assure us that this is not the case, and that our disadvantages as regards transit have been reduced very much of recent years. This contention is, we think, proved to be correct by the fact that America grows her own cotton, like India, she makes her own machinery to a very large extent, is provided with high-class skilled labour, and is also nearer the cotton fields, and yet she has to pay at least 35 per cent. duty upon the commonest cotton fabrics in order to keep us out. The problem is still further complicated by the silver question.

A consideration of all the circumstances of the case shows us that the whole cotton industry of the country is in a state of unstable equilibrium, and the very causes which gave it prominence and developed it are now tending to transfer it to India and other countries where labour is cheap, hours long, and materials abundant. The manufacturers have, therefore, the right to ask our legislators that they shall, as far as possible, remove everything which tends to make the competition unfair.

THE NORTON FITZWARREN RAILWAY ACCIDENT.

In the Board of Trade report of this accident, Colonel Rich remarks:—"This very serious collision was caused by the signalman at Norton Fitzwarren station cabin having forgotten that he had placed the down goods train from Bristol on the up main line. He ought to have put the goods train on to one of the branch lines. He placed it on the main up line at 1.10 a.m., fourteen minutes before the up special train arrived. The driver of the goods train stated that he whistled to call the signalman's attention and to intimate that he wanted to go, immediately after the broad-gauge pilot engine returned on to the main down line about 1.19, and that he changed his head lamp from red to green about 1½ minutes before the special arrived; but as his regulations direct that he shall keep the red light exhibited so long as he is not on his proper line, I cannot understand why he changed it at the time he said he did. If he had exhibited the red light, it might not only have drawn the signalman's attention to the train being on the up line, but the driver of the special would probably have observed it after he passed the up home-signal, when there was time to stop the special train by applying the continuous brake. I consider that the driver of the goods train's negligence, in disregarding the company's regulations, contributed to the catastrophe. The regulations further provide that the guard of the goods train shall go himself, or send his assistant, to the signal cabin, and remind the signalman of the position of his train. The guard did not go, nor did he tell his brakesman to do so, and by his neglect he also contributed to the collision. The signalman had been on duty 4½ hours; the driver of the Bristol goods, 7 hours 40 minutes; the guard of the Bristol goods, 7¼ hours. I recommend that all stations where there is much shunting, or where stopping trains are liable to be set aside for fast trains to pass, should be provided with refuge sidings at the proper side of the railway; and in addition to the present rules, which are very good if carried out, lifting bars may sometimes be advantageously used to lock the signals of the line on which trains have to wait for 'Line clear,' as collisions, consequent on the signalman forgetting that he has a train standing at his home or advance signals, are not uncommon. I am informed that many signalmen put one of their flag sticks in the spring catch of the signal levers of the line that is blocked, to prevent their forgetting that a train is waiting to proceed, and pulling off the signals of the line that is occupied. I would suggest that a slide bar, a loop, a wedge, or some other mechanical contrivance, marked 'Train waiting' should be fixed to the levers in the cabin to do this, and prevent these levers from being pulled by mistake."

TRADE PROSPECTS WITH ZAMBEZIA.

An address was given on Wednesday, the 17th ult., at the London Chamber of Commerce, by Mr. E. A. Maund, on the trade prospects of the territory which has been newly styled Zambezia, which is now being opened up by the Chartered Company. The climate of Mashonaland is good, though, as in all tropical regions, precautions have to be taken in selecting the sites of buildings and in dieting. The soil is very fertile, and can grow wheat, potatoes, cabbages, carrots, and other vegetables, fruits of all kinds, rice, and indiarubber. Mr. Maund considers, from his personal experiences on the spot, that there will be a ready sale to the natives of cotton goods (blue and white "limbo"), coloured beads, trade knives; guns, powder, and lead for hunting; axes, American ploughs, and old clothes. There will also soon be a great demand for corrugated iron houses. The gold alone in Mashonaland would develop Zambezia into, perhaps, the richest acquisition of the empire, and there would be a rush to the new colony unexampled in the history of South Africa. It is chiefly on account of its great richness in gold that we must look for the commercial value of Zambezia. The country can doubtless, both climatically and agriculturally, support its probable large white population. To and from the busy mining centres, soon to spring up, commerce must flow. The development of the gold industry must be pushed forward on sound commercial principles. There will be no necessity for expensive white labour, except as overseers, mine captains, and gangers, and for dealing with machinery. The author suggested that what is wanted in our colonies are Schools of Mines under State direction. Victoria now has one at Ballarat, and South Africa wants one. The Chartered Company should institute one, for it will shortly require so many experts, competent assayists, geologists, and managers, that without efficient and skilled men investors may be misled. Zambezia is fast assuming the character of an organised colony under the administration of the Chartered Company, and when the rush comes it will find a strong executive ready to receive and regulate it, and thus order is wisely assured.

THE LATE MR. WILLIAM JOHN.

We regret to have to announce the death of Mr. William John, the well-known naval architect, on the 26th ult., at Madrid. Mr. John's professional abilities were of a high order. He was a native of Pembroke, and was one of the first students of the Royal School of Naval Architecture and Marine Engineering, and was cotemporary, as a student, with Mr. W. H. White, Director of Naval Construction; Dr. Francis Elgar, Director of the Admiralty Dockyards; Mr. R. Sennett, formerly Engineer-in-Chief of the Royal Navy; and Mr. A. J. Durston, the present Engineer-in-Chief. Mr. John made the calculation for the first curves of stability for a ship ever constructed. He calculated the stability of the ill-fated "Captain," and pointed out the dangers to which she was liable, a short time before she was lost. After passing out of the Royal School of Naval Architecture with the highest honours attainable, he was for several years employed in the Construction Department at the Admiralty. He left the Admiralty service, in 1872, to join that of Lloyd's Register Society, and there he distinguished himself by his grasp of the problems that arose in connection with the mercantile marine, and by his success in dealing with them as the scientific assistant to Mr. Martell, the Chief Surveyor. His treatise on "The Masting of Vessels," first brought out in the form of a report to the Committee of Lloyd's, is reckoned the standard authority on the subject, and has been officially translated into the languages of the leading maritime nations. Mr. John contributed numerous papers to the Transactions of the Institution of Naval Architects, all of which are marked by great power of thought and clearness of conception of the subjects with which they treat, and one of his most recent successes was the carrying off, in a competition open to the naval architects of the world, of the prize of $25,000 offered by the United States Government for a design for the warship "Texas," now building at Norfolk, Virginia. In 1881 Mr. John left Lloyd's to become general manager of the Barrow Shipbuilding and Engineering Company. During the last two years he has practised in London. He was a member of the late Board of Trade Committee on life-saving appliances in ships, a member of council of the Institution of Naval Architects, and a Fellow of the Royal School of Naval Architecture and Marine Engineering. Mr. John was forty-five years of age.

THE LATE MR. LANT CARPENTER.

Mr. William Lant Carpenter died on the 23rd ult., at his residence, Harlesden, near London. He was a son of the late Dr. W. B. Carpenter, the eminent physiologist and author of works on mental physiology. His grandfather was Dr. Lant Carpenter, of Bristol, and his aunt was Mary Carpenter, who was well known for her work in connection with reformatories, and for her efforts to improve the condition of the people in India. Mr. Lant Carpenter was a mechanical engineer by profession, and was manager of the school of electrical engineering in Princes Street, Hanover Square, W. He had earned a considerable reputation amongst men of science, and was much interested in science teaching. He was a warm supporter of the Recreative Evening Schools Association, and other similar philanthropical institutions.

Letters to the Editor.

IMPROVEMENTS IN THE MANUFACTURE OF NITRIC ACID.

To the Editor of "Industries."

Sir,—In a recent number of *Industries* Mr. Blount asked me to explain certain statements that have been published in a German paper, and I answered briefly that, for the want of time, I could not answer all criticisms, which are based upon evident misunderstanding, but that out of courtesy to Mr. Blount I would, as soon as possible, explain those points which have been misunderstood.

Now, the first and most essential point for many industries is that with my system of manufacture I do not produce weak nitric acid at all, but only such as will have an average specific gravity of 1·500. This has been quite overlooked in the criticism, and I was reminded of the well-known practice to regulate the heat so as to have a temperature of 80° when distilling acid of 44° B. and over, and a temperature of 120° when acid below this strength is made. If anybody can afford to get acids of all strengths, and to sell them separately, he may do as he likes, but the average manufacturer prefers to have acid of no other strength than the one he wants.

When I said that with my system the distillation can be carried on as hot as may be liked, I was speaking to experts, who could understand that I do not work a blast furnace, but want to get nitric acid with as little nitrous acid as possible. Naturally there are comparatively great differences in temperature, as, for instance, between 80° and 120°; but whereas everybody else carries his work on as slowly as possible, I can drive mine as fast as required, as the acid results are always good.

It will not do to say that any dark acid which may result can be discoloured. I have no difficulty in "bleaching" nitric acid even in two hours, although generally it takes as many days, but it is always a costly and inconvenient process, which slightly weakens the acid, and why resort to it if we can do without it?

I also am told the startling news, that there are such things as "receivers" (or "pots"), which are very good for condensation, and that 5 of them are sufficient for a charge of 6 to 7 cwt. of nitrate. The plant of retorts, which I showed, makes 36 cwt. of nitric acid (1·500 sp. gr.) *daily*. In order to make this according to the above plant 16 retorts (charged with 6 cwt. of nitric each), with 80 pots and 4 towers, would be necessary, because in order to have perfect condensation in 5 pots very slow work is necessary. A charge cannot be worked off in less than 24 to 28 hours, and therefore, allowing time for the cooling of the retorts and recharging, only every 48 hours can a fresh charge be made, which is the general practice.

Now if I do the same work with 4 retorts, 4 batteries, and 1 tower, in 24 hours only, and do not get any weak acid at all, there is surely some improvement. And every manufacturer will see at once that 16 retorts and 80 pots will take three times as large a building as my system, and that the cost of such a plant must be at least three times that of mine, and certainly much more than £1,500, as is believed. I have now had through my hands a good many plants of different factories, all over the world, and I have never found a single one to contradict my statement.

In order to show the work of my system, I give below the record taken out of a day's work. The acid was drawn into carboys as it was formed, and each examined separately. They showed:—1st carboy, 1·530; 2nd, 1·550; 3rd, 1·550; 4th, 1·515; 5th, 1·510; 6th, 1·485—average sp. gr., 1·525.

As regards the mastic used for jointing the pipes, I have no difficulty whatever; the special mastic which I use becomes as hard as a brick, and never cracks. If the circumference of the joints is taken into consideration, I have rather less difficulty than others have with the smallest number of pots, and I have recently made some improvement. Besides which, all the joints are of a smaller diameter than usual, so that there is less risk of leakage.

In conclusion, I may repeat that the system works very satisfactorily indeed, and will be soon erected in other parts of the world, and that by people having very long experience in the matter.

Yours, &c.,
Oscar Guttmann.

Dunster House, Mark Lane, London, E.C.,
29th December, 1890.

OUR BIG GUNS, AND HOW THEY ARE MADE.

To the Editor of "Industries."

Sir,—General Braddock's last words were, "Whoever would have thought it!" and it does not need high imagination to conceive some high official at Woolwich making the same remark over the cracked rings of the latest failure in big guns. The fact, I fear, is that the military mind does not change much, and that very much the same dulness of insight and apprehension which proved fatal to Braddock still rules the construction of our heavy ordnance.

At a meeting of the Royal United Service Institution, held on March 3rd, 1879, at which Sir Henry Lefroy, K.C.M.G., R.A., F.R.S., presided, and at which Major-General Younghusband, R.A., was present, the late Dr. C. William Siemens read a paper, partly on the "Application of Steel to Military Purposes," in which he gave clear warning that he anticipated fractures in the rings of guns where they are shrunk on in the way now in vogue. He says, after pointing out the error of shrinking rings on as tight as possible upon bodies which are subsequently to be expanded by heat when used, "if a steel gun or a ring forming part of the same was put into a furnace, heated up to a temperature of, say, 600° C., and the inside was subjected to cooling action while the outside was maintained at the temperature of the furnace, a distribution of stress would result which would be highly advantageous to the strength of the gun. The chilling of the inside surface of the ring or gun would cool the metal towards the inside circumference. This metal could not shrink, nor would the inner diameter of the gun diminish, because the diameter would be determined by the mass of metal still in the heated condition. The vacancies produced in the cooled metal would be filled up by the inflow of metal from the heated mass outside,

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resulting in equilibrium of the metal at the diameter originally due to the heated mass, and the temperature will gradually vary from, say, 100° C. inside to 600° C. outside. If the gun be afterwards taken out and allowed gradually to cool, but without stopping the cooling action from within, the whole mass will cool down to the minimum temperature. If we imagine the ring to consist of a succession of concentric cylinders, each cylinder would acquire a tensile strain due to its previous temperature, which, being a minimum on the inside and a maximum on the periphery, there would result a distribution of tension throughout the mass, being negative or compressive in the interior and more and more tensile towards the exterior. Then, when the full pressure of powder gas was active, the strain upon each portion would be equal, and the resulting strain would be opposed by the whole elastic strength of the metal. The internal portion of the tube would, with such a mode of construction, have no other function to perform than to resist the abrasion that is necessarily going on in the gun. This question is now very much before the scientific public, and therefore I thought it well to bring before you my own view of the matter."

The foregoing appears clear and simple enough, and is an important utterance by one of the leading, if not the leading man of his time, calling the attention of the officials present to an eminent danger threatening matters in their charge. That no notice whatever was taken of the said utterance by either the chairman or General Younghusband in their replies to and discussions on the paper in question certainly appears remarkable, and I think the easiest explanation is that they did not understand the import of what Dr. Siemens said. At all events, from then until now no attention has been given to Dr. Siemens' advice, for rings are shrunk on as tightly as may be considered proper on one another, with a hardened steel tube inside, and when the inside layers expand from the heat of the ignited gunpowder and burst those outside, every one is surprised, and says, "Who would have thought it?" like General Braddock—who would have made a good "Woolwich authority" had he lived now.

It seems to me that by your publishing the above facts you will go some way towards stopping the present childish waste of public money. That the Arsenal officials will ever change their methods until they are compelled I suppose no one now expects, and that they are capable of carrying out Dr. Siemens' suggestions is not to be looked for at all. They do not yet believe in gaseous fuel for reheating wrought iron, and it is matter of common knowledge that they caused a large contractor to give up the use of Siemens' furnaces, as they thought the gas injured the iron. Therefore it is not to be expected that they could themselves design the furnace and gas apparatus which I know Dr. Siemens contemplated. However that may be, I think I may call upon them to explain why they have for nearly twelve years ignored such plain, easy advice from such a high authority as Dr. C. W. Siemens.

Yours, &c.,
R. R. Gubbins,
Late Lieut. 4th Batt. 60th Rifles.

Belvedere, 26th December, 1890.

BAKU AND ITS INDUSTRIAL PROSPECTS.

To the Editor of "Industries."

Sir,—Since I wrote to you last I have been looking around, and find that the glass which is used here, either for windows or bottles, comes from Northern Russia. Consequently it costs a high price. For empty wine bottles 3d. (or 10 kopeks) per bottle is charged. I find that at the north of the Caspian Sea there is plenty of sand to be got of nearly pure silica. There are also plenty of salt and sulphur in the immediate neighbourhood, yet there is no glass works near here. It strikes me that if some one with capital were to come here he might get a fortune in a short time in that line. He would require a few skilled workmen, and the rest would be easy. The Russians in this part are not skilled workmen in the highest sense, but they are very good at imitation, and a few good men would soon set a glass works going.

I believe I have the privilege of erecting the first trussed roof out of flat timber in the district. It is one of 35ft. span. Usually two round poles, about 9in. diameter at the larger end and 7in. at the other end, answer for a tie beam, and for 35ft. span a wooden pillar is put from the ground to the ridge. The principals are spaced about 7ft. centre to centre.

Flat timber is difficult to get here, and, as I said in my last letter, a saw mill with machinery for moulding would, without doubt, be a profitable investment. As it is, the timber in flat planks has the bark on each edge, and is dressed to dimensions by the axe. A carpenter is well equipped if he possesses an axe and a small frame saw. There is, therefore, a considerable waste of timber. There is a large number of casks used here, all of which are made by hand.

Yours, &c.,
Engineer.

Baku, 6–18th December, 1890.

ROYAL METEOROLOGICAL SOCIETY.

At the usual monthly meeting of this Society, which was held on the 17th ult., Mr. H. F. Blanford, F.R.S., Vice-President, being in the chair, the papers named below were read. The following is a brief abstract of each:—

1. "Note on a Lightning Stroke presenting some Features of Interest," by Mr. R. H. Scott, F.R.S. On January 5th a house near Ballyglass, Co. Mayo, was struck by lightning, and some amount of damage done. A peculiar occurrence happened to a basket of eggs lying on the floor of one of the rooms. The shells were shattered, so that they fell off when the eggs were put in boiling water, but the inner membrane was not broken. The eggs tasted quite sound. The owner's account is that he boiled a few eggs from the top of the basket; the rest were "made into a mummy," "the lower ones all flattened, but not broken."

2. "Note on the Effect of Lightning on a Dwelling House," by Mr. A. Brewin. This was an account of the damage done to the author's house at Twickenham on September 23rd.

3. "Wind Systems and Trade Routes between the Cape of Good Hope and Australia," by Captain M. W. C. Hepworth. The author was of opinion that the best parallel on which commanders of vessels navigating the South Indian Ocean between the Cape of Good Hope and the Australian Colonies should run down the longitude is between the 41st and 42nd parallels during the winter months, and between the 45th and 46th parallels during the summer months.

4. "Report on the Phenological Observations for 1890," by Mr. E. Mawley. Taking the year ending August, the weather of the autumn, winter, and spring, and of the first summer month could scarcely have been more favourable for vegetation, while that of July and August proved altogether as unpropitious.

5. "The Climate of Hong Kong," by Dr. W. Doberck. This was a discussion of the meteorological results at the Hong Kong Observatory and at the Victoria Peak during the five years 1884–88.

THE PROPOSED CHANNEL BRIDGE.

The *Times* Paris correspondent, writing on the 26th ult., gives the following interesting information regarding the proposed Channel Bridge:—

"The preliminary scheme for the construction of a bridge between France and England was prepared from incomplete and, to some extent, old hydrographic and geological documents. As the previous surveys did not appear sufficient to the promoters of the enterprise, it was resolved to make a complete exploration of the Straits of Dover in order to collect precise information with reference to the hydrography and sea bottom of the Straits. With the authority of the Minister of Marine, the management of the surveying company was intrusted to M. Renaud, hydrographic engineer, to whom was added as assistant M. Duchanoy, mining engineer. An analysis of their report is published to-night. In the preliminary scheme the bridge started from the Cran aux Œufs, south of Cape Grisnez, went on over a bottom which sank to 55 metres as far as the Colbart Bank, touched the north point of the Colbart and the southern part of the Varne, and finally reached Folkestone. Between the Colbart and the English coast the bottom is of moderate depth.

"The operations were commenced on board a Boulogne tug, the 'Ajax,' which was supplied with the necessary apparatus for sounding and boring. A beginning was made in that part of the Straits lying between the Varne and Boulogne known as the French Channel. Between the Varne and Folkestone the surveyors went on board an English vessel, the 'Jubilee,' placed at their disposal by Sir Edward Watkin, President of the Submarine Tunnel Company. The English Admiralty having intimated that it would prefer the observations near the British coast to be made from an English vessel, the desire thus expressed was complied with. Soundings and borings were taken from July 3rd to September 1st. From the observations made, M. Renaud has come to the conclusion that the most advantageous line for the bridge is not that fixed on in the preliminary scheme. The line he recommends is straight. It starts from a point 350 metres north-east of the light to the west of the South Foreland, and it terminates 300 metres north-east of the entrance of the tunnel near Cape Grisnez. Its length is 33,450 metres. The greatest depth of water met with on the line was from 50 to 51 metres, a depth extending only over a distance of 1,700 metres. The length of the bridge along the line now proposed is shorter by 5,150 metres than that suggested in the preliminary scheme. Moreover, it avoids depths of 55 metres, and those over 50 metres extend only over a comparatively short distance. The soundings show that the submarine soil is solid everywhere, and that there is in no place mud or soft clay. The study of the fauna made for the survey by M. Giard, professor at the Sorbonne and director of the Laboratory of Marine Zoology at Wimereux, near Boulogne, and M. Bouner, sub-director of the same laboratory, proves that between Cape Grisnez and the Colbart only a rocky bottom occurs. The apparatus only brought up animals which live on rocks, and none which live in gravel, sand, clay, or mud. From this it is concluded that there is no chance of the Straits ever being silted up. As regards the bridge itself, the line being shortened and the height of the piles diminished in consequence of the greater shallowness of the water over which it passes, considerable diminution of expense is secured as compared with the first scheme. Instead of four millions of metres cube of masonry there will only be three-and-a-half millions. About 50,000 tons of metal will also be saved. Lastly, there will be 92 piles instead of 112, and of these 92 piles 17 will be sunk in depths of 30 to 40 metres, 31 in depths of 40 to 50 metres, and the others in depths of less than 30 metres.

"In summing up the advantages of the new scheme, the report says the new line gives greater facility for sinking the piles, a better shelter from the wind and seas from the south-west along the French coast, a slight lowering of the height of the bridge, and a considerable diminution of the masonry and weight of the metallic structure."

THE MANCHESTER SHIP CANAL.

We gather from an official report that, with reference to the damage done to the works of the Canal by the recent floods, the Mode Wheel Locks at Barton Aqueduct were cleared out in the course of a few days, and that since then the other locks at Barton, Irlam, and Latchford have been pumped dry, and masonry and concrete work resumed. The cuttings near Trafford Hall, at Barton, Stickens Island, Hulme Bridge, Davey Lulme, Irlam, and Latchford are now emptied, and excavation has recommenced. Concrete work and masonry have sinced been pushed on with vigour, except when it has been interfered with by the frost. The cutting at Partington will be pumped dry in about sixteen days, while at Pomona one portion of the dock has been cleared of water and excavation resumed. The second portion of the dock will be emptied as soon as the frost is over. It is stated that the masonry and concrete work at the various docks and locks has withstood the severe test in a most satisfactory manner, and that the completed portions of the slopes of the cuttings, the temporary bridges, and railways damaged by the flood have now been restored. The brickworks at Thelwall, which were flooded, and which are capable of producing upwards of 450,000 bricks per week, have been ready for work for some days past. The volume of water which passed down the Irwell during the time of the late flood was considerably in excess of that at the time of any flood since the great flood of 1866; and it is conjectured that, had it not been for the large works now in course of construction, the effect of the flood would have been nearly as serious as in that year.

Reviews.

The Art of Electrolytical Separation of Metals, &c. By G. Gore. London: "The Electrician" Printing and Publishing Company, Limited. 1890.

The author sets himself the difficult task of treating this exhaustive subject systematically. Electrometallurgy is generally treated in one of several ways. The purely scientific man regards it as an interesting mixture of electricity, chemistry, and thermodynamics, with side lights of osmosis and dissociation, and gives it an interminable and somewhat unreadable literature of its own: the electrical engineer troubles himself little about such things, and thinks of back pressure, electromotive force, capacity, and resistance; while the practical electroplater still goes on passing the current of seven Smee cells through his solutions. Dr. Gore's work is chiefly useful as a large collection of information of the greatest value to the practical electrometallurgist. Probably few electrical engineers realise how much more they might know about actual practice in such processes as the electrical refinement of copper. Dr. Gore's book contains a full account of almost everything that has been done by previous workers. The scientific part of the book is weak, but the rest is extremely good.

Fehland's Engineers' Pocket-Book for 1891. Berlin: Springer.

This is the latest edition of the well-known pocket-book of engineering and other formulæ. We would strongly advise engineers who work from pocket-books not to rely on English formulæ solely. Engineering practice varies in different countries. The best thing to do is to learn from all sources, and to adopt good points from other countries.

Force, as an Entity, with Stream, Pool, and Wave Forms. By Lieut.-Col. W. Sedgwick, R.E. Sampson Low, Marston, Searle, & Rivington. 1890.

The author tells us in his preface that he has endeavoured to treat the subject of force from an engineer's point of view, or in a simple and practical way. The remainder of the preface, however, dispels any hope which we might have founded upon this statement, for, in the short space of ten pages of large print, we are introduced to such widely divergent subjects as the Enormous and Irregular Growth of Novels, Carlyle's Theory of the Infernal and Celestial in Man, Drunk-

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enness and Opium-eating, the Survival of the Fittest, the Mission of the Anglo-Saxon Race in the Development of Civilisation, the Death of General Gordon, the Principal Religions of the West and of the East, and the advantages and disadvantages of Home Rule for Ireland. On the last page of the preface the author modestly informs us that as a literary production the book is of the poorest, and, after perusing the volume, we have no hesitation in expressing our complete agreement with him on this point.

The work is divided into ten chapters, bearing the following headings:—Introduction, Streams and Pools of Force, The Form of the Atom, Chemical Combination, Electricity, Physics, Mechanics, Solar Systems, The Origin of Life, Humanity. With regard to the author's theory of Force, which we suppose is to be considered the main subject of the book, we must allow him to speak for himself by giving a few extracts, as we have been utterly unable to form any definite idea of what he means. The following, culled from the Introduction, is supposed, as far as we can understand, to represent the teaching of Faraday and Rankine:—"If, then, gravitation, which is, as we know, an attractive force under which points approach one another, is a substance taking the form of lines of force, then heat, or some other form of repulsive force, under which points recede from one another, must likewise be a substance, and take the form of lines of force also." We are then told that "if force is in reality a substance, it must be a fluid, able to lay hold of particles of matter and transport them along with it as it flows, much in the same way as water in a river lays hold of particles of silt and sand and carries them along." The author then remarks:—"But fluids have three principal forms—the *stream*, or current; the *pool*, or accumulation; and the *wave*. And if force is a fluid, then we may conclude that lines of force are in reality streams or currents of force, thread-like in their minuteness, and, indeed, far finer than the finest thread we can distinguish with the aid of the microscope, but otherwise exactly corresponding to the streams or currents in rivers, lakes, or seas. While centres of force plainly are pools or lakes along the course of the lines of force, corresponding, on a minute scale, to the pools or lakes along the course of a river."

The author's Cosmic theory appears to be that all the phenomena of the universe are due to the action of two kinds of forced action, namely, attractive force, emanating from the Deity, and repulsive force, emanating from the Evil One. Ultimately the repulsive forces will be compelled to beat a retreat, and the attractive forces will reign supreme, or, in other words, Good will triumph over Evil.

Much of the last chapter—that on Humanity—is very amusing, but we cannot find time or space to seriously notice it.

THE STEAM ENGINE, CONSIDERED AS A THERMODYNAMIC MACHINE. By James H. Cotterill, M.A., F.R.S., Professor of Applied Mechanics in the Royal Naval College. London: E. & F. SPON. 1890.

This is said to be a second edition, revised and enlarged, of Professor Cotterill's standard work on the steam engine which was published in December, 1877, but it would be more correct to speak of it as a third edition of a small work which he published in 1871, and which was eagerly studied by students of thermodynamics. Up to that time the only text-book published in England, which treated of the theory of the steam engine as founded on the science of thermodynamics, was that by Professor Rankine on the steam engine and other prime movers, which is written in such a condensed, and in many cases abstract form, that it is very hard reading for all except very advanced students. Professor Cotterill's notes were drawn up to assist students of engineering and others interested in steam engines in following Rankine's methods, and these were all that were available for six years, till he published his complete treatise, of which the book we are noticing is the second edition. In this book it was attempted for the first time to study more completely than had hitherto been done the process of the conversion of heat into work in steam engines. Although the book has now been several years out of print it took a very long time to exhaust the first edition, a fact which is a commentary on the low state of engineering education in Britain. Books which are specially written to pass Science and Art Department or Board of Trade examinations are sold by the thousand, whereas those which aim at giving a thorough knowledge of fundamental principles take years to exhaust even a first edition.

Professor Cotterill says that he has undertaken the preparation of a new edition with great reluctance, feeling that, considering the progress made since 1877, a new book rather than a new edition of an old one would be required to deal with the subject in a manner at all commensurate with its difficulty and importance. On consideration, however, it seemed that, the ground occupied and the method of treatment being in many respects different from those adopted by others, the book might, with some changes and additions, still prove useful. The author says that this opinion would not have been altered if he had had the advantage of being able to consult the two able American treatises by Professors Peabody and Volson Wood (both of which we have reviewed), which appeared some time after the greater part of the volume was in type. We quite agree with Professor Cotterill that there is room for a treatise such as his, which treats of what may be called the physics of the subject, and explains the phenomena which occur in the use of steam, without bringing the results into the shape which are immediately useful in practical calculations—that is to say, for an educational book, which, while it leads in the direction of practical applications, is intended primarily for the purpose of elucidating phenomena. In the present day teachers and students alike are too much in the habit of looking to what pays directly, wholly forgetting that in education, as in commerce, what pays ultimately and best is not always what pays most at first. In the last edition of his work, Professor Cotterill said his chief object was to facilitate the study of Rankine's work, and, by the employment of fresh experimental evidence, to carry it on a few steps beyond the point at which Rankine left it. This object was attained in a very satisfactory manner, and he produced a work which was highly prized by all real students. We may be allowed to say, however, that some of the methods employed were rather cumbrous, and apt to weary students. Like many teachers who aim at only employing elementary mathematics, he made his demonstrations more lengthy, and in many cases more difficult to understand, than if he had boldly assumed a greater knowledge on the part of his readers. The graphic representations of physical phenomena adopted by the author were a great advance on previous methods, and were of much assistance in enabling the students to understand the real nature of these phenomena.

In the present edition, considerable additions and improvements have been made on the original work. The first nine chapters have been re-written, with additions to illustrate more fully the principles of thermodynamics, and further notes regarding them are given in the appendix. These chapters, in our opinion, contain the most useful explanation of the laws of thermodynamics to be found in any English treatise, and are well worthy of being studied even by those who do not intend becoming engineers, so that their notions of the subject may become more real, for the majority never get beyond a very hazy idea as to their meaning and scope. Chapter VIII., on "Losses of Efficiency in Heat Engines," should be studied with special care, as it gives a very clear idea of the manner in which heat is used in engines. The following chapter, on "Clearance and Wire-Drawing," is more special in its nature, and may be studied with advantage, both by students of physics and engineering. Chapters X. and XI., which treat of the action of the sides of the cylinder, and of experiments on steam engines, have been entirely re-written. At the time of the publication of the previous edition of the book, although it was obvious that cylinder condensation was the rule in steam engines, and its absence the exception, the want of experiments on the subject prevented an opinion being formed as to the law which it followed. Since that time, however, considerable attention has been paid to the subject, especially by the experiments of Messrs. Muir and Willans and Major English. Professor Cotterill has adopted some of Major English's conclusions, and has deduced a theory of the conduction of heat in cylinders. From this he has worked out a simple formula, which gives a fair approximation to the amount of steam wasted in single-expansion non-jacketed engines by initial condensation and other causes. This formula, of course, involves a constant to be determined by experience for each type of engine, but the values of the constant in a large number of examples of engines of widely different types appear fairly consistent. Our space will not allow us to discuss that formula at present, but we ask our readers to compare Professor Cotterill's method with that adopted by Mr. Bodmer in the articles on "Steam Engine Economy," which recently appeared in our columns.

The last chapter in the book is the one which will possibly be read with most interest by engineers, as it gives details of experiments on steam engines, and states the conditions of economical working. The action of feed-waters, a part of the subject which has been much neglected, is also dealt with. The few observations made on compound engines and on jacketing are intended chiefly as suggestions, as the author thinks that no real progress can be made until the question of cylinder condensation in a single-expansion non-jacketed engine has been more thoroughly studied. That may be true, but still we think the author might have done more to redeem the intention he expressed in the preface to the last edition of the work, to add chapters on the working of compound engines, and to the modern theories about superheated steam. No book on the steam engine can be considered even approximately complete without an explanation of the action of multiple-expansion engines, while the subject of superheating is one which, if properly studied and experimented upon, might obviate in many cases the multiplification of cylinders. We hope that before another edition of the book is required Professor Cotterill will have sufficient information on both of those subjects to enable him to treat them pretty fully, even suppose it should be at the expense of causing his book to appear in two volumes.

LUMIÈRE ELECTRIQUE. J. P. Anney. Paris: TIGNOL. 1890.

This is an elementary handbook, specially designed, not for the intelligent public, nor for the enthusiastic student, but for those who have to deal with private electric light installations. The book deals with considerable minuteness with everything that has to do with the arrangement and running of electric machinery. We hope we may soon see an English translation of this excellent work. A second volume is promised, which is to deal with central station work.

THE RIVER IRWELL AND ITS TRIBUTARIES: A MONOGRAPH ON RIVER POLLUTION. By George E. Davis and Alfred R. Davis, Manchester. Manchester and London: JOHN HEYWOOD. 1890.

The second half of the title of this little book is a fair indication of its nature and scope. In the course of their practice as consulting chemists, the attention of the authors has been directed to the subject of river pollution, and the means for its prevention or mitigation. For a study of this kind the Manchester district affords ample opportunity, industries of the most diverse character contributing to the defilement of its watercourses, and full advantage has been taken of this circumstance.

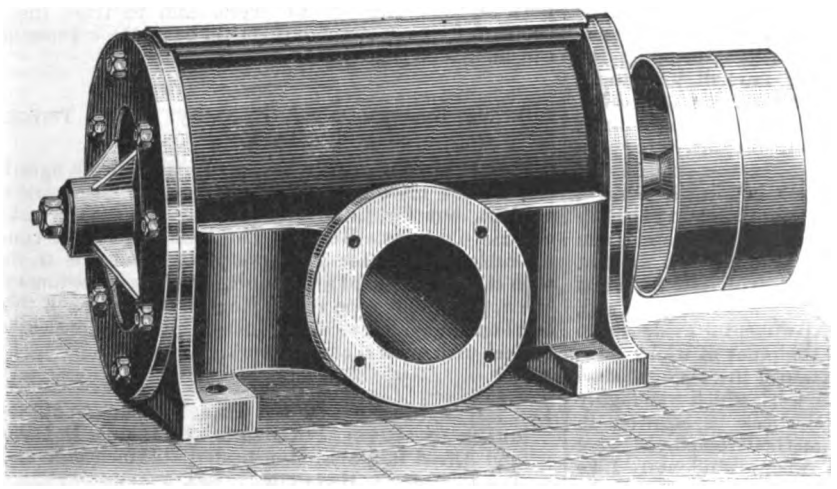
The River Irwell, rising near Bacup, receives tributaries that drain an area of 180,000 acres. On its way to Manchester, it is largely used for manufacturing purposes, and on leaving the city at Throstle Nest Weir is in a highly polluted condition. Since it is probable that at this point it will eventually flow into the Manchester Ship Canal, the reach of which between Barton and Manchester will, as the authors say, "act as one vast settling tank," the need for some improvement is tolerably obvious. Having premised the necessity for reform, the authors proceed to give numerous analyses of the Irwell and its tributaries in their normal condition of flow, and also in flood and drought. Some of these results are sufficiently startling. In the case of several of the branches it appears that their contents in seasons of drought compare unfavourably with the raw sewage of some northern towns, and in all the degree of impurity is objectionably high. Having proved the existence of serious pollution, the authors endeavour to assign to the various sources of impurity the proportion for which each is responsible. At one time waste from works was thought to contribute more than was due to the influx of sewage, but at present there is reason to believe that the reverse is true, and that the manufacturer, though far from innocent, is not the greatest offender. Cotton mills and weaving sheds, bleach works, paper mills, dye and print works, woollen mills and tanneries, are all causes of pollution, the effluent in many instances being loaded with putrescent and putrescible organic matter sufficient to defile any stream of moderate dimensions. Contrary to vulgar belief, chemical works rarely contribute anything specially injurious; in fact, the commonest effluent—solution of calcium chloride—is innocuous, save for the increase in hardness caused by it.

Reviewing these facts, and considering means for the improvement of the present state of things, the authors lean to the opinion that it would be preferable, in the event of the enforcement of any restriction on the privilege of unlimited pollution, to frame the prohibition in general terms, and to fix a maximum amount of impurity as permissible in any effluent, rather than to attempt to regulate the practice of each industry. The book concludes with a description of the methods of analysis employed. These avowedly present little novelty, and are recorded in order to admit of comparison of the samples examined with those that may be analysed at any future time. The method for determining the "oxygen absorbed" differs in several respects from that commonly used, notably in operating in alkaline solution and at a high temperature, conditions which probably account for the high absorptions recorded. The *brochure* is accompanied by a map of the Irwell and its tributaries, and gives, in a compendious form, a mass of information, valuable alike to those concerned in the general question of river pollution and to those whose local interest is affected in this particular instance.

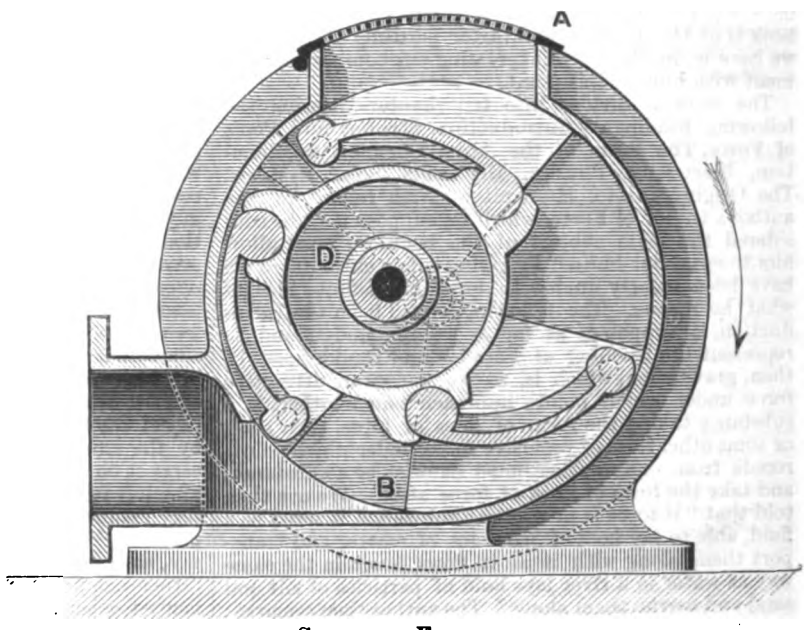
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SKINNER'S IMPROVED BLOWER.

CONSTRUCTED BY THE PATENT PUMP AND BLOWER SYNDICATE, WATER LANE, LONDON, E.C.



GENERAL VIEW.



SECTIONAL ELEVATION.

SKINNER'S IMPROVED BLOWER.

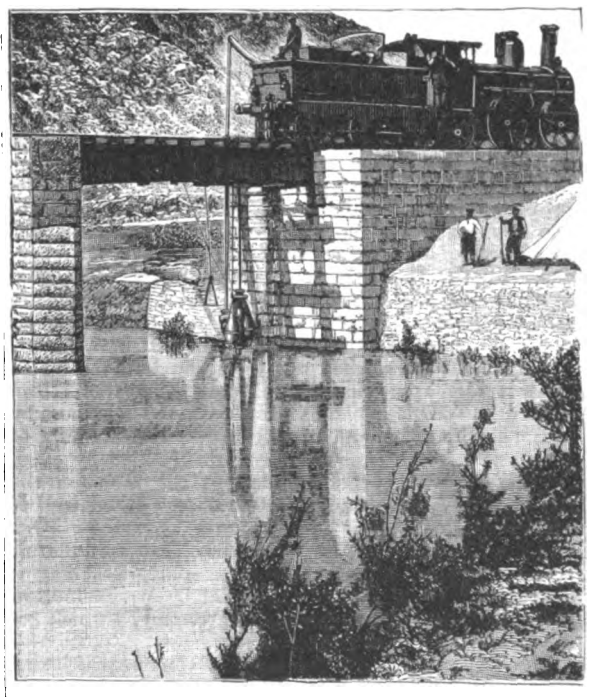
THE engravings given above show in elevation and section Skinner's improved blower, which consists of an outer cylinder or casing, closed by covers at each end. In the section the inlet passage is at the top, but the position of the inlet and outlet can be reversed if required. Inside the cylinder already mentioned, but eccentric to its axis, revolves an inner cylinder or drum D. To the periphery of this drum are attached the blades as shown. The outer ends of these blades are pivoted to segment plates. These segments are free to revolve round a fixed stud in the centre of the cylinder cover (this arrangement being shown dotted in the section), and the pressure on the blades is transmitted through the medium of the segments to the centre, thus reducing the friction to a minimum. The segments also perform the duty of keeping the ends of the blades in close contiguity, though without actual contact, with the inner circumference of the outer cylinder during the entire revolution, while they allow the blades to expand and increase in velocity as they approach the point of greatest eccentricity, and decrease again as they approach the point of the least eccentricity. Thus, when the inner cylinder is made to revolve in the direction of the arrow, the air contained in the cylinder between the points A and B, which is nearly half the contents of the cylinder, is carried forward and discharged three times in one revolution. The driving shaft is carried by a long hollow interior bearing extending from one of the end covers, and on this is also mounted the inner cylinder. The makers of the blower are the Patent Pump and Blower Syndicate, 7, Water Lane, London, E.C.

THE "SIMPLEX" GAS ENGINE.

IN our issue of August 2nd, 1889, we published in full, with illustrations, a paper read by Mr. Edward Delamare-Debouteville, of Rouen, before the Institution of Mechanical Engineers, on "Gas Engines, with a Description of the 'Simplex' Gas Engine." A series of trials with one of these engines, indicating 100 horse-power, has recently been made by Dr. M. A. Witz, of Lille, at the works of the makers, Messrs. Matter & Co., of Rouen. The engine under notice was of the single-cylinder type, having a cylinder 22·2in. diameter, with a stroke of 37·4in. and a speed of 100 revolutions per minute. It was fitted with automatic self-starting apparatus, and worked in conjunction with a "Dowson" gas plant, producing gas from English anthracite, and heated by ordinary coke. The steam used for injection purposes had to be obtained direct from a locomotive boiler, as a superheater, which is generally auxiliary to this plant, was not provided. The effective work of the engine was measured by means of a rope brake, which Messrs. Matter found to fulfil the requirements of a prolonged trial of twenty-four hours duration with one stop of half an hour for oiling purposes. The results, which were very satisfactory, showed the consumption of anthracite per horse-power per hour to be 516 grammes, consumption of coke per horse-power per hour 96 grammes, giving a total of combustible material per horse-power per hour of 612 grammes, which is equivalent to 1·24lb. of fuel per English horse-power per hour. These results are given in a well-illustrated book by Dr. M. A. Witz, in which are full particulars of the trials. The book also contains a comparative statement of gas engines and steam engines of equal power.

A NEW USE FOR THE PULSOMETER.

THE accompanying engraving represents a rather novel application of the pulsometer, for filling the tenders of locomotives with water. The arrangement is made by the Pulsometer Engineering Company, Limited, of 61 and 63, Queen Victoria Street, London, and, we are informed, has been adopted upon one of the Eastern railways, and appears likely to meet with considerable

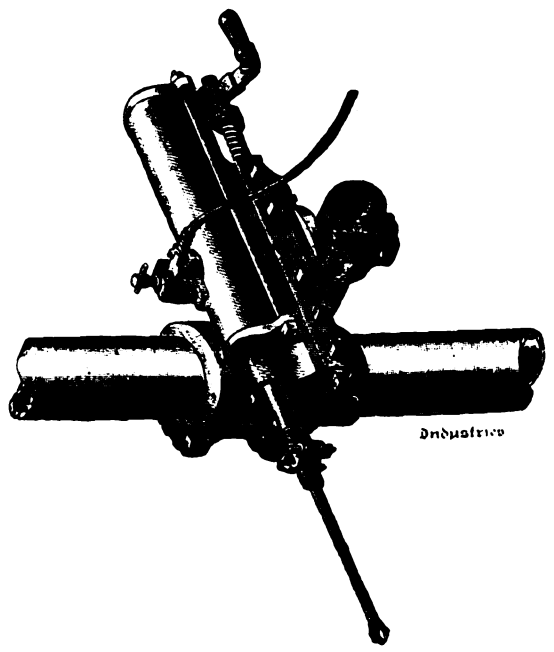


success. The pulsometer itself is of the ordinary pattern, connected with the feed tanks and steam valves by flexible piping, and when not in use is carried on the tender. When about to be used it is simply lowered into a convenient stream or lake by suitable means. We are informed that the engineer on the railway mentioned has stated that the working of the pulsometer, as applied in the way shown, is extremely satisfactory.

NEW TYPE OF MARVIN ELECTRIC DRILL.

THE Edison General Electric Company, of New York, U.S.A., are now manufacturing and exploiting a drill making use of the principles of the "Marvin system of percussion tools." This drill, illustrated below, consists simply of a reciprocating iron bar impelled backward and forward by the action of two solenoids which are alternately thrown into action by pulsating electric currents.

This alternate action of the two coils is accomplished without the aid of commutators, collectors, or other moving parts on the drills which are involved in reciprocating motions in other machines, but is accomplished by the use of pulsating currents, positive impulses being



delivered to one coil and alternately negative impulses to the other. Since there are no moving parts in the drill except the reciprocating bar or plunger, there is no wear except in the guides. The heaviest parts of the drill are the tripod weights, which weigh about 100lb. each, and the two solenoid coils, which weigh about 55lb. each; and the largest piece, the cylindrical casing in which are enclosed the coils, is 38in. long by about 6in. in diameter. The total weight of drill and tripod is about 400lb.

The drill makes about 600 strokes per minute of a maximum length of about 4in., and will cut at the rate of 2in. per minute in the hardest granite with a 1½in. bit, and with a consumption of about 5 h.p.

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The drills are run in parallel. The current, which is pulsating, is derived from a generator exactly similar to the standard Edison dynamo, except that it is supplied with pulsating current collectors, in addition to the regular commutator. The machine is thus self-exciting, and allows of continuous current apparatus being run on a separate circuit from it, at the same time that pulsating currents are delivered to the three wires leading to the drills. We are indebted to the *Electrical Engineer*, of New York, for our illustration.

NOTE ON THE LAW OF HYSTERESIS.*

By Chas. Steinmetz.

The magnetism of a magnetic circuit will vary periodically if subjected to a periodically varying magneto-motive force. The variations of the magnetisation, however, will not be simultaneous with the variations of the magnetic force, but show a certain lag, so that the curve of magnetisation, as a function of the magnetic force, forms a kind of loop, the well-known curve of hysteresis.

This phenomenon proves that in the production of the magnetic circuit by the conversion of electric energy into magnetic energy, and in the destruction of the magnetic flow by its reversion into electric energy, a certain amount of energy has been lost—that is, converted into heat.

The amount of energy converted into heat by hysteresis in a full magnetic cycle depends on the maximum magnetisation. It increases with increasing magnetisation, but faster than the magnetisation, so that, when for a magnetisation of B=3,000, the loss by hysteresis amounts to 736 ergs per c.c.; for four times as high a magnetisation, or B=12,000, the loss is 6,720, that is, more than nine times as high. On the other hand, the loss increases more slowly than the square of the magnetisation, because the square law would require a loss of 11,776 for B=12,000.

A great number of experimental researches on the loss of energy due to hysteresis, with different maximum magnetisations, have been made by Ewing; but the law is still unknown which gives the dependence of the hysteresis upon the magnetisation.

In trying to find at least a clue to this law, I subjected a very complete set of Ewing's observations, consisting of ten tests from an induction of 1,974 lines of induction per square centimetre, up to 15,560 lines per square centimetre, to an analytical treatment by the method of least squares, to ascertain whether the losses due to hysteresis are proportional at all to any power of the magnetisation, and which power this is.

The exponent of the power was so very nearly 1·6 that I can substitute 1·6 for it, and combine those observations of Ewing in the formula

$$H = \cdot 002\ B^{1\cdot 6},$$

where H is the loss due to hysteresis, in ergs per cubic centimetre per cycle, and B the maximum induction.

In Table I., in the first column, are given the values of the magnetic force F, in absolute units; in the second column is given the maximum induction B; in the third column the permeability; in the fourth column the hysteretic loss E, in ergs per cubic centimetre, as observed by Ewing; but in the fifth column the hysteretic loss calculated by the formula:

$$H = \cdot 002\ B^{1\cdot 6}.$$

The sixth column gives the differences of the observed and the calculated values; the seventh column gives these differences in percentages of E.

In the diagram given above these calculated values of hysteretic loss are shown in the curve; the black crosses show the values of hysteretic loss E observed by Ewing.

For comparison there are shown, in dotted lines, the curves of magnetic force F and of permeability as functions of the induction B.

It will be seen that the observed values of hysteretic loss are very near the calculated curve through the whole range of observation, and do not show any tendency to deviation, which justifies my considering this coincidence as something more than a mere accident, and, indeed, as an indication of a general law, although certainly this law might be more complicated than the formula.

In Table II. are given the values of hysteretic loss, calculated by the formula:

$$H = \cdot 002\ B^{1\cdot 6}.$$

To one interesting fact I wish to draw attention: The hysteretic loss seems to be independent of the magneto-motive force F, and only dependent upon the magnetisation B; it therefore shows no special singularity at the point of the beginning of magnetic saturation, but increases in the last two observations in Table I., which, for an increase of B by 3,500, require an increase of F by 68, showing high saturation, according to the same rule as in the first eight observations, where B = 12,000 corresponds to F = 7. Therefore the "knee" of the magnetic curve is no singular point of the curve of hysteresis $H = \cdot 002\ B^{1\cdot 6}$, as the diagram shows.

TABLE I.

Comparison of Ewing's observed values of E, the energy consumed by hysteresis in soft iron, with the values calculated by the equation:

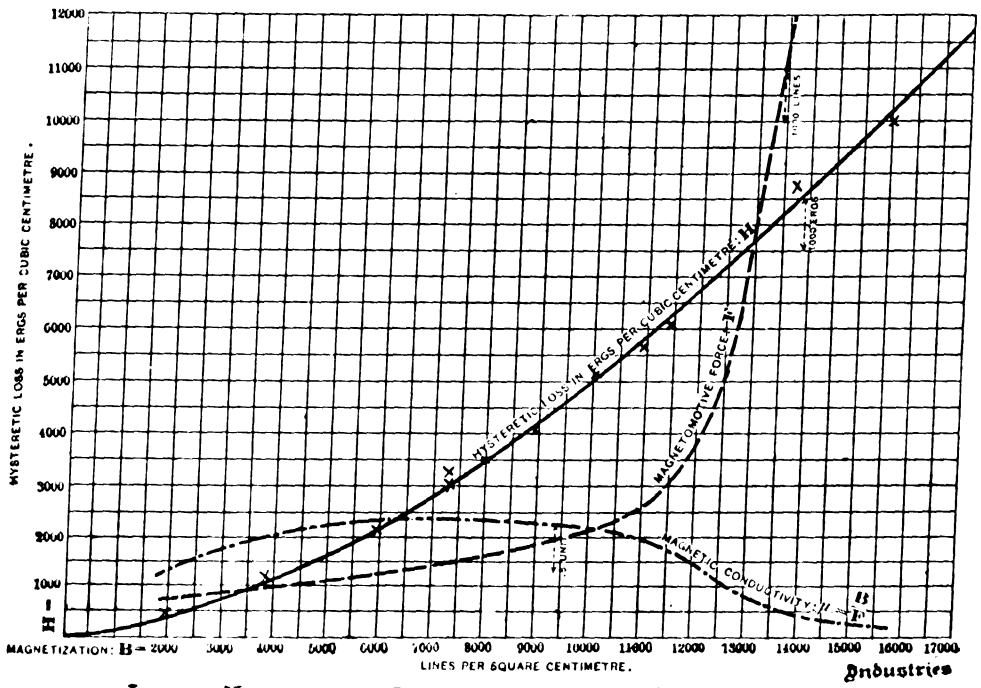
$$H = \cdot 002\ B^{1\cdot 6}.$$

F	B	μ	E	H	E - H	Diff. in Percentage.
1·50	1,974	1,330	410	375	35	8·5
1·95	3,830	1,964	1,160	1,082	58	5·0
2·56	5,950	2,324	2,190	2,190	0	·0
3·01	7,180	2,385	2,940	2,956	−16	−0·5
3·76	8,790	2,340	3,990	4,080	−90	−2·3
4·96	10,590	2,133	5,560	5,510	50	0·9
6·62	11,480	1,734	6,160	6,260	−100	−1·7
7·04	11,960	1,700	6,590	6,690	−100	−1·5
26·5	13,700	517	8,690	8,310	380	4·4
75·2	15,560	207	10,040	10,190	−150	−1·5

* Abstract of a paper published in the *Electrical Engineer*, of New York.

NOTE ON THE LAW OF HYSTERESIS.

By Charles Steinmetz.



Loss by Hysteresis at Different Degrees of Magnetization.

TABLE II.

Energy consumed by hysteresis, in absolute units per cycle and per cubic centimetre soft iron, for the induction of B, calculated by the equation:

$$H = \cdot 002\ B^{1\cdot 6}.$$

B	H	B	H
1,000	126	11,000	5,850
2,000	382	12,000	6,720
3,000	736	13,000	7,640
4,000	1,160	14,000	8,600
5,000	1,658	15,000	9,610
6,000	2,220	16,000	10,660
7,000	2,840	18,000	12,870
8,000	3,520	20,000	15,230
9,000	4,240	25,000	21,760
10,000	5,020	30,000	29,280

ADULTERATIONS OF OLIVE OIL.

Adulterated olive oil has a very injurious effect when used in place of unsophisticated oil for oiling wool prior to dyeing. Not only is free acid highly prejudicial, since it strongly attacks the cards used in the subsequent spinning, but the addition of drying oils, resin, or mineral oils often causes very serious disturbance to the dyeing operations themselves. Cholesterin is often present in sophisticated oil, and it is known to be very obstructive to an even fixation of the colouring matter. These adulterations, of course, can be detected and estimated by the professional chemist, but Horvitz has recently given a summary of simple qualitative reactions which can be applied by those who have little knowledge of the detailed methods of oil analysis, or who have limited time at their disposal, which are as follows:—(1) A drying oil can be detected in olive oil by placing a clean copper wire in a mixture of 2 cubic centimetres of nitric acid and 5 cubic centimetres of the suspected oil. The mixture is then stirred with a glass rod, and after half an hour the copper rod will have a pink colour if a drying oil has been added. (2) A resinous or mineral oil is detected by first saponifying the oil—*i.e.*, by warming it with a solution of alcoholic potash, then evaporating off the alcohol and extracting the dried soap with petroleum ether. The ether will dissolve the resin or mineral oil if present, and after evaporating the ether, the residue is treated with bromide of tin (formed by adding dry bromine to tin filings), when a purple colour is produced. (3) Cholesterin can also be detected in the unsaponifiable portion by means of Schulze's colour reactions. Of these the most characteristic is to rub the residue with a few drops of strong sulphuric acid and then add chloroform, when a blood-red colour is produced, which changes through violet to blue on the subsequent addition of nitric acid.

THE RELATIVE STRENGTHS OF HIGH EXPLOSIVES.

Lieut. Willoughby Walke, of the U.S. Artillery, has recently communicated to the Journal of the American Chemical Society an important paper on the relative strengths of modern high explosives, which is interesting as illustrating the considerable variation in the comparative strengths, not only of different explosives of acknowledged value, but of the same explosive manufactured at different times and under slightly different conditions. It will be recollected that Mr. C. E. Munroe has already pointed out that the firing point of an explosive is also a very variable number. In his more recent experiments a thin copper cartridge was placed in a molten bath of tin or paraffin, the initial temperature noted by a thermometer, and the bath quickly heated until the explosive flashed off, when the temperature marked by the thermometer was again noted. The following table shows some of the results obtained:—

Description of Explosive.	Firing Point in deg. C.
Compressed military gun-cotton	186–201
Air-dried „ „	179–186
„ „ „	186–189
„ „ „	137–139
„ „ „	154–161
Gun-cotton dried at 65° C.	136–141
Air-dried collodion gun-cotton	186–191
„ „ „	197–199
„ „ „	193–195
„ gun-cotton.....	192–197
„ „	194–197
Hydronitro cellulose.....	201–213
Nitro-glycerine	203–205
Kieselguhr dynamite, No. 1.....	197–200
Explosive gelatine.....	203–209
„ „ camphorated	174–182
Mercury fulminate	175–181
Gunpowder	278–287
Hill's picric powder	273–283
„ „ „	273–290
Forcite, No. 1.....	184–200
Atlas powder, 75 per cent.	175–185
Emmensite, No. 1	167–184
„ No. 2	165–177
„ No. 3	205–217

Lieut. Willoughby Walke, in his experiments, employed a Quinan pressure gauge for registering the pressures developed by the explosives in preference to other methods used by the older investigators, as even the *crusher* used by Berthelot gave only approximate results, as shown by MM. Sarau and Vieille. The instrument employed consisted of a heavy block of wood bolted to a cast-iron base, in which were four iron guides set around a 4in. circle. A steel plate is let into the iron block flush with

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its upper surface, and a ring holds the guides in place at the top. The piston is a cylinder of tempered steel moving freely between the guides, and rests on a plug of lead which is to be compressed. The piston weighs 12¼lb., and the explosive is placed in a parabola-shaped cavity at its top. The shot was also made of tempered steel, 4in. diameter and 10in. long, and weighed 34⅓lb.

The instrument is worked in the following manner:—The lead plug is placed upon the steel plate, the piston placed gently upon it, and the shot next lowered upon it. The fuse is lighted, and the charge, in exploding, throws out the shot and compresses the lead plug. The accuracy of the test is based upon the assumption that the lead plugs are of uniform density and homogeneous in structure, and the author, by cutting his plugs from bars of pure lead manufactured from large masses of metal at a high temperature, believes that the error from want of these conditions is reduced to a minimum. The amount of compression is finally expressed in foot pounds by plotting the actual compressions measured by the Quinan gauge against the work actually done on the lead by known pressures. The author, however, did not plot out his results in this manner, but preferred simply to use the method for determining the relative strengths of the explosives examined, instead of calculating from the observed compressions the absolute pressures exerted. The following table gives a summary of the results obtained, the order of strength being given in numbers, nitro-glycerine having assigned to it the value of 100:—

Name of Explosive.	Compression of Cylinder in Inches.	Order of Strength.
Explosive gelatine (made by Vouge's process)	0·585	106·17
Hellhoffite	0·585	106·17
Nitro-glycerine (old)	0·551	100·00
Nobel's smokeless powder	0·509	92·38
Nitro-glycerine (fresh)	0·509	92·37
Explosive glycerine (made from above)	0·490	88·93
Gun-cotton (1889)	0·458	83·12
„ (1885)	0·458	83·12
Nitro-glycerine (made by French process)	0·451	81·85
Gun-cotton (laboratory)	0·448	81·31
Dynamite, No. 1	0·448	81·31
Dynamite de Trauzl	0·437	79·31
Emmensite	0·429	77·86
Amide powder	0·385	69·87
Oxonite (from fused picric acid)	0·383	69·51
Tonite	0·376	68·24
Bellite	0·362	65·70
Oxonite (picric acid not fused)	0·354	64·24
Rack-a-rock	0·340	61·71
Atlas powder	0·333	60·43
Ammonia dynamite	0·332	60·25
Volney's powder, No. 1	0·322	58·44
„ „ No. 2	0·294	53·18
Melinite	0·280	50·82
Silver fulminate	0·277	50·27
Mercury fulminate	0·275	49·91
Mortar powder (Dupont)	0·155	23·13

Notes.

RAILWAYS IN COLOMBIA.

A Foreign Office report from Bogotá, United States of Colombia, states that no new railways were begun during the past year, and those already begun have not been extended. Several projects for the completion of the unfinished and at present useless railways in the country are being considered by Congress. It seems probable that a scheme proposed by an English company, the River Plate Trust Loan and Agency Company, Limited, of London, for completing the railway between Bogotá and the River Magdalena, at Tirardot, will be accepted. The other schemes are mostly proposed by American companies, and have met with a great and unexpected amount of opposition in both Houses of Congress, and as yet nothing definite can be said as to their chance of success.

ALIUM.

According to Mr. Rice, in the *Electrical Engineer*, of New York, Professor E. Thomson wants the metal got from clay to be called "alium." The Americans have always had considerable difficulty with the word "aluminium," owing to a determination to put an accent on the second syllable. They generally call it "aluminum" with the accent on the second or fourth syllable. "Alium" is certainly shorter and more euphonious, and leaves no opening for great variation in pronunciation, such as occur in many chemical words. Unfortunately aluminium is too well established to be easily changed; but when we remember that "eleemosynary" has telescoped into "alms," we may hope that "aluminium" will contract into "alium," and that "aluminum" will disappear from American literature.

BRITISH TRADE IN URUGUAY.

In the import trade of Uruguay Great Britain is almost without a competitor in the following articles:—Bagging, baize, carpets, cloth, coal, copper, cotton piece goods, iron bars, plates, roofing, hoops and pipes, lead and lead piping, rails, salt, soda, steel, sewing thread, tin and tinplates, waterproofs, and woollen mixtures. Though first in the following goods, we are closely approached by some of our rivals, and the hint deserves attention:—Arms and accoutrements (Belgium), canvas (United States and Germany), blankets and cotton (Germany and France), iron manufactures (Belgium, France, and Germany), and linen piece goods (Belgium, Germany, and France). The imports from England and Belgium show a general increase. The Merchandise Marks Act has had a beneficial effect in checking the practice of exporting from England as English goods, articles which are really of Continental origin.

MINING IN COLOMBIA.

Some activity has been lately displayed in work on the various mineral lodes which have been discovered from time to time in the Panama district, but as yet the results in bullion shipments have not been encouraging. A Foreign Office report states that the principal mine under development is the Cana, a mine situated in the Darien district, which gave great results in the old colonial period. The old workings have been explored and cleared out where necessary to future operations, new shafts sunk, and tunnels and drifts projected to reach the ore deposits. Pumping and hoisting machinery has been erected, and mills for dealing with the ore are now in course of erection. Some reserve is shown by the company's agent as to the positive character and value of the mine, but the geueral belief seems to be that there is mineral of paying quality, and in considerable quantity in the neighbourhood. At Las Cascadas, near the line of railway, work is in progress on a vein which shows free gold, and a part of which could be easily washed in the primitive way if water were obtainable in sufficient quantity, but the developments are not sufficiently advanced to justify opinion as to its value.

AMERICAN ELECTRICAL NOMENCLATURE.

The Americans have always been remarkable for a kind of conservatism which leads them to cling to old English words, or to primary meanings of them. A number of American expressions that we call slang are really old English. On the other hand, they have great facility in coining new words and phrases. The American electrician, however, has developed a new vice, in perversely assuming a wrong meaning. An English electrician, discussing a theoretical point with an American, often finds that there appears to be a complete lack of common ground. For instance, he will be told that two alternators are not "phased," or that the "leakage" in the transformers amounts to so many amperes. Magnetisation is frequently confused with induction in both countries, and the confusion of magnetomotive and magnetic force is perhaps inherent in the loose ideas which demand such a conception as "magnetic resistance." "Direct driving" in America means driving by a belt. Such loose expressions as "rate of speed" and "strength of current" are common, unfortunately, to both countries.

THE NEED OF A GOOD INSULATING MATERIAL.

There is a great want of an insulating material which will stand heat and damp, and can be worked or moulded. Porcelain is brittle, and warps a great deal in firing. It is also inaccurate in its dimensions. Moreover, it cannot be worked. Ebonite is too dear; it warps or softens under heat, and no cement will stick to it. Wood does not insulate well enough for high pressures, and warps easily. Celluloid warps, and is inflammable. Marble resembles loaf sugar in its character too closely to be durable. Slate is treacherous. One firm is bringing forward a material which consists of pure silica. This looks very promising. It comes out accurate to size, but must be moulded before firing, and cannot be worked. Portland cement is being worked with by one or two inventors. Shellac and mica make a very good material, but heat affects it. Various sulphur and earthy cements come out apparently well, but are inflammable. Spence's "metal" might be useful if the makers of it could be found. Vulcanised fibre, celluvert, and parchmentised fibres are exceedingly valuable for low-tension work, but some of them—we are not certain about all—break down at once under high pressures. Asbestos and shellac are combined to form tobacco pipes, and this material may be useful for electrical work, as there is so little shellac that it will stand considerable heat. An American production made of bone dust with some gum or resin compressed hydraulically was introduced about five years ago. It was expensive, but could be made to imitate almost any opaque stone, marble, or porcelain, and could be turned, screwed, or tapped. It seems to have disappeared.

THE LAW OF THE LOSS OF POWER IN IRON.

In another column we give an abstract of a paper by Mr. Steinmetz, showing that the energy absorbed per cubic centimetre of iron is $0{\cdot}002\ B^{1{\cdot}6}$, where B is the maximum induction. We do not know if Mr. Steinmetz has compared results calculated by this formula with those obtained from unannealed or hard iron and various qualities of soft iron. In any case it seems hardly possible that the result is more than accidental. Mr. Steinmetz's may be a useful empirical formula, but it is hardly likely to have any natural foundation, striking though the coincidence may be. It must be remembered that an empirical formula can be made to adapt itself to a great many curves by suitable choice of the coefficients, just as an enormous number of curves can be traced with fair accuracy with one French curve. Any one curious on these points may look up the hosts of curves of dynamo characteristics arrived at by empirical formulæ which obviously had no scientific foundation. Again, the candle-power of incandescent lamps is said to be proportional to the fifth or sixth power of the electrical power spent in the filament. Its life is supposed to be some other power of its efficiency, and so on. Mr. Steinmetz's formula may be useful, but most empirical formulæ do far more harm than good. The most interesting point, perhaps, is that there is no "knee" in the loss curve corresponding to the knee in the magnetic force and magnetisation curve. According to Ewing's theory, it is hardly to be expected there would be; in fact, it might almost follow that above the knee the loss of energy in reversal would lessen relatively to the magnetic force, though not necessarily relatively to the magnetisation.

TEXTILES IN SWITZERLAND.

An official report on the Swiss trade of 1889 states that the Swiss cotton industry has since the year 1876 been passing through a period of great depression, but the report for the past year is satisfactory, and indicates improvement. A gradually increasing demand both at home and abroad facilitated the sale of the large surplus stock of yarn, which had accumulated from previous overproduction, and this, coupled with a rising of prices, restored activity and confidence to the trade generally, though the high price of raw cotton prevented the year being a very remunerative one. The cotton industry is a great sufferer from the high protective duties in force in the neighbouring countries, and it is also sorely pressed by English competition. Raw cotton is imported chiefly from the United States and Egypt, and cotton goods from Great Britain. The greater portion of Swiss yarns go to Germany, Austria-Hungary, and Italy. The white cotton textures are largely purchased by the Alsatian printers, while the coloured and printed textures find the best markets in the East, especially in the Straits Settlements and India. The export to the Danube States of both white and coloured textures has assumed considerable importance during the last three years, but a greater demand for cheap English and Belgian goods is now said to be manifesting itself in those countries. Embroidery, which is generally included in the cotton industry, is carried on chiefly in the cantons of St. Gallen and Appenzell. Handwork has now been replaced by machinery for all except the finest embroidery, but in both branches of the trade the reports of last year are satisfactory. There was some improvement in the woollen industry during the year, especially in the manufacture of cloth. It has, however, lost much of its importance, and the linen industry is in a similar position.

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Patent Record.

APPLICATIONS FOR PATENTS.

The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

16th December, 1890.

14609A. Mills, B. J. B. ..... Power-transmitting devices (*Johnson*). (September 16th, 1890.)

15th December, 1890.

20410. Lewis, G. A..... Bolt action of breechloading rifles.
20415. Haigh, H. R..... Furnaces for puddling, &c.
20418. Garside, E. A..... Machines for sizing woollen warps.
20423. Carr, D. E. ..... Sheaf elevator and bandcutter.
20437. Urry & Fabini ..... Steam boilers.
20440. Dart & Baker..... Automatic railway signalling.
20441. Ferrari & Leprou..... Steam engines.
20444. Knauer, C. ..... Chenille machines.
20446. Cowper, E. A. ..... Apparatus for drying air for blast furnaces.
20448. Shaw, Shaw, & Tate... Rotary engines.
20449. Donnithorne, E. G. M. Gas engines.

16th December, 1890.

20455. Leigh, H. H. ..... Pneumatic guns (*Beaumont*).
20465. Miller, J. N..... Rotary engines.
20469. Wood, R. O. ..... Brake mechanism for vehicles.
20472. Dumas, R. ..... Multiple-ported balanced slide valves.
20479. Douglas, G. ..... Machines for tentering textile fabrics.
20486. Morison & McAdam ... Lathe attachment.
20487. Hartley, J. W. ..... Screw tapping machines.
20489. Greenhill, M. C. ..... Liquid meters.
20504. Pickard, A. ..... Machinery for drilling square or other shaped holes.
20505. Murphy, J. ..... Tools for operating upon valve seats.
20508. Lake, H. H. ..... Thrust bearings (*Simonds*).
20515. Duncan, G. S. ..... Regulating the supply and return of hydraulic machines.
20519. Vieuxmaire, C. J. ..... Printing machines.
20521. Voss, A. C..... Cocks.
20524. Pickard, W. P. ..... Automatic car brake. (16th May, 1890.)
20529. Williams, Foster, & Co., Ld., & Carlton Apparatus for the reduction of copper from its ores.
20531. Brennan, D., Jun..... Crushing rolls.
20532. Brennan, D., Jun..... Feed regulators for crushing rolls.
20533. Brennan, D., Jun..... Apparatus for reducing ores.
20535. Fales, E. ..... Steam boilers and superheaters.
20545. Thompson, W. P. ..... Draw-off cocks or valves (*Beins*).
20548. Horn, W. W. ..... Car coupling (*Testard*).
20550. Cowper-Coles, S. O. ... Apparatus for coating metallic articles.

17th December, 1890.

20560. Lang & Walmsley..... Looms.
20573. Wild, J..... Self-starting gas or oil engines.
20576. Robinson & Robson ... Wire rope making machines.
20584. Culpan, J..... Change shuttle box mechanism for looms.
20599. Mays, J. A..... Pump or exhauster.
20603. Wade & Cherry ..... Centrifugal and other pumps.
20606. Regnault, R. J. M..... Gas furnaces.
20610. Phillips, F. C..... Car starter and brake (*Phillips*).
20624. Bayly, J. P. ..... Car couplings (*Godsey*).
20625. Bayly, J. P. ..... Machine for moving earth (*Lemmon, Pecket, & Vives, Sen.*).
20638. Stanley, R. ..... Boring or tunnelling machines.

18th December, 1890.

20656. McGee & McGee..... Thread spooling machines.
20662. Green, J. B. ..... Railway indicating apparatus.
20675. Horn & Keetman ..... Hydraulic press.
20680. Penwarden, C. W. H.... Screw-cutting lathes.
20682. Munro, J. ..... Steam boiler and other furnaces.
20688. Sanderson, E. ..... Crushing apparatus.
20689. Postans, A. J. ..... Chuck.
20697. Bentall & Reuben Hunt & Co. ..... Grain grinding mills.
20699. Taynton, R. W. ..... Governor for marine steam engines.
20703. Clarkson, T. ..... Centrifugal concentrators for minerals, ores, &c.
20708. Johnson, T. ..... Printing machines.

19th December, 1890.

20716. Claridge & Middleton Machines for drilling square or any other shaped holes.
20719. Blake, J. ..... Steam boilers.
20736. Heys, W. E. ..... Speed regulator for steam engines and other motors operated by elastic fluids (*Schaffer & Budenbery*).
20756. Browne & Sullivan ... Brake appliances.
20760. Boult, A. J. ..... Steam boilers (*Barlet*).
20769. Smith, W. M. ..... Compound engines.
20811. Lawry & Meats ..... Carding machinery.
20813. Gibbs, A. ..... Machinery for preparing the clay for brickmaking.
20816. Wardle, J. W. ..... Rotary blower and air compressor.
20826. Barlow, J. ..... Gas engines.
20829. Gill & Bradley ..... Guillotine paper-cutting machines.
20832. Scott, T. ..... Tubular marine boilers.

ELECTRICITY.

15th December, 1890.

20424. Von Dolivo-Dobrowolsky & The Company Allgemeine Elektricitäts Gesellschaft ..... Alternating current motors.
20425. Von Dolivo-Dobrowolsky & The Company Allgemeine Elektricitäts Gesellschaft ..... Regulation of the speed and power of alternating current motors.

16th December, 1890.

20498. Bayly, J. P. ..... Wire connectors (*Moore*).
20522. Haight, H. J. ..... Indicating telephonic and signalling system.
20538. Boult, A. J. ..... Lamps (*Tommasi*).
20540. Thompson, W. P. ..... Welding metals electrically (*Coffin*).

17th December, 1890.

20571. McDonald, McDonald, & McDonald..... Arc lamps.
20612. White, W..... Socket holders for incandescent lamps.
20632. Cowper-Coles, S. O. ... Coating of metallic articles by electro-deposition and apparatus therefor.
20639. Le Blon, Oblasser, & Goddyn ..... Arc lamps.

18th December, 1890.

20651. Mance, Sir H. C..... Transformers.
20712. Ortelli, E. ..... Batteries.

19th December, 1890.

20743. Farr, W. J. ..... Automatic releasing and resetting signal.

20th December, 1890.

20784. Engledue, W. J..... Elements for galvanic batteries.
20821. Coming, F. G. ..... Apparatus for transferring electric car batteries. (21st May, 1890.)
20830. Bayley, H..... Ceiling roses and wall connectors.
20831. Oakley & Spurrier ... Ceiling roses and wall connectors.

CHEMISTRY.

17th December, 1890.

20628. Waymouth, S. ..... Fire extinguishing compounds.

18th December, 1890.

20666. Pritchard, H. ..... Manufacture of aluminium.

19th December, 1890.

20748. Read Holliday & Sons, Ld., & Seidler..... Dyeing and printing with certain azo colouring matters.
20752. Lewes, V. B..... Manufacture of hydrogen gas or a mixture of hydrogen and carbon monoxide and apparatus therefor.

20th December, 1890.

20845. Lake, H. H. ..... Colouring matters (*Kalle & Co.*)

MISCELLANEOUS.

15th December, 1890.

20419. McCracken, J..... Making steel.
20428. Haselden, F. ..... Screw propellers.
20433. Middleton, R. E. ..... Methods of pumping out mines.

16th December, 1890.

20478. Brownhill, W. ..... Manufacture of metal tubes.
20485. Ingham & Shackleton Loom shuttles.
20516. Eckhardt, G. B. ..... Stone-grinding wheels.

17th December, 1890.

20565. Macdougall, A. ..... Endless wires for paper-making machines.
20609. Watt, A. ..... Extraction of zinc and lead from their ores.

18th December, 1890.

20644. Dobson, W. ..... Grinding the flats of travelling flat carding engines.
20659. Laurie, D..... Smoke consuming appliances.
20685. Lockwood, W..... Packing for pistons.

20th December, 1890.

20772. Waddington, J. ..... Loom shuttles.
20782. Briggs, W. ..... Marine cement.
20783. Richmond, J. ..... Miner's boring standards.
20797. Bayly, J. P. ..... Pipe coupling (*Lawson*).
20799. Bayly, J. P. ..... Brick kiln (*East, Porte, & Phippen*).
20835. Murrie, J., Jun. ..... Fire alarm.
20841. Wade, J. L. ..... Compound asbestos packing for piston rods and stuffing boxes.
20842. Baldwin & Wright ... Adjustable wrench.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

14555. Jackson.
20066. Turney.
20078. Martignier.
20201. Robertson.
20462. Fletcher.
20529. Gallon & Chapman.
20711. Danischewsky.
20867. Martin & Stuart.
20037. Walton.
20076. Fewson.
20185. Rhodes & Lee.
20314. Lowe.
20527. Sharp.
20665. Baswitz.
20746. Baier.
20897. Bull.

1890.

231. Thompson & Thompson.
478. Monette.
733. Hall.
774. Jones.
818. Fortune & Bentham.
917. De Rechter.
927. Pilkington.
959. Davy.
983. Grimshaw.
985. Grimshaw.
1189. Huelser (*Ortmann*).
1355. Haswell & Haswell.
1723. Saunders.
1779. Barker.
1860. Lamplough.
1883. Mills (*Seigle-Goujon*).
1955. Ross.
2053. Stephens & Stephens.
2335. Showell & Baker.
2412. Westwood.
2473. Bennison.
2520. Tipper.
2541. Bird.
2548. Hilditch.
2573. Salter, Holdship, & Walker.
2608. Barker & Wilson.
2639. Fisher.
2675. Wilson.
2680. Parkinson & Parkinson.
2726. Kennedy.
2737. Stead.
2740. Wood & Whitaker.
2756. Thame & Sanguinetti.
2787. Seddon.
2809. Hall (*Lockwood*).
2887. Schnarrendorf.
3075. Light.
3224. Muller.
3235. Schooling.
3413. Sier.
3548. Hayter.
3979. Krook.
4667. Kister.
5391. Cox.
6403. Cizek.
6918. Deacon.
7657. Gale.
9668. Herendahl, Miller, & Warner.
10812. Seel & Wright.
12041. Boyd.
12238. Boult (*Saltzkorn & Nicolai*).
12536. Becker.
13009. Odell.
13300. Capra.
13366. Lake (*Woodbury*).
13976. Scattergood.
14417. Wylam.
14634. Inglefield.
14968. Lake (*Goldsmith*).
15043. Lake (*Abshagen*).
15474. Payne.
15485. Lake (*Storms Manufacturing Company*).
15691. Hardy.
15897. Stone.
16103. Breitschmid.
16311. Challenger.
16547. Ells.
16763. Thompson (*McKenney*).
16794. Lake (*The Fontaine Safety Signal Company*).
17041. McShane. (26th March, 1890.)
17387. Brook.
267. Wise (*Gregg*).
635. Hancock.
772. Sharp.
797. Earnshaw.
819. Wood & Hepplestone.
925. Gustave Wilhelm Mohrstadt & Christopher William Oates.
1119. West & Spittle.
1210. Dale.
1440. Herbst & Ortmann.
1766. Shelley.
1828. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
1975. Heard & Birkinshaw.
2241. Robinson.
2401. Wilson.
2458. Downton.
2505. Mueller.
2527. Cornwell.
2542. Bird.
2550. Scherer.
2585. Hudleston & Willans.
2604. Farmer.
2622. Bittinger.
2673. Lockwood & Ball.
2678. Carruthers.
2686. Bown & Capewell.
2713. Birks.
2733. Harrison.
2739. Ingham.
2742. Johnson (*Risk*).
2769. Schlund.
2800. Lemming & Wilkinson.
2835. Vavasseur.
2904. Lake (*Garnier & Weil*).
3163. Alexander.
3282. Fiddian.
3360. Dobson.
3431. Naylor & Williams.
3855. Puvrez.
4296. Burrell.
4939. Beyer & Beyer.
5885. Sample.
6866. Brewis.
7186. Thompson (*Coffin*).
8546. Dolby.
9689. Dustin & Thomas.
10147. Tracy.
11710. Briggs.
12170. Lake (*La Société Alfred Junod & Co.*).
12476. Lewis, Lewis, & Lewis.
13020. Thomson & Unbehend.
13362. Edwards (*Cassalette & Kumhardt*).
14309. Hembry.
14582. Thompson (*The National Typographic Company*).
15084. Van Depoele. (22nd May, 1890.)
15677. Alexander.
15685. Williams.
15866. Barter.
15905. Coupal.
16286. Pape & Wermann.
16346. Currie.
16719. Hefferman.
16764. Thompson (*McKenney*).
16815. Heaton.
16865. Lake (*Morton*).
17172. Lake (*Delehanty*).
17318. Lidster.
17415. Sellars.

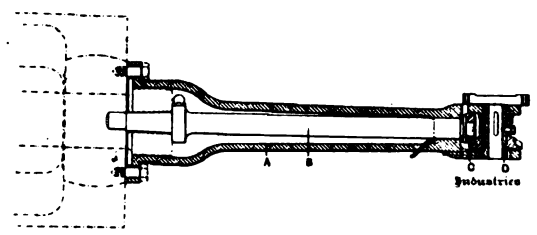
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17447. KLEIN.
17670. HOWIESON & WHITTELSEY.
17723. WRIGHT.
18183. MONROE.
18292. DRAKE & GORHAM.
18319. TURNBULL (*Holyoke Machine Company*).
18366. LEOPOLD.
18405. POPE & HAYNES.
18451. WADE.
18469. VENTRIS.
18476. HABLITZEL. (20th May, 1890.)
18526. IMRAY (*La Société L. Durand Huguenin & Cie.*).
18565. SMITH (*The Singer Manufacturing Company*).
18606. TURNBULL.
18609. BOND.
18625. LAKE (*Lemp*).
18631. LAKE (*Thomson*).
18635. HADDAN (*National Pneumatic Tool Company*).
18645. BOULT (*Sharpneck*).
18653. THE BOTTLE SEAL COMPANY, LD. (*Painter*).
18659. HUELSER (*Kruger*).
18732. CAJOT.
17556. PREST (*Waring*).
17680. STEIN.
17691. POSENER.
18157. ROGERS.
18281. FORD.
18318. MORLEY.
18355. LISLE.
18361. RICKETT & HYATT.
18404. UMPLEBY.
18418. ROBERTSON.
18467. STROHBACH.
18475. ROY. (17th May, 1890.)
18494. SAUER.
18519. WALTER.
18531. MOODEY.
18553. MEYER.
18562. WELLS & WILLIS.
18576. NEVILE.
18578. FOWKES.
18604. BURDON.
18607. CLARK.
18622. SCHMIDT & SILSBEE.
18629. LAKE (*Miller*).
18633. SHELDON.
18641. LAKE (*Wood*).
18642. LAKE (*Stanley Manufacturing Company*).
18655. THE BOTTLE SEAL COMPANY, LD. (*Painter*).
18685. HARE.
18742. IDRAC.
18773. COLDICOTT.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

MACHINE TOOL ATTACHMENT.—*W. F. Pettigrew, London.*—The attachment is for the purpose of machining those parts of engines, such as the steam, exhaust, and other ports, valve faces, and other parts which are inaccessible in the ordinary way, and is designed to be attached to the sliding head of milling, drilling, and other like machines. The accompanying illustration shows a longitudinal section of an attachment constructed according to this invention. Bolted to a milling or drilling machine is one end of a cylindrical casing A so fixed that the nose of the machine



spindle can revolve freely within the casing. Running in a bearing formed in the outer end of A is a spindle B, the opposite end being screwed into the nose of the machine spindle. On the outer end of B is a pinion C, which gears with a bevel gear wheel fixed to a hollow spindle D running in bearings in the end of A as shown, and which spindle is formed to carry milling cutters, taps, drills, slot drills, rymers, rose bits, &c. Claims: (1) In a machine tool attachment for the purposes above specified, a hollow spindle forming a tool holder and means for rotating the said spindle upon or about its axis; (2) the combination of a casting and spindle, the said spindle fitted to rotate in the spindle of the machine to which the machine tool attachment is fixed; (3) the improved machine tool attachment consisting of the parts constructed and combined as described and illustrated, and operating in conjunction with a machine as stated, and for the purpose above specified.—No. 19866. December 10th, 1889. 8*d.*

STEAM TRAPS.—*J. Butterworth, Micklehurst, Mossley, near Manchester.*—The inventor constructs a steam trap in the following manner:—A vessel or chamber of any convenient shape, called the water chamber, is employed, into which the water of condensation is allowed to drain. This water chamber is fitted near its lower end with a double-beat or equilibrium valve mounted on a spindle carrying at its upper end a ball float. A branch pipe on the valve casing passes through the side of the water chamber, so supporting the valve casing, and is secured on the outside by a T piece to the discharge pipe leading to the drain. The other end of this T connection leads up to the air valve outlet situated in the cover of the water chamber, and which is surrounded with a circular beading forming an open-topped cavity. Into this a domed cover may be inserted, to which is connected the last-mentioned pipe, so allowing any drip or foul gas to be led away with the water of condensation. The action of the apparatus is as follows:—As soon as sufficient water of condensation accumulates in the water chamber to reach the ball float, the same becomes sufficiently buoyant to raise the equilibrium valve, so opening the two escape orifices and allowing the water to escape. Claims: (1) The improved arrangement and construction of steam traps substantially as described; (2) in a steam trap or discharge pipe of any analogous apparatus the employment of an improved double-beat equilibrium valve and float, mounted and operated substantially as described.—No. 1465. January 28th, 1890. 6*d.*

PISTONS.—*W. Jowett, Mellor, near Marple Bridge, & G. Spencer, Hyde, both in Cheshire.*—The object of the present invention is to effect a close fit between the piston and its cylinder. In the accompanying illustration Fig. 1 is a vertical section, and Fig. 2 a plan, taken without the junk ring, of a piston, constructed with these improvements, for a double-acting engine. A is the piston block, B the piston rod, C the junk ring, D D^1 are the piston rings, E E^1 are the inclined faces of the ends of the piston rings, F F^1 are the cylindrical holes bored radially in the piston block for the reception of the rams G G^1, H H^1 are the wedge-shaped heads of the rams fitting between the inclined faces E E^1 of the piston rings, I I^1 are packing rings on the rams, J J^1 are openings from the faces of the piston and communicating respectively with the radial cylindrical holes F F^1 in the rear of the rams G G^1, K K^1 are holes bored in the piston block radially thereto and each diametrically opposite to the one of the holes F F^1, L L are spiral springs abutting against the bottoms of the holes K K^1 and pressing upon the inner faces of the piston rings, and X Y are respectively the opposite faces of the piston. The action of the apparatus is as follows:—Supposing fluid pressure is being exerted on the face X, the fluid will enter the opening J and

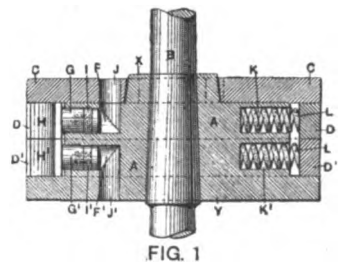


FIG. 1

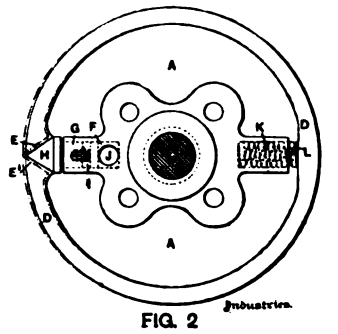
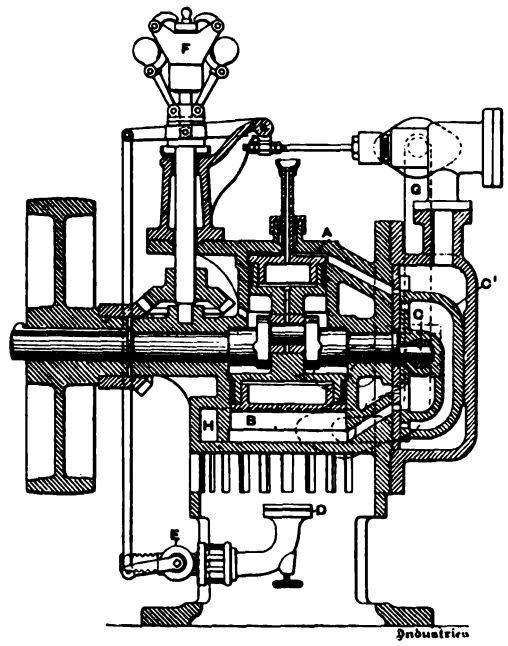


FIG. 2

exert its pressure on the base of the ram G, forcing its wedge-shaped head between the inclined faces of the ends of the piston ring, thus expanding the piston ring; at the same time the spiral spring L is pressing the diametrically opposite portion of the ring into close contact with the walls of the cylinder. It is thus claimed that the pressure of the piston ring against the walls of the cylinder is in direct proportion to the fluid pressure on the piston. Claims: (1) A piston having its ring or rings expanded by the fluid pressure acting upon the face of the piston, constructed and arranged substantially as hereinbefore described and as illustrated by the accompanying illustrations; (2) in a piston to be acted upon by fluid pressure, the combination and arrangement of a divided ring having its ends formed to inclined faces, a radial ram having a wedge-shaped head working between the inclined faces of the ends of the piston ring and a radial spiral spring acting upon the inner face of the piston ring diametrically opposite to the ram.—No. 16141. October 11th, 1890. 6*d.*

COMPRESSED AIR MOTORS.—*J. C. Mewburn, London.* (*D. R. Proell & O. L. Kummer & Co., all of Dresden, Germany*).—The principal object of this invention is to prevent undue reduction of temperature in the cylinder when using air expansively. The accompanying illustration is a sectional elevation of a compound



motor constructed according to this invention. The pistons of the high and low pressure cylinders A and B are connected together by a common piston rod and connected to the driving shaft by means of a sliding block in the usual manner. An eccentric crank C on the main shaft actuates the slide valve C^1 in a similar manner, the slide being constructed substantially as shown and represented in the illustration in a position to allow the exhaust from B to escape. The gas jet D for heating the bottom of the low-pressure cylinder B is governed by a tap E actuated by means of a connecting rod attached to one end of a lever pivoted to the sliding collar of an ordinary governor F at its centre, and to a bracket, as shown, at its other end. This latter end of the lever carries a small arm, by means of which the throttle valve in the supply pipe G is actuated. Around the low-pressure cylinder an annular space H is formed, through which the compressed air may be caused to pass before entering the high-pressure cylinder, so absorbing heat from the gas jet D. Four claims are made.—No. 132. January 3rd, 1890. 8*d.*

DIES FOR PRESSES.—*J. H. Tozer & W. Tozer, both of London.*—The invention has reference to the manufacture of hollow articles from blanks of metal, and relates more particularly to the formation of boxes of railway or other buffers. For this purpose a sheet of metal is taken of a thickness greater than that of the walls of the buffer case to be produced. This plate is suitably heated, and is then subjected to the pressure and action of a male and female die constructed in the ordinary manner—that is, the female die being formed internally of a shape similar to that of the outside of the case to be pressed, and the male die being formed externally of a shape similar to the inside of the case to be pressed. The male or movable die has formed around it, and enclosing it, a suitable movable casing, the lower end of which is of an internal diameter equal to that of the size of the opening of the female die. This casing is, before the male die is operated, forced down upon the plate to be operated upon, so holding it, but allowing the male die to act upon that part over the female die into which it is forced by the former. The outer portion of the plate thus remains unaffected by the pressing operation, and constitutes the flange of the finished case, which flange may be afterwards made thinner and cut to the desired size and shape by the action of a second pair of dies of the usual construction. Four claims are made.—No. 1294. January 24th, 1890. 8*d.*

LUBRICATORS.—*K. A. W. Jakobson, Christiania, & T. Röstad Moss, Norway.*—In the accompanying illustrations Fig. 1 is a vertical section and Fig. 2 a plan of a lubricator constructed according to this invention. The frame A has formed in it a cylinder B of variable diameter, in which works a plunger and rod C and slide C^1, operated by means of a rod D, carrying a

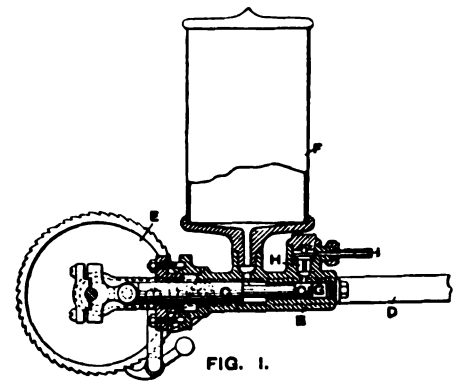


FIG. 1.

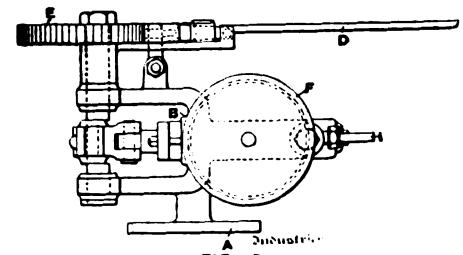


FIG. 2.

pawl. The latter actuates the ratchet wheel E, the shaft of which has formed on it a crank connected to the rod C. Connected to the cylinder B is the oil reservoir F. The plunger and rod C and slide C^1 are so arranged that the plunger C closes the passage leading from the oil reservoir immediately before the slide C^1 opens the passage G leading through the non-return valve H and tube I to the parts to be lubricated; in consequence of the unequal diameter of the cylinder B, a compression is caused of the oil contained in the cylinder, and the oil being subjected to the pressure of the plunger is compressed and so forced to the required places. Claims: The lubricator as described in two claims.—No. 14537. September 15th, 1890. 6*d.*

CARDING ENGINES.—*T. S. Whitworth, Cheetham, Manchester.*—This invention relates to what are known as revolving flat carding engines, and consists principally of improvements upon a prior patent, No. 3556 of 1884. Secured to the bend of the carding engine is a circular surface having the same axis as the main cylinder of the carding engine. Upon this circular surface, and capable of being turned thereon, is mounted a disc, a portion of the surface of which is formed as a spiral curve, which curve supports a number of brackets, each of which may move longitudinally in suitable guides formed in the "bend" of the carding engine. The outer ends of these brackets support the "revolving flats" when such "flats" are carding. In order to form the outer ends of the brackets of a curve concentric with the axis of the main cylinder a "grinding roller" or milling tool is secured to the main cylinder, and is so mounted as to be capable of being adjusted nearer to or farther from the axis of the main cylinder. In order to readily attach the grinding roller or milling tool to the main cylinder, upon the arms of the main cylinder are formed facings to which the brackets for supporting the grinding roller may be fixed. After the outer ends of the brackets have been formed of a curve concentric with the axis of the main cylinder by the grinding roller, the latter and the parts carrying it are removed. When it is desired the flats may be adjusted nearer to or farther from the axis of the main cylinder by the disc being turned upon the circular surface by which it is carried. Four claims are made, embracing the arrangement as described, with modifications.—No. 1260. January 24th, 1890. 8*d.*

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GUIDE EYES FOR SPINNING FRAMES.—*J. Wood, Allerton, near Bradford.*—The invention relates to an improved guide eye for the top boards of spinning frames. A guide eye constructed according to this invention is formed of a suitable metal plate provided at its upper side and around the hole in its centre with a flange, which is let into the top board, the plate being secured by screws in the ordinary manner. The lower inside edge of the eye is faced with brass, this brass being in the form of a bush let into the eye and provided with a smooth surface for the yarn to bear against. The usual angular slot leading from the eye to the edge of the top board is cut in the usual manner. Claims: The improved construction of guide eyes substantially as described.—No. 17085. October 25th, 1890. *6d.*

PRESSES.—*R. Picard, Paris, France.*—The apparatus here described is for the purpose of simultaneously cutting or shearing and embossing metals. In the accompanying illustrations Fig. 1 is a vertical longitudinal section, Fig. 2 a front elevation, and Fig. 3 a transverse section of such an apparatus. The eccentric A on the main driving shaft B is connected by means of a ball joint to the slide C carrying the tool. This slide is formed of two parts, coupled together by means of the key D, the withdrawal of which instantly arrests the movement of the tool. The eccentric A is made adjustable by means of two cheeks A^1 and set screws, as shown, so that the travel of the slide C can be varied. The strip to be cut is fed over the table guide E, which is adjustable in every direction by means of two grippers F, one of which is mounted at each side of the machine. The horizontal movement of the slide F^1 carrying the grippers F is effected by means of a rocking lever G pivoted at G^1, whose movement can be regulated as desired, and which is operated by means of a disc H keyed to B, and provided by two rollers H^1 engaging successively in a groove in a disc I, the rotation of which is transmitted by means of toothed gearing to the toothed wheel J carrying the actuating pin K. The grippers are closed by means of springs placed beneath their lower jaws, the opening being effected by means of a cam L working between the two jaws, and itself operated by the levers M, which are connected to a cross-bar N so as to work in unison. The actuating power is derived from a groove in a disc O secured to B, in which works a roller mounted upon a slide P coupled to the cross-bar N by means of a key Q, which can be displaced at will by a hand lever R. Three claims are made.—No. 6030. April 21st, 1890. *11d.*

FIG. 1

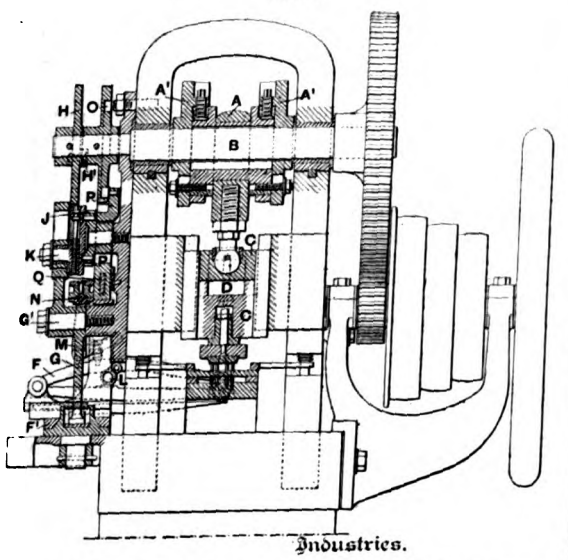
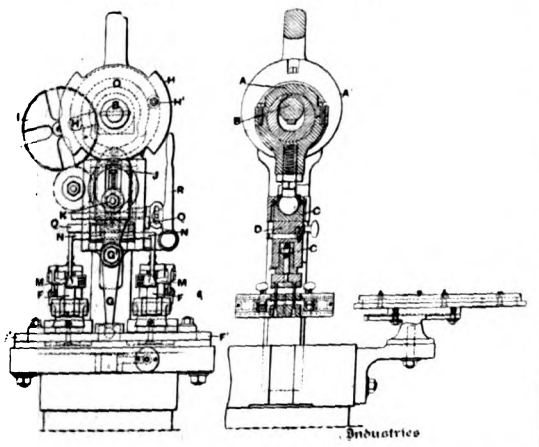


FIG. 2. FIG. 3.



REDUCTION OF METALLIC ORES.—*J. T. King, Liverpool.* (*C. Adams, Pittsburgh, Pennsylvania, U.S.A.*)—The invention relates to the reduction of ores by means of a current of heated gas, such as carbonic oxide, and consists essentially in subjecting the ores to the action of a horizontal stream or streams of heated reducing gases moving in a continuous zig-zag path. For the above purpose the inventor constructs chambers or receptacles of a convenient shape and size with gas inlets and outlets, and with diaphragms, partitions, or other dividing pieces, so disposed that the heated reducing gases are caused to travel through the ore placed in such chambers in a horizontal path. The inventor also constructs the reducing apparatus with a reservoir for receiving and containing the reduced ore, and combines the said apparatus with an open-hearth steel-melting furnace when iron ores are being reduced. Nine claims are made, embracing the construction of apparatus embracing the general improvements as described.—No. 1443. January 28th, 1890. *1s. 1d.*

MACHINE BELT FASTENERS.—*W. Thompson, Crompton Fold, Shaw, near Oldham, Lancashire.*—For the purpose of this invention the inventor casts in malleable iron a light plate of a width somewhat less than that of the strap to be joined, and having a row of three or more holes at each end, and at the back of the plate a projecting socket cast round each hole (which may be slotted as desired), the depth of the sockets being about equal to the thickness of the belt. The ends of the strap are cut in the form of a "butt" joint, and have holes punched in them, which, when the ends are brought together, coincide with the sockets in the metal plate, which latter are pressed into the holes in the belt. The whole is then made fast by means of corresponding rivets, preferably cast with small teeth at the back of the head, these rivets being pressed in from the back of the leather and riveted on the face of the plate. The rivets may be either cast separately or cast in groups on a single plate, which answers for the heads of all the rivets. Claims: (1) That these hollow tubes or sockets take all stress off the rivets and prevent the rivets from springing or bending during the time of fastening; (2) that these hollow slotted sockets expand during the time of insertion, thereby making a firm junction.—No. 12265. August 6th, 1890. *6d.*

VALVES FOR STEAM STEERING GEAR.—*J. Shenton, Oldham, Lancashire.*—The object of this invention is to provide partially rotating steam valves which are balanced, more sensitive, prevent wire drawing, and the wear of which can be compensated for. In the accompanying illustration Figs. 1 and 3 are sectional plans, Fig. 2 a sectional end view, and Fig. 4 the valve plug of a partially rotating valve constructed according to this invention and applied to steam steering gear. Between the ordinary regulating valve A and the cylinders B is employed a conical partially rotating valve C. In the valves C (Fig. 4) are formed two ports D D^1 on their upper ends, which cross each other (Fig. 3). These ports are so arranged that by partially rotating C and moving the regulating valve A connection can be made between the front end of the cylinder through port E and the exhaust or steam supply. Two other ports F F^1 are made in C which similarly admit and exhaust steam from the back end of the cylinder through port E^1. To compensate for wear in C its lower shank C^1 rests upon screwed plug G fitted into the valve casing and fixed by means of lock-nuts. Thus by lowering G the valve C can be allowed to drop as desired. The stuffing-box of the upper shank C^2 of C is made packingless as follows:—A cylindrical casing H is screwed into the valve casing and fixed by lock-nut H^1. Passing through the outer end of this casing is the shank C^2 of C. Around C^2 and inside H are two flanged bushes I forced respectively against the outer end of H and the top of C by a suitable spiral spring. The inventor also describes a method of applying the above-described arrangement to stationary engines. Three claims are made, embracing the construction and use of partially rotating valves as described, with modifications.—No. 18963. November 26th, 1889. *8d.*

FIG. 1 FIG. 2

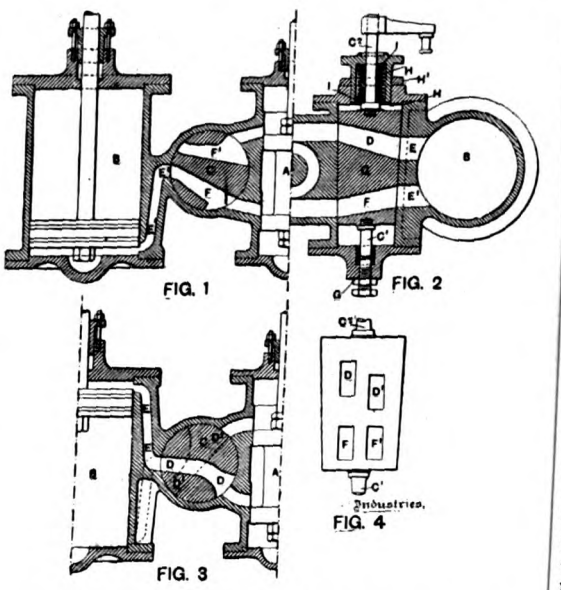
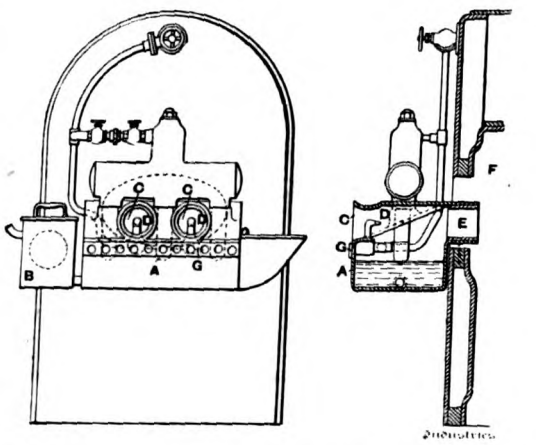


FIG. 3 FIG. 4

THRUST BLOCKS.—*H. Lamb, Erith, Kent.*—The thrust block constructed according to the invention consists of a ring formed of two halves and clamped in the usual manner to the shaft whose longitudinal movement it is desired to prevent. Formed in this ring, between its inner and outer peripheries, are suitable openings, in which are fixed pins, placed radially to the axis of the ring, and carrying upon them conical-shaped rollers of hard steel, with their larger end outwards, the peripheries of which project beyond each side of the ring. One side of this plate, when fully fitted with the conical rollers as described, is placed against a block on the shaft or against the block of the screw itself (when applied to propeller shafts). On the opposite side of the ring carrying the conical rollers is fixed to the shaft a solid metal plate of a suitable size and shape to sustain the thrust pressure of the shaft on the bearing. In this solid plate, and also in the bearing block on the shaft, are formed grooves corresponding with the shape of the rollers in the ring fixed to the shaft, such grooves being deep enough to admit the rollers just such a distance on either side that they can work freely without any portion of the ring touching either the block or the plate. Claims: (1) The application of rollers in connection with thrust blocks or bearings for the shafts of marine and other machinery; (2) the construction and use of a suitable frame to contain these rollers, as described.—No. 1991. February 6th, 1890. *6d.*

OIL BURNERS FOR STEAM BOILERS.—*G. S. Grimston, London.*—The invention relates to oil burners to be used for heating steam boiler furnaces. In the accompanying illustrations Fig. 1 is a front view and Fig. 2 a vertical section of a steam boiler having an oil burner fixed thereto, constructed according to this invention. The oil basin A is supplied with oil to a constant level from a cistern B fed by a ball-cock. Above the oil level in A are formed conoidal air inlets C. In line with each of these inlets is a central nozzle for a steam jet D, acting as an injector for drawing in air, and the vapour on the surface of the oil being kindled directs the flame through passage E into the flue F of the boiler. Besides the air entering at C additional air enters by apertures below, regulated by a valve G. The boiler H mounted over the flame chamber is for the purpose of supplying the nozzle D with steam until steam is generated in the main boiler. The inventor also describes a forge heated by a similarly constructed burner. Claims: An oil burner for furnaces, consisting of a basin supplied with oil, above the basin on the one side an air inlet, with steam injector jet, and on the other side a flame passage, arranged and operating substantially as described.—No. 952. January 18th, 1890. *8d.*

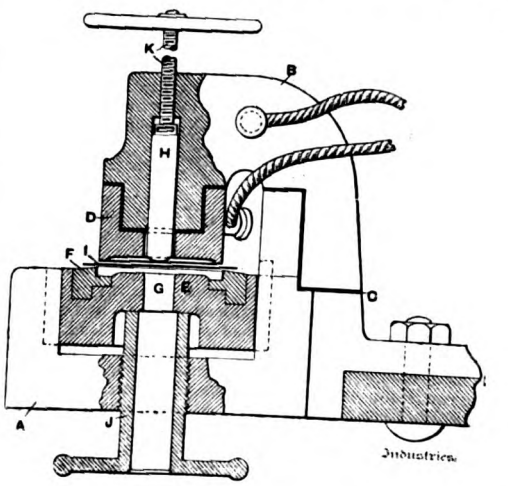
FIG 1. FIG. 2.



ELECTRICITY.

ARC LAMPS.—*A. Apps, London.*—The object of the present invention is to improve the colour and increase the intensity and steadiness of electric arc lights with the least expenditure of electric energy. To effect this the arc is fed with hydrocarbon vapour by causing the vapour to pass up through the lower carbon from a suitable reservoir containing the hydrocarbon situated at or near the bottom. The upper carbon is of the usual kind. The lower carbon is fitted with a tube or lining containing a very small hole, through which the oil from the reservoir first ascends by capillary attraction, and, subsequently becoming vaporised, passes into the arc, playing between the electrodes The hole in the carbon is lined with a suitable refractory insulating material, such as kaolin, lime, or plaster of Paris. Claims: (1) A tubular carbon for electric arc lamps containing a lining of refractory material as described; (2) a carbon for electric arc lighting having an axial passage provided with a lining for supplying liquid by capillary attraction as described; (3) the combination of an electric lamp carbon having a small central tube of refractory material with a source of hydrocarbon supplied at the inlet end of the tube as described; (4) the combination of a tubular carbon with a plastic refractory insulating material and a core adapted to form a capillary tube within said plastic material when dry, substantially as described.—No. 8427. May 31st, 1890. *6d.*

PRESSES.—*M. W. Dewey, Syracuse, New York State, U.S.A.*—The inventor here draws cartridge cases out of sheet metal in the ordinary manner, electricity being, however, utilised to heat the sheet metal to make it more pliable. The accompanying illustration is a side elevation partly in section of a press for this purpose. The part A of the framework is insulated from the arm B at C as shown. Fixed on but insulated from B is the annular stationary cutting die D. Working in A *is a disc E*, having on its upper surface the disc-cutting ring F, and having formed in its centre a hole G, through which the metal is forced by means of a cylindrical plunger H. The arm B is connected to one pole of the electric generator and the die D to the other. The operation is as follows:—A sheet of metal I having been placed between D and E, the latter, together with F, is raised



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by means of a screw J. A sheet metal disc is so cut, and the electric circuit is completed from H through the metal disc to D. The disc so becomes heated, and the plunger is then operated by screw K and forces the disc through E, thereby forming a cup or case, which is afterwards finished in the usual manner. Six claims are made.—No. 16416. October 15th, 1890. 8*d*.

ELECTRICAL CONDUCTORS.—*L. W. Tracy & J. E. Granniss, both of New York, U.S.A.*—The invention relates principally to the covering of insulated electrical conductors with lead sheaths and also to the formation of lead piping. In the accompanying illustrations Fig. 1 is a vertical section and Fig. 2 a plan of an apparatus for effecting the object of this invention, and Fig. 3 is a vertical section of a modified form of such an apparatus. Referring to Figs. 1 and 2, A is the head of the press, B the lead

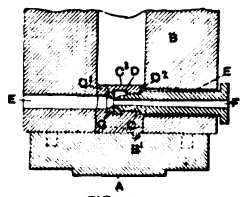


FIG. 1.

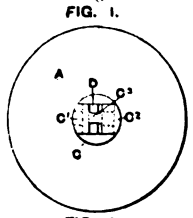
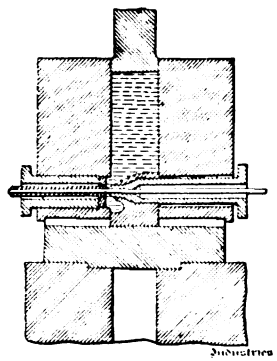


FIG. 2.


FIG. 3.

cylinder, and C the block mounted upon A and located in the lower end of B. The block C has two vertical portions C^1 C^2 with an intervening space D which constitutes the lead pipe forming chamber. Each portion C^1 C^2 of the block is apertured as shown, and openings E are formed in the walls of B coinciding with those in C. The core bar F is inserted through the opening in B and is screwed into the position C^2 of C as shown. The die G is seated in the opposite portion C^1 of C as shown. It will thus be seen that as the lead is pressed down B it will be forced to escape through the annular outlet formed by the end of F and the die G, and as the insulated wire is caused to pass through the die the lead forms a covering around it. In Fig. 3 the block C is slightly modified in form. It will be obvious from the above that if no insulated wire is passed through the apparatus the lead will issue in the form of a tube. Seven claims are made.—No. 9937. June 26th, 1890. 8*d*.

MAGNETIC SEPARATORS.—*F. Christy, Chelmsford, & J. H. Carter, London.*—The object of the present invention is the separation of iron from bones and other substances as the latter are being fed into a disintegrator or other grinding machine. For this purpose a cylinder of iron is employed, which is studded with a large number of electromagnets set radially, and the outer ends being of alternate polarity. The magnets are so wound and commutated that during one-half of a revolution they are active and the other half passive. The material to be treated in the grinding machine is fed on to the top of this cylinder, and carried forward as the cylinder revolves, the non-magnetic material falling off at the side and so into the grinding machine, the iron being carried half round and dropped into a separate receptacle. The feeder for supplying the material to the cylinder is continually shaken to cause the iron by gravity to sink below the bones, and so come in direct contact with the poles of the magnets in the cylinder. When dealing with material having about the same weight and density as iron, this mechanical separation is assisted by placing powerful electromagnets on the underside of the feeder. Claims: (1) In a magnetic separator the combination of a revolving electromagnetic cylinder and shaking feed shoot substantially as described; (2) in a magnetic separator the combination of a magnetic cylinder, shaking feed shoot, and powerful magnets beneath the shoot as described; (3) the combination of a disintegrator and magnetic cylinder as described, the magnetic cylinder serving the double purpose of a magnetic separator and an automatic feeder to the grinding machine; (4) the magnetic cylinder, with studs, standing out radially from a central core in lines parallel with its axis, and with two or more studs in each line, each carrying a magnetising coil, and with coils so wound that the pole pieces in each line and in alternate lines are of alternate polarity as described; (5) the construction of a magnetic cylinder substantially as described.—No. 530. January 11th, 1890. 8*d*.

CHEMISTRY.

PRESERVING FLAX, HEMP, &c.—*E. T. Truman, London.*—For the purpose of preserving hemp, flax, jute, cotton, gutta percha, indiarubber, or wood from decay, the inventor employs any of the oxides of manganese, lead, barium, and copper, and more particularly the peroxides of manganese, lead, and black oxide of copper, which are known to have the property of decomposing ozone in practically unlimited quantities, and by its decomposition converting it into pure oxygen. The reason that these oxides tend to preserve hemp, flax, and other substances is, the inventor believes, that ozone is the active agent in inducing gradual decay, and therefore its decomposition by the said oxides on coming in contact therewith, and its consequent conversion into pure oxygen, prevents decay or oxidation of the materials to which such oxides are applied. In employing these oxides for the preservation of hemp, flax, gutta percha, indiarubber, &c., they may be mixed with ozokerite, tar, or other such substances necessary or desirable for their utilisation or application. Claims: The treatment of hemp, flax, jute, cotton, and other substances, in order to preserve the same, with one or more of the following oxides substantially as described:—Black oxide or peroxide of manganese, black oxide of copper, peroxide of lead, and peroxide of barium.—No. 19773. December 9th, 1889. 4*d*.

RECOVERY OF ZINC FROM GALVANISED IRON.—*H. Grimshaw, Clayton, Manchester.*—For effecting the above the inventor dissolves the zinc from the surface of the iron or steel by means of a solution of the chloride, of the nitrate, or of the sulphate of zinc, or of a mixture of these solutions, by the aid of heat and with or without the addition of sulphuric, hydrochloric, or nitric acid. The process may be originated by employing a diluted solution of hydrochloric, nitric, or sulphuric acid, when the acid of the bath will combine with the zinc to form the salt in solution, or the salt may be dissolved in water to form the bath. In either case, in continuing the process, fresh portions of acid and fresh quantities of the galvanised metal are added from time to time as may be required, and the saturated liquid may be drawn off and the cleansed metal be removed as they respectively accumulate, so that the process may be continuous. If the heat developed by the reaction is insufficient to maintain the bath at a temperature of about 200° F. artificial heat may be applied. Claims: The above-described process for the recovery of zinc from galvanised iron or steel, which process consists in dissolving the zinc in a hot solution of the chloride, sulphate, or nitrate of zinc, either neutral or acidulated with hydrochloric, sulphuric, or nitric acid, substantially as set forth.—No. 1053. January 21st, 1890. 4*d*.

MANUFACTURE OF AZOAMINES.—*J. Imray, London.* (*La Société Anonyme des Matières Colorantes et Produits Chemiques de St. Denis, A. F. Poirrier, & D. A. Rosenstiehl, all of Paris, France.*)—This invention relates to the manufacture of azoamines by the reduction of the azo colouring matters derived from nitramines. This invention is based upon the fact that the following phases may be noted during the above process:—(1) The first product of the reaction is a colouring matter derived from azoxyamine. Two molecules of nitrated azo matter combine into one, losing three atoms of oxygen out of the four that are united with the nitrogen in the compound; (2) as the reducing agent continues to act, the last atom of oxygen is removed in its turn, and there are formed azo matters derived from azoamines; (3) in a third phase, the last-named substances are converted into free azoamines and into an amido derivative, the nature of which need not be considered here. The first phase above-mentioned already forms the subject matter of a prior patent. The process which forms the subject of the present invention is based on the reactions mentioned under the second and third heads. Example: Paranitraniline is diazotised and coupled in the well-known manner with bisulphonaphthol. 100 kilos. of the azo colouring matter thus obtained are dissolved in 1,000 litres of water rendered alkaline by the addition of 100 litres of caustic soda solution of 40° Bé. The temperature is raised to 50° C. to facilitate solution, and then 80 kilos. of glucose of 75 per cent. are introduced. When the whole is well mixed it is heated to ebullition, the violet colour of the liquor gradually changing to a brown. By cooling the para-azoaniline is separated in the form of crystalline needles; it is collected and washed with water, and purified by being redissolved in hydrochloric acid, filtered and neutralised by soda. The azoaniline is then precipitated, collected, washed, and dried. Claims: The manufacture of azoamines by the reduction of the azo colouring matters obtained from nitramines, as described.—No. 1579. January 29th, 1890. 6*d*.

PRODUCTION OF ALUMINIUM.—*H. White, Cheshunt, Hertford, executrix of W. White.*—The inventor manufactures aluminium from aluminium fluoride prepared artificially by evaporating to dryness a solution of alumina or aluminium hydrate in hydrochloric acid. The aluminium fluoride is heated with sodium or potassium, or both; aluminium is liberated and fluoride of sodium (or of potassium, or both) is formed. An excess of aluminium fluoride is preferably used, as it helps, by combining with the fluoride of sodium (or of potassium, or both), to form a suitable flux for the metal. This flux, when treated with sulphuric acid, gives up its fluorine as hydrofluoric acid, which is used for dissolving alumina or alumina hydrate in preparing fresh supplies of aluminium fluoride. Claims: (1) The use of the fluoride of aluminium obtained by evaporating to dryness a solution of alumina or aluminium hydrate in hydrofluoric acid; (2) the production of aluminium substantially in the manner described.—No. 859. January 16th, 1890. 4*d*.

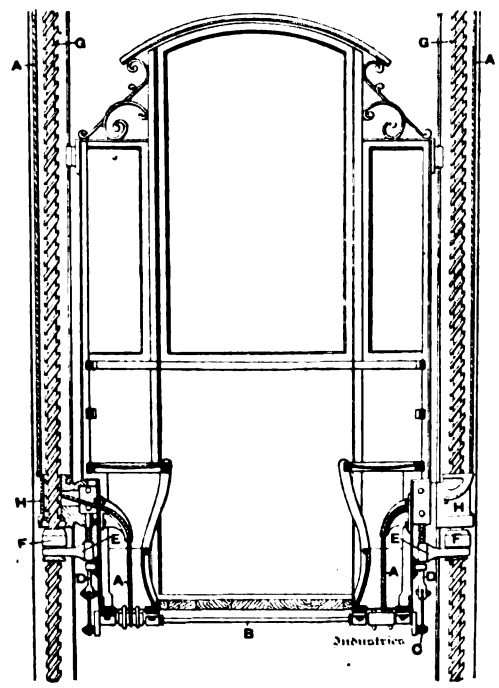
COLOURING MATTERS.—*O. Imray, London.* (*The Farbwerke Vormals, Meister Lucius & Brüning, Hoechst-am-Main, Germany.*)—By heating a mixture of aniline, hydrochlorate of aniline, and of amidoazobenzol, there is produced an "induline," from which the inventors have isolated (1) an induline, $C_{24}H_{18}N_4$ (HCl), the base of which forms with organic acids stable salts soluble in water; (2) an induline soluble in spirit, the base of which does not form salts with organic acids. By heating the induline, $C_{24}H_{18}N_4HCl$, with aromatic meta- and para-diamines there are produced colouring matters of the induline series soluble in water, as described in Letters Patent No. 16325 of 1888. Valuable colouring matters of the induline series soluble in water are also produced from the induline soluble in spirit (2) on its being heated with aromatic diamines, notably with paraphenylenediamine. Example:—100 parts by weight of the induline soluble in alcohol, 150 parts by weight of paraphenylenediamine, 30 parts by weight of hydrochlorate of paraphenylenediamine are heated to 180° C. in an enamelled vessel furnished with a stirrer, until a sample dissolved in diluted hydrochloric acid takes a still bluer colouring; the action will generally require about three hours for completion. From the reaction-product the portion of paraphenylenediamine not used up is extracted by boiling with water. The residue is then dissolved in 2,000 parts by weight of water and 70 parts by weight of hydrochloric acid of 30 per cent. at a raised temperature, the solution is filtered, and the colouring matter is precipitated by means of common salt. The colouring matter dyes mordanted and non-mordanted cotton blue tints. Claims: The manufacture of colouring matters of the induline series soluble in water, by heating with aromatic meta- or para-diamines the induline soluble in spirit which in the production of the induline $C_{24}H_{18}N_4$ is formed conjointly therewith.—No. 1699. January 31st, 1890. 4*d*.

EXPLOSIVES.—*J. Y. Johnson, London.* (*C. Pieper, Berlin, Germany.*)—The invention relates to the manufacture of gunpowder from nitrocellulose or from compounds thereof with nitrate of potash, camphor, or other substances capable of accelerating or retarding combustion. The following is an example of the process embraced by this invention:—20lb. of nitrocellulose with or without admixtures are put into a dough-kneading machine, 20lb. of acetic ether, or of a mixture of alcohol and ether, are added, and the machine is put in operation. After the kneading has been continued for about one hour the nitrocellulose is dissolved and a gelatine-like mass is obtained; 10lb. of water having a temperature of about 60° C. are then poured upon the mass, which causes the division of the gelatine into grains in a few minutes. In order to expel from these grains the solvents employed, they are exposed to a hot liquid or vapour incapable of dissolving or acting chemically on the substance of the grains, the temperature being carried to a degree somewhat above the boiling point of the solvent so as to ensure its complete expulsion by evaporation. After having been separated from the liquid the grains are dried and finally treated in the ordinary manner for producing finished gun or blasting powder. Claims: The process of gelatinising and granulating nitrocellulose or a compound thereof with other substances substantially as described in two claims.—No. 2547. February 17th, 1890. 6*d*.

MISCELLANEOUS.

COATING WIRE WITH TIN.—*F. Baker, Aston, Warwickshire.*—To effect the above purpose the inventor takes a loose coil of steel or iron wire, and by means of electro-deposition coats it with tin in the ordinary manner, so obtaining a much more even coating than by the usual method of dipping the coil into a fluid bath of tin. The coil is then placed upon a swift or reel, from whence it is drawn through a suitable die or dies to smooth and finish the wire, which is effected by means of a revolving block, drawing the wire through the die in the ordinary manner. Claims: The process of manufacturing coated iron or steel wire substantially as described.—No. 14591. September 16th, 1890. 4*d*.

BRAKE MECHANISM FOR LIFTS.—*A. J. Boult, London.* (*G. Backman, Paris, France.*)—The object of the invention is to prevent the cage falling in case the supporting ropes or chains break. The accompanying illustration shows a lift fitted with the improved brake mechanism. A are the two supporting ropes, which, passing through the lower part of the cage, have their ends fixed to levers on a rod B, so holding it in the position



shown. Each end of B has a crank C, to which is connected a sliding rod D carrying a bracket E, embracing loosely an internally threaded collar F, which works on the screw-threaded rods G fixed at each side of the lift. Attached to each side of the cage is a bracket H, through which the rods G also pass. The opposite faces of F and H are bevelled to fit one another. The operation is as follows:—Should the cords A break the rod D would be freed. The cage and bracket E would commence to descend at a greater speed than the collar F, owing to the friction of the latter upon the rods G. The two faces of F and H, therefore, come in frictional contact, so preventing F from revolving and consequently stopping the downward travel of the cage. Three claims are made, embracing the apparatus as described, with modifications.—No. 18602. November 20th, 1889. 8*d*.

TREATMENT OF TIN REFUSE.—*T. Teague, Pinwood, Devoran, Cornwall.*—By this invention the natural alloys of tin and other metals resulting from the refining of smelted tin in the ordinary manufacturing process, technically known as "hard head," are melted with copper or any alloy containing copper in any proportion required, by which an exceedingly hard bronze is formed, which is very suitable for machine bearings, wire, and all the purposes to which bronze is at present applied. The inventor prefers to use a proportion of "hard head" of about 10 per cent. Claims: To make bronze by melting "hard head" with copper or any alloy containing copper in any proportion required.—No. 19687. December 7th, 1889. 4*d*.

Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.

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ENGINEERING PROGRESS IN 1890.

GENERAL MECHANICAL ENGINEERING.

The completion of the Forth Bridge may be claimed as one of the triumphs, not only of civil, but also of mechanical engineering. The special tools which were designed, chiefly through the ingenuity of Sir William Arrol, and the methods of construction which were adopted were all essentially connected with mechanical engineering, and their study will be found to embrace almost every department of the profession. For details of these, however, we must refer to the very complete descriptions which have appeared in our columns and in those of other technical journals, and to the proceedings of various Engineering Institutions, in which they are described.

In the department of steam engineering there has been no striking invention or new development, although progress has been made in the use of higher pressures of steam, and consequently in the construction of boilers. In marine engineering the triple and quadruple systems may be said to have displaced the ordinary compound for all practical purposes. Of the former, the engines of the White Star liners, the "Teutonic" and the "Majestic," may be taken as examples of the best practice. They are of about 17,000 horse-power, and propel the ships by means of twin screws. The cylinders are not steam-jacketed, for the experience of Messrs. Harland & Wolff has confirmed the opinion we have expressed on the subject, that in marine engines in which the steam is used in three or four cylinders there is no advantage to be gained from jacketing—in fact, that very often the reverse is the case, for unless the steam is constantly renewed the jackets get filled with water. To prevent this contingency—at least, by means which would be at all economical—is a work of considerable difficulty. The cylinders are, however, fitted with liners, and are air-jacketed. In the construction of the engines many improvements have been introduced in design and construction. There is now a tendency to simplification in the construction of marine engines by causing many of the subsidiary parts to be practically self-contained. For instance, in the engines we are considering the condenser is quite separate, and, being made of brass, is comparatively light, although the aggregate length of tubes is said to be about twenty miles. The circulating pumps are also distinct, and are of the centrifugal form, by Messrs. Tangye, of Birmingham. The air pumps, however, are worked from back levers from the high and low pressure engines. The two sets of engines are quite distinct, and are separated by bulkheads. In the "City of Paris," however, this arrangement was not found to be sufficient, and the connecting rod of the disabled engine drove a hole through the bulkhead and caused both engine-rooms to be flooded, but it is difficult to conceive any design that would stand in such circumstances.

Of the smaller kinds of marine engines the quadruple-expansion engines made for torpedo boats by Messrs. Yarrow & Co., of Poplar, may be mentioned as examples of the most recent practice. The boilers are of the loco-marine type which have been made by this firm for some years. The engines are quadruple expansion, and the cylinders are placed, not in pairs, as is usually the case, but in a line, in order that the vibration which is so common in high-speed engines may be reduced. The order of arrangement is high, second intermediate, first intermediate, and low. As in the large passenger ships, so in torpedo vessels, the main engines are relieved, as far as possible, of all subsidiary work, which is performed by six auxiliary engines, and, notwithstanding all this, there is fair accommodation for the men, even in small boats of this description. The speed obtained from these boats is over 24 knots per hour. In connection with torpedo boats may be mentioned the water-tube boilers made by Mr. Thornycroft, which are a distinct advance in some respects, giving, as they do, great heating surface with small weight.

The use of triple and quadruple expansion engines is now becoming common for other than marine purposes, and especially for pumping and manufacturing. During the year we have given illustrations of typical examples of the various kinds, and we must refer to these for details.

Valve gears are the parts which seem to engage the attention of engineers to a very great extent. Visitors to the Paris Exhibition in 1889 must have been struck with the great variety and ingenuity of the designs. We have reprinted a paper by Mr. J. J. Harper (see *Industries*, Vol. IX., page 520), which gives a good account of the most important, and to which we would direct the careful attention of our readers.

Considerable developments have taken place in the design of small motors of various kinds, including steam engines, hydraulic motors, gas engines, and motors worked by compressed air. Among steam engines those for agricultural purposes, in which portability and ease of management are preferred to economy, have received most attention, chiefly on account of the publicity afforded them by agricultural exhibitions. The designs for gas and air engines continue to increase, and during the year we have given a considerable number of new designs, but none of them seem to call for any special notice.

In locomotive engineering there has been nothing strikingly new, although a study of the various designs which have been produced shows many points of improvement. Compounding of locomotives does not seem to be receiving so much attention in this country from railway engineers as it does on the Continent, especially in France and Germany. The question of the best railway brake may still be considered an undecided question, although the field is now considerably narrowed by the disappearance of many competitors for the position. Some time since a trial was made on the Indian State Railways, but from the reports which were published of them nothing decisive may be expected. There is little excuse for indefinite information on this subject, as appliances are now available which record the whole behaviour of a brake during a trial with the utmost accuracy. This is a subject which we think might be taken up by the Board of Trade and settled in a satisfactory manner.

Machine tools and appliances of all kinds continue to be designed and developed, which display great skill in design and excellence in workmanship, as can be seen from a perusal of our pages. We must confess, however, that in some respects the Americans keep ahead of us in labour-saving appliances. They are not behind either in originality of design for engines and machines of all kinds. On the Continent also we have very keen competitors in every department of mechanical engineering. This was brought out very distinctly by the exhibits of the Paris Exhibition, and especially by those from Switzerland, which embodied good designs with first-class workmanship. Those who were qualified to give an opinion on the subject attributed this in great part to the excellent opportunities which the Swiss have for technical education.

SHIPBUILDING AND MARINE ENGINEERING.

England and Wales.

In reviewing the shipbuilding industry a year ago we stated that it "would be safe to prognosticate another output exceeding one million tons," and now that 1890 has closed it is found that, in round figures, its output has been about one and a quarter million tons—practically identical in extent of tonnage to that of the year 1888. It will be interesting to see if "history will again repeat itself" by a severe falling off in production during the current year. Had it not been for the "rush" of orders that occurred a few months ago, it would have been tolerably safe to prophesy an output for 1891 of the same extent as that of 1884—viz., three-quarter million of tons—but this, we hope, will be exceeded, and there is some reason for the anticipation, especially in the fact that there is a large amount of British Government work in the hands of private contractors, which will assist to swell the output of the current year.

In the accompanying tables we show a summary of the work in England and Wales, giving the individual outputs for the last year of each shipbuilding firm at the seven principal shipbuilding centres. It will be seen the Tyne continues to lead the way as the most active shipbuilding river; but whereas in 1889 the output increased 68,000 tons, it has during the last year fallen over 46,000 tons, the Wear having a smaller decline—under 20,000 tons—thus becoming a better second. The Tees and West Hartlepool stand alone amongst the English shipbuilding centres in having not decreased but increased outputs, the former having improved upon the year 1889 by over 17,000 tons and the latter by nearly 14,000 tons. The Humber has suffered severely, its output being less than half that of the previous year. On the whole the returns for the Mersey are not unsatisfactory, as out of the seven vessels built by Messrs. Laird Bros. five were war vessels for the Chilian and Argentine Republics; still shipbuilding and marine engineering cannot be described as flourishing at this centre. Barrow-in-Furness, of which a special tabular return would be given, were it not that the entire output of the port is that of the Naval Construction and Armaments Company, Limited, has fairly held its own, when it is remembered that the tonnage launched included three cruisers for the British Admiralty, viz., H.M.S. "Latona," H.M.S. "Melampus," and H.M.S. "Naiad." This company's output of marine engines is also swollen by the new engines and boilers supplied and fitted to the steamers "Araucania" and "Patagonia."

There have been no startling departures in practice during the year that has closed. Steel continues to be the principal material for shipbuilding, although for small merchant and fishing craft iron yet retains considerable popularity, and will probably continue to do so. In marine engineering quadruple-expansion engines have been constructed by a few firms, viz.:—Messrs. Wigham Richardson & Co., Walker; Messrs. Wm. Allan & Co., Sunderland; Messrs. George Clark, Limited, Sunderland; Messrs. Yarrow & Co., Poplar; and Messrs. Simpson, Strickland, & Co., Dartmouth. The present depression in the freight market may stimulate a demand for increasing economy in coal consumption, and lead to a wider adoption of higher working pressures of steam and four-cylinder engines. So far, 200lb. pressure is the greatest that has been adopted, and only in a few instances. Experience is, however, being gradually accumulated, and as hitherto the quadruple-expansion engine, when well designed, has given, even with comparatively low-pressure steam, satisfactory results, there appears to be little doubt that in time the "quadruple" will supplant the "triple" expansion engine.

TABLE I.

SHIPBUILDING IN ENGLAND AND WALES.

Rivers or Ports.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
The Tyne	127	228	234,834	235,062	204,251
The Wear	88	6,507	190,524	197,431	112,860
The Tees	68	210	127,529	127,739	66,850
West Hartlepool	43	—	99,847	99,847	47,630
The Mersey	31	9,379	21,258	30,637	31,108
Barrow	6	—	24,665	24,665	*52,600
The Thames	102	4,321	11,900	16,221	31,994
The Humber	44	232	9,392	9,624	14,160
Whitby	4	—	8,682	8,682	4,980
Blyth	8	58	7,309	7,367	4,160
Milford Haven	4	2,860	3,008	5,868	2,280
Hayle	3	—	5,833	5,833	2,800
Cardiff	6	—	3,297	3,297	2,222
Maryport	2	3,200	—	3,200	—
Workington	2	2,512	372	2,884	360
Southampton	3	2,250	—	2,250	364
Chepstow	19	1,115	225	1,340	780
Brixham	18	758	—	758	—
Rye	2	280	—	280	—
Cowes	6	29	181	210	24
Plymouth	4	168	—	168	—
Devon	1	113	—	113	—
Yarmouth	1	92	—	92	—
Goole	1	77	—	77	—
Gosport	1	70	—	70	—
Gloucester	1	60	—	60	—
Bristol	1	—	50	50	40
Brimscombe	6	—	26	26	29
Falmouth	1	—	25	25	30
Amlwch	1	—	—	—	60
	604	34,519	749,357	783,876	579,582

* Includes 4,000 i.h.p. for the new engines and boilers fitted to the steamers "Araucania" and "Patagonia."

TABLE II.

THE TYNE.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Palmers' Shipbuilding and Iron Co., Ld.	14	—	45,312	45,312	35,950
Sir W. G. Armstrong, Mitchell, & Co., Ld.	13	—	28,110	28,110	46,700
C. S. Swan & Hunter	11	—	26,454	26,454	18,950
John Readhead & Sons	11	—	23,599	23,599	18,688
R. & W. Hawthorn, Leslie, & Co.	9	—	19,688	19,688	21,400
Tyne Iron Shipbuilding Co., Ld.	8	—	18,016	18,016	10,250
R. Stephenson & Co., Ld.	5	—	15,795	15,795	16,300
Wigham Richardson & Co.	9	55	14,523	14,578	*10,650
Edwards' Shipbuilding Co. Ld.	6	—	10,450	10,450	6,060
W. Dobson & Co.	7	173	10,265	10,438	6,400
Wood, Skinner, & Co.	10	—	10,065	10,065	6,010
Schlesinger, Davis, & Co.	3	—	7,867	7,867	4,140
T. & W. Smith	3	—	2,356	2,356	1,500
Hepple & Co.	6	—	790	790	2,700
J. P. Rennoldson & Sons	5	—	722	722	1,608
Jos. T. Eltringham & Co.	5	—	658	658	1,590
Teams Shipbuilding Co.	1	—	100	100	150
Thomas Brown	1	—	64	64	180
	127	228	234,834	235,062	204,251

* Besides 5,100 i.h.p. for four engines supplied to vessels built by other firms.

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TABLE III.
The Wear.

Shipbuilders	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
J. L. Thompson & Sons	13	—	32,040	32,040	21,840
Wm. Doxford & Sons...	9	—	28,386	28,386	16,100
Short Bros.	11	—	25,073	25,073	12,900
James Laing.....	9	—	22,701	22,701	13,920
Sunderland Shipbuilding Co., Ld.	6	—	15,715	15,715	9,400
John Blumer & Co.	8	—	14,270	14,270	7,920
W. Pickersgill & Sons..	5	6,507	5,716	12,223	2,580
R. Thompson & Sons ...	7	—	11,377	11,377	6,420
John Priestman & Co....	6	—	10,428	10,428	5,820
Bartram, Haswell, & Co.	4	—	10,013	10,013	6,300
Osbourne, Graham, & Co.	4	—	6,098	6,098	3,300
S. P. Austin & Son.....	3	—	5,978	5,978	3,180
The Strand Slipway Co.	3	—	3,129	3,129	3,180
	88	6,507	190,924	197,431	112,860

TABLE IV.
The Tees.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Sir Raylton Dixon & Co.	20	—	43,665	43,665	21,490
Ropner & Son	12	—	32,662	32,662	17,670
Richardson, Duck, & Co.	14	150	24,711	24,861	14,160
Craig, Taylor, & Co. ...	8	—	15,398	15,398	7,530
R. Craggs & Sons.....	5	—	5,553	5,553	2,640
W. Harkess & Son	9	60	5,540	5,600	3,360
	68	210	127,529	127,739	66,850

TABLE V.
West Hartlepool.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
W. Gray & Co., Ld. ...	27	—	64,253	64,253	28,700
E. Withy & Co.	11	—	26,024	26,024	14,460
Irvine & Co.	5	—	9,570	9,570	4,470
	43	—	99,847	99,847	47,630

TABLE VI.
The Mersey.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Thomas Royden & Sons	4	2,809	8,238	11,047	5,000
Laird Bros.	7	—	9,166	9,166	21,850
W. H. Potter & Son ...	3	5,354	986	6,340	600
R. & J. Evans & Co. ...	1	1,146	—	1,146	—
John Jones & Sons	5	—	2,482	2,482	3,400
Cochrane & Co.	10	—	386	386	258
Harland & Co.	1	70	—	70	—
	31	9,379	21,258	30,637	31,108

TABLE VII.
The Thames.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Thames Shipbuilding and Iron Co., Ld. ...	7	—	10,672	10,672	22,130
R. & H. Green	21	2,720	718	3,438	288
A. W. Robertson & Co.	10	1,360	151	1,511	55
Forrest & Son	26	241	52	293	195
Yarrow & Co.	28*	—	—	—	8,920
John J. Thornycroft & Co.	—†	—	—	—	
Westwood, Baillie, & Co.	3	—	150	150	300
R. Watkins & Co.	3	—	92	92	68
Samuda Brothers, Ld.	—‡	—	—	—	
T. G. Tagg & Son	4§	—	65	65	38
	102	4,321	11,900	16,221	31,994

* Mostly torpedo boats, not measured for tonnage. † No returns.
‡ No launches, but extensive Government contracts on hand.
§ One of these vessels electrically propelled.

TABLE VIII.
The Humber.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Earle's S. & E. Co., Ld.	9	—	4,429	4,429	4,880
Cook, Wilton, & Gemmell	17	—	2,577	2,577	4,890
Cochrane, Cooper, & Schofield	14	—	2,211	2,211	4,120
Smith & Stephenson.....	3	232	—	232	—
T. Charlton	1	—	175	175	270
	44	232	9,392	9,624	14,160

Scotland.

Although 1890 shows one of the largest outputs in shipbuilding and marine engineering on record, still in Scotland about the usual proportion has been done, and the Clyde has maintained its pre-eminence amongst the shipbuilding centres. The following figures show how the production of the various centres in Scotland stand in 1890 as compared with the previous twelve months :—

	1890. Tons.	1889. Tons.
Clyde	361,518	335,201
Forth	32,900	33,859
Dundee	24,494	18,311
Aberdeen	9,228	9,470

In previous years we have given a table showing the growth of the Clyde shipbuilding trade. This may be repeated, with the addition of the past year, and the following figures show the Clyde production during the last thirty-one years :—

	Tons.		Tons.
1890	361,518	1874	262,430
1889	335,201	1873	232,926
1888	280,037	1872	230,347
1887	185,362	1871	196,229
1886	172,440	1870	180,401
1885	193,453	1869	192,310
1884	296,854	1868	169,571
1883	419,664	1867	108,024
1882	391,934	1866	124,513
1881	341,022	1865	153,932
1880	241,114	1864	178,505
1879	174,750	1863	123,262
1878	222,353	1862	69,967
1877	169,710	1861	66,801
1876	174,824	1860	47,833
1875	211,824		

So that 1890 stands third on the list as regards amount, being only surpassed by the great years of 1882 and 1883. Unfortunately, the last of the great orders came at the end of 1889, and while during the first half of 1890 the production was enormous, the scarcity—indeed, the almost total absence of new work—rendered the prospect very gloomy. In August, however, an unexpected improvement took place, and a considerable number of orders were placed at all the chief ports, and at prices which, considering the depressed state of the freight market, must be considered fairly good. The prices of materials are less than they were a year ago, but wages are maintained, and the price of labour has been considerably increased by the irregular working of the men. If prices fall, or even if few new orders come in, the question of a reduction of wages must be seriously faced, and it is to be hoped that sufficient common sense will prevail to bring about a readjustment without resort being had to strikes.

The first table in the next column gives details of production on the Clyde and neighbourhood during the past year, and a comparison with the previous year.

The total number of 303, as compared with 249 for the preceding year, shows that the average tonnage was smaller last year than in 1889. Messrs. Russell & Co. again head the list, with a record which we would imagine will stand for some years to come—namely, 70,370 tons. That firm has now two yards in Port Glasgow and one in Greenock, and seems to have got a firm hold of the trade in the larger sailing vessels, for of the thirty-four vessels launched twenty-six were sailing vessels with a total tonnage of 50,634, but none were of any design or construction requiring special notice. During the year we have given details of the more important vessels launched from Clyde yards, so that all that is necessary now is to to recall a few of the more important. From the Fairfield Company's yard there were several notable vessels—for instance, the "Normania," for the Hamburg-American Steam Packet Company; the "Dunottin Castle," for the Castle Mail Packet Company; and three steamers for the Norddeutscher Lloyd, of Bremen. Messrs. J. & G. Thomson, of Clydebank, completed seven vessels, of which three were warships, two second-class protected cruisers for the British Government and one cruiser for the Government of Japan. They also constructed three fast twin-screws for the London and South-Western Railway Company's Channel Islands passenger service. Messrs. Denny & Co., of Dumbarton, had several splendid specimens of river passenger, such as the "Duchess of Hamilton," for the Clyde service of the Caledonian Railway Company, the "Clacton Belle," for the London, Woolwich, and Clacton-on-Sea Steamboat Company, besides a number of large steamers for Indian and Colonial service. In glancing over the lists of the other builders, notwithstanding the large output, we do not see much calling for special remark, as the majority of the vessels are intended for ordinary passenger or goods traffic.

	1890. Vessels.	Tons.		1889. Vessels.	Tons.
Messrs. Russell & Co., Greenock...	34	70,370	...	21	46,500
Fairfield Company, Govan	8	33,705	...	8	23,830
Messrs. Denny & Bros., Dumbarton	8	28,509	...	29	25,230
Messrs. D. & W. Henderson, Partick	15	21,196	...	17	11,806
Messrs. Barclay, Curle, and Co., Ld., Whiteinch.....	7	19,496	...	6	12,760
Messrs. Charles Connell & Co., Scotstoun	7	13,012	...	8	15,020
Messrs. A. Stephen & Sons, Linthouse	7	16,841	...	8	18,430
Messrs. Caird, Greenock	5	16,318	...	7	16,461
Messrs. Scott, Greenock	11	15,882	...	12	20,630
Messrs. James & George Thomson, Ld., Clydebank.....	7	14,880	...	3	12,316
Messrs. A. & J. Inglis, Pointhouse	7	11,554	...	3	8,304
Messrs. Robert Duncan & Co., Port Glasgow.....	7	10,742	...	7	11,257
Messrs. Mackie & Thomson, Govan	11	7,802	...	5	2,215
Ailsa Company, Troon	7	6,044	...	7	3,771
Messrs. W. Hamilton & Co., Port Glasgow.....	3	5,351	...	3	5,312
Messrs. R. Napier & Sons, Govan	1	5,650	...	3	11,640
Messrs. Napier, Shanks, & Bell, Yoker.....	4	5,616	...	4	5,165
Messrs. A. M'Millan & Co., Ld., Dumbarton	4	5,280	...	7	10,344
Messrs. Fleming & Ferguson, Paisley	10	5,150	...	6	8,620
Messrs. Murdoch & Murray, Port Glasgow	7	4,624	...	3	6,269
Messrs. Wm. Simons & Co., Renfrew	10	4,310	...	10	3,375
Messrs. Blackwood & Gordon, Port Glasgow	6	4,289	...	2	800
London and Glasgow Co., Govan...	2	3,600	...	3	8,666
Messrs. Lobnitz & Co., Renfrew ...	16	3,558	...	8	6,507
Messrs. Alley & M'Lellan, Polmadie	26	3,385	...	—	1,517
Campbeltown Company.....	2	2,951	...	3	4,434
Messrs. M'Night & Co., Ayr	5	2,510	...	5	4,558
Messrs. D. J. Dunlop & Co., Port Glasgow	5	2,305	...	5	6,700
Messrs. Scott & Co., Bowling.....	5	1,970	...	5	2,064
Messrs. Fullerton & Co., Paisley	6	1,774	...	4	965
Messrs. T. B. Seath & Co., Rutherglen.....	11	1,646	...	7	527
Messrs. Jno. Reid & Co., Port Glasgow.....	3	1,128	...	7	12,754
Messrs. Murray Bros., Dumbarton	7	1,104	...	—	—
Messrs. M'Arthur & Co., Paisley	5	906	...	5	752
Messrs. Davy & M'Kendrick, Govan	5	794	...	—	—
Abercorn Company, Paisley.....	1	742	..	1	86
Messrs. White & Co., Plantation...	—	550	...	—	—
Messrs. MacGill & Co., Irvine.....	3	419	...	3	326
Messrs. Fife & Son, Fairlie	13	172	...	12	91
Mr. D. M. Cumming, Parkhead ...	2	146	...	3	34
Mr. R. M'Allister, Dumbarton ...	—	120	...	—	—
Mr. T. Orr, Greenock	—	93	...	—	—
Other yacht and boatbuilders	—	300	...	—	—
	303	361,518			

On the Forth the work done during the year was somewhat less in amount than that done during the preceding year, as is shown by the following figures :—

	1890. Vessels.	Tons.		1889. Vessels.	Tons.
Grangemouth Dockyard Company	18	17,155	...	14	14,047
Ramage & Ferguson, Leith	6	8,584	...	9	13,036
S. & H. Morton, Leith	4	3,641	...	5	4,090
Messrs. Hawthorns, Leith.....	6	800	...	2	680
Jno. Scott & Co., Kinghorn	5	2,720	...	8	1,006

In Dundee the output was larger than in 1889, and included the "America," built by Messrs. Gourlay & Co. for the National Steamship Company, which is the largest vessel ever launched on the Tay. The following are the details of the different yards for 1889 and 1890 :—

	1890. Vessels.	Tons.		1889. Vessels.	Tons.
Messrs. Gourlay Bros. & Co.	5	11,616	...	6	8,333
Messrs. W. B. Thompson, Ld.....	8	8,466	...	6	8,470
Messrs. A. Stephen & Sons.....	2	4,415	...	2	1,508

In Aberdeen the production was about the same as in 1889, the following being the figures :—

	1890. Vessels.	Tons.		1889. Vessels.	Tons.
Hall, Russell, & Co.	8	5,684	...	5	5,770
A. Hall & Co.	4	1,595	...	5	3,320
John Duthie, Sons, & Co.	3	1,949	...	2	380

The total indicated horse-power of the engines constructed in Scotland during the year 1890 was 422,778, and the following table gives abstracts of the returns :—

	I.H.P.
Fairfield Company, Govan.....	53,950
J. & G. Thomson, Clyde Bank	44,300
W. Denny & Co., Dumbarton	37,850
Muir & Houston, Kinning Park	18,975
Dunsmuir & Jackson, Govan	17,450
Fleming & Ferguson, Paisley	17,150

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	I.H.P.
W. B. Thomson, Dundee	14,150
James Howden & Co., Glasgow	14,010
J. & J. Thomson, Finnieston	14,100
Caird & Co., Ld., Greenock	13,900
A. & J. Inglis, Pointhouse	13,810
Barclay, Curle, & Co., Ld., Stobcross	13,800
Gourlay & Co., Dundee	13,200
Rowan & Sons, Finnieston	12,500
A. Stephen & Co., Linthouse	12,250
D. & W. Henderson, Meadowside	11,500
Hutson & Corbett, Kelvinhaugh	10,750
Bow & M'Lachlan, Paisley	10,275
Rankin & Blackmore, Greenock	8,300
Ramage & Ferguson, Leith	7,071
Scott & Co., Greenock	7,800
R. Napier & Sons, Govan	7,000
Blackwood & Gordon, Port Glasgow	6,650
Ross & Duncan, Govan	6,212
Hall, Russell, & Co., Aberdeen	6,030
Mr. Kemp, Govan	5,300
W. Simons & Co., Renfrew	5,240
D. J. Dunlop & Co., Port Glasgow	2,823
John Scott & Co., Kinghorn	2,720
W. King & Co., Ld., Glasgow	2,700
London & Glasgow Company, Govan	2,800
Duncan Stewart & Co., Glasgow	2,300
John Duthie, Sons, & Co., Aberdeen	2,150
Hawthorns & Co., Leith	2,620
A. Hall & Co., Aberdeen	1,580
Alley & M'Lellan, Glasgow	1,060
Hanna, Donald, & Wilson, Paisley	1,050

These figures represent not only the engines made for the vessels built in Scotland, but also for a considerable number built in England, and other parts of the world. For instance, the engines and boilers for H.M.S. "Edgar" were constructed by the Fairfield Company, while the vessel itself is being built in one of the dockyards. Some of the makers of the smaller sizes of engines export them in considerable numbers to foreign countries, where the hulls are being constructed. A very large proportion of the vessels launched during the year were, as usual, for foreign owners, so that the progress of other nationalities in marine engineering and shipbuilding has not been sufficient to affect our trade to any material degree. The following table gives the number and gross tonnage of the vessels built in Scotland in 1890 for home and foreign owners:—

	Vessels.	Tons.		Vessels.	Tons.
Germany	13	45,317	Japan	2	2,990
Norway	18	19,727	South Africa	3	1,060
France	8	12,940	Other countries	6	3,040
Belgium	4	7,153	London	37	65,183
Spain	4	5,806	Liverpool	23	46,015
Greece	1	1,223	British Government	2	7,000
Portugal	1	699	English ports	22	12,053
North America	6	9,835	Glasgow	65	89,801
South America	14	7,485	Scotch ports	42	49,406
Australasia	11	16,670	Ireland	6	5,229
China	2	3,996			

There is still considerable work on hand, but, as few orders are coming in, that will soon be completed, and the prospects are not particularly bright; but it is possible that during the present year a considerable number of fresh orders will come in.

Ireland.

The output in 1890 at Belfast is less than that in 1889, but it ought to be remembered that in that year the "Teutonic" and "Majestic," both of very large dimensions, were launched from the yard of Messrs. Harland & Wolff. The following table gives the production of the different yards for the two last years:—

	1890. Vessels.	Tons.	1889. Vessels.	Tons.
Messrs. Harland & Wolff, Ld.	13	48,633	12	56,430
Messrs. Workman, Clark, & Co., Ld.	10	15,631	7	17,710
Messrs. MacIlwaine & M'Coll, Ld.	5	2,105	8	8,883
Messrs. Paul Rogers & Co., Carrickfergus	4	414	—	—

At Londonderry Messrs. J. C. Biggar & Co. launched from the Foyle Shipbuilding Yard one steamer of 3,318 tons, and four sailing vessels aggregating 7,276 tons, making for the year a total of 10,594 as compared with 7,268 for 1889.

CIVIL ENGINEERING.

Bridges.

The most important work in civil engineering which was completed in this country during the past year was undoubtedly the Forth Bridge, a structure which embodies almost every department of constructive skill, and which is the crowning work of the railway system of the country. On the 24th January, 1890, the first train was driven across the structure, and on the 4th of March the opening ceremony was performed by the Prince of Wales. We devoted so much space to a description of the bridge, not only in our ordinary issues, but also in a special number, that it is altogether unnecessary to enter into details, but we may note a few of the chief facts connected with it. Its extreme length, including the approach viaduct, slightly exceeds a mile and a half, and the actual length of the cantilever portion of it is a little over a mile. The weight of steel used in it amounts to 54,000 tons, and the extreme height of the structure above mean water level is over 370ft. above high-water mark, and above the bottom of the deepest foundation 450ft., while the rail-level above high water is 156½ft. The entire cost of the structure has been about three-and-a-quarter million pounds sterling, and notwithstanding this large amount we are pleased to learn that the traffic which is passing over the bridge is even now sufficient to afford a fair return for the money invested, and of course this will go on improving, as the completion of the bridge must necessarily lead to important changes and developments in the railway service of the East of Scotland. Everybody, therefore, connected with the Forth Bridge, engineers, contractors, and railway directors, are to be congratulated on the success of the undertaking, both from an engineering and financial point of view.

The Tower Bridge over the Thames has been several times referred to in our current issues. It is making satisfactory progress, and promises to be of great use. Its design and construction embody many novel features, which we have explained on previous occasions.

Canals and Ship Railways.

The most important civil engineering work which is now being carried on in this country is the Manchester Ship Canal, of the progress of which we give a special account in another column, and have also given detailed accounts, from which our readers would see that it is being pushed on with energy and vigour, with the aid of the best skill and the most improved engineering appliances, and there can be little doubt of its successful completion, and ultimately of its financial success.

For a good many years past, in reviewing the progress of civil engineering, the Panama Canal has always received a considerable amount of attention. This year it is a blank, for all work has been suspended on account of the financial collapse of the company. It has been always very difficult to pronounce a definite opinion either on the financial or the engineering aspects of the undertaking on account of the contradictory reports which have been published regarding it. We have on various occasions pointed out the engineering difficulties which did not seem to be faced by those in charge. The report recently issued by the financial liquidator seems to prove that the undertaking has existed, not so much for the benefit of the shareholders, as of the financiers and promoters, who have managed to secure a very large share of the total capital subscribed. The latest reports are that an agreement, extending the period within which the Panama Canal is to be completed, has been signed by the Columbian Government and by a representative of the liquidators of the Panama Canal Company, so that evidently the undertaking has not been given up.

The rival scheme to the Panama Canal—that is, the Nicaraguan Canal—seems to promise an early completion and financial success. The concession to the company has been ratified by Nicaragua, and is favoured by the United States Government. The undertaking is now backed by some of the most influential men in the United States. During the past year over $3,000,000 have been expended on the work, and the progress which has been made seems to indicate that the canal will be completed within six years. The total cost of the undertaking is estimated at $64,000,000, an amount which is thought by some well-informed persons to be less than one-half of what is still required to complete the Panama Canal. The success of the Nicaraguan scheme will add to the difficulties of the Panama Company, for it will have a competitor which will have all the advantages of a very much smaller capital.

As we have pointed out several times during the year, canals and inland navigation generally seem to have entered on a new era of activity under conditions suited to the requirements of modern times. The subject received great attention at an important conference held in Manchester in July of last year, and which was attended by eminent engineers from the chief European countries, who discussed, not only the general conditions of the problem of inland navigation, but also many proposed works. We must refer our readers to an account of the proceedings for details, but we have no doubt that the conference helped to bring to a point many schemes which were floating indefinitely about. There were competing plans for a new Forth and Clyde Canal, which we would have liked to have heard discussed more fully from an engineering and also from a financial point of view. Details were given of a proposed ship canal between Birmingham and Liverpool, which, if carried out, would be of great importance to the trade and commerce of the country. Many other schemes have been mooted. The North Staffordshire Railway Company are applying for powers to enlarge the Thames and Mersey Canal, so as to make it available for larger vessels, and is intended to join the Bridgwater Canal at Preston Brook. The Aire and Calder Navigation is also to be connected with the proposed canal from Sheffield to the Humber. But improved canals are not to have it all their own way; these are likely to have competitors in ship railways, and especially in that form designed by Mr. William Smith, of Aberdeen. Mr. Smith, like other enthusiasts, sees opportunities for the application of his invention, not only in various parts of this country, but in many parts of the world. In company with Mr. W. R. Kinniple, he has made a survey of a route to connect the Bristol and the English Channels, and they consider that a ship railway might be constructed for £35,000 per mile sufficient to accommodate vessels of 1,000 tons burthen, and a syndicate is about being formed to carry out the project. If it turns out a successful scheme, it will no doubt lead to many others. Ship canals and railways are being introduced in several parts of America, and others are being proposed.

Dock, Tunnel, and Harbour Works.

Means of communication are being improved to meet increasing traffic, and these include great varieties of design. One of the most novel is the elevating ferry boat which has been placed on the Clyde at Finnieston, and which was designed and built by Messrs. Simons, of Renfrew. It has been most successful since it was placed on the station, and has carried a large amount of heavy and passenger traffic. At the same part of the Clyde a subway is being constructed by a private company.

There is a proposal for a tunnel to connect Ireland and Scotland, but as yet it is "in the air." Bridges and tunnels of all methods of design have been constructed in many parts of the world, but for details of these we must refer our readers to the proceedings of the Engineering Institutions.

Considerable extensions have recently taken place in the dock accommodation both on the Mersey and the Clyde. For an account of the former we refer our readers to Vol. C. of the Minutes of the Proceedings of the Institution of Civil Engineers, which also contains much useful information regarding the Bars of Tidal Estuaries, and the very complete papers on the Shanghai, Hong Kong, and Yokohama Water Works, which ought to be carefully studied by all interested in hydraulic engineering. The new water works for Manchester are making good progress, and so also is the extension of those for Glasgow.

Railways.

In the department of railway engineering the year 1890 was remarkable for the number of projects put forth rather than for the actual work done. The most ambitious scheme is the proposed extension of the Manchester, Sheffield, and Lincolnshire system to London, and practically means a new trunk line into London. No doubt it will be most vigorously opposed by the other companies, but if carried out it will be a great convenience to a very large district. There are various proposals for the extension of railway accommodation in the metropolis and neighbourhood and on the part of the great trunk companies of the country, but these do not call for any special remark. As regards Scotland, there is the Highland Railway which we commenced to describe on page 12 in our issue of last week. The people of Edinburgh are distracted by the competing plans of the North British and the Caledonian Companies. It is certainly time that something were done by both companies, as the terminal stations in that city are a disgrace to all concerned. The railways of America make steady progress, but in these our iron and steel manufacturers have now little interest, as their wants are supplied from American sources. Those of India are of much more importance to the iron and steel industries of this country, and it is satisfactory to find that not only are they being developed at a considerable rate, but also that the traffic is sufficient to enable them to pay good dividends. It is a fact to be noted that in ten years the traffic on Indian railways has more than doubled. The Chinese have done practically nothing to justify the great expectations which some people had formed of their wishes and requirements, thus proving that the opinions we have frequently given on the subject were correct. China will have railways, but it will be by a comparatively slow process, and by utilising native labour and resources as far as possible. On the other hand, the Japanese are going ahead at a rapid rate, and in 1889 had 1,000 miles open for traffic. A great part of the rails and the rolling stock came from this country, but for some years past the construction has been carried out almost entirely by native engineers, and with very good results. Considering that it is only twenty years since the first lines were contemplated by the Japanese the progress they have made is very creditable.

On the whole, the work done in the department of civil engineering in the year 1890 has not only been of great importance and variety, but also opens up prospects of wider developments in the future.

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IMPROVED FORESTRY MACHINERY.

CONSTRUCTED BY MESSRS. ARBEY & FILS, MACHINISTS, PARIS.

(*For description see next page.*)

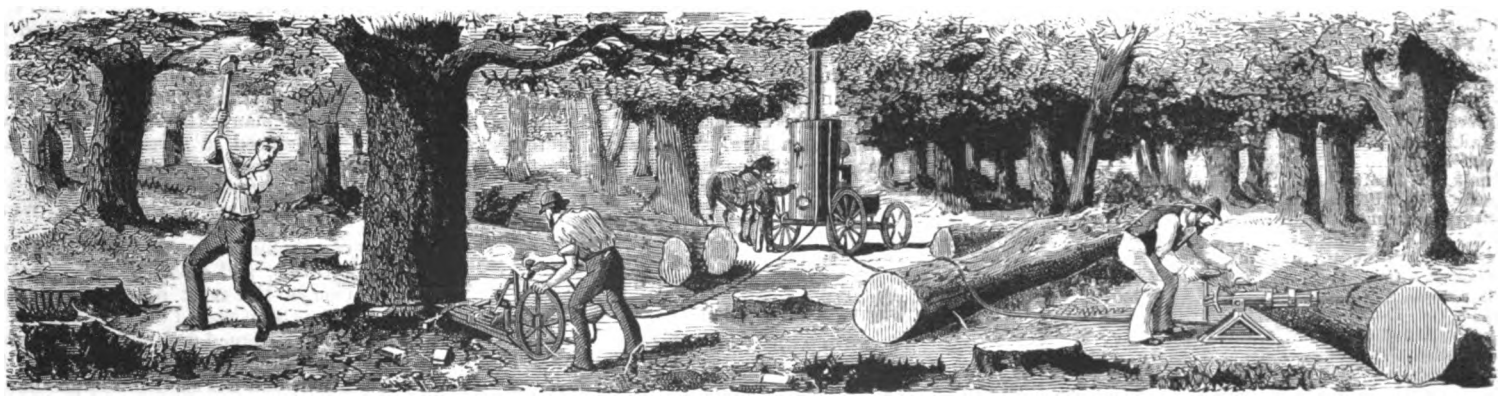


FIG. 1.—GENERAL VIEW OF MACHINES AT WORK.

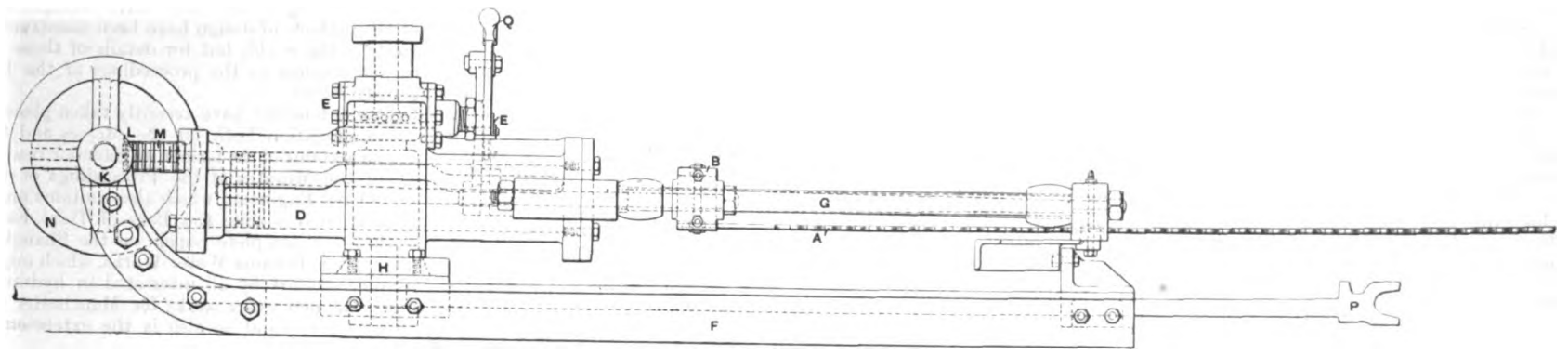


FIG. 2.—SIDE ELEVATION OF TREE FELLING MACHINE.

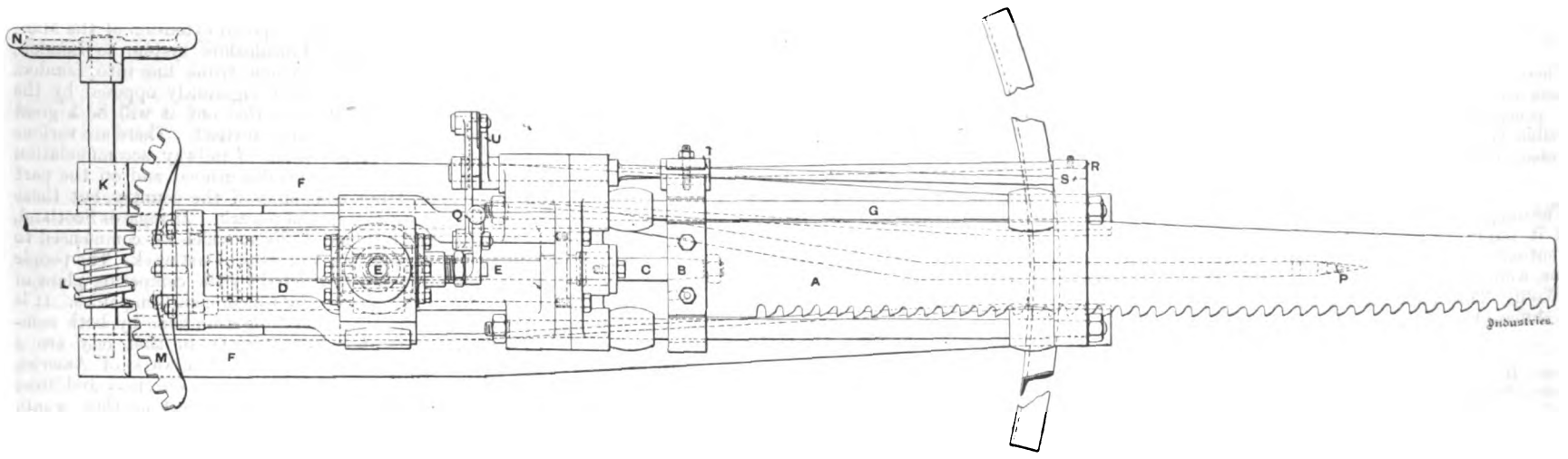


FIG. 3.—PLAN.

THE PROGRESS OF THE MANCHESTER SHIP CANAL IN 1890.

CONSIDERABLE progress has been made in the entire length of this great undertaking during the past twelve months, and but for two unfortunate accidents the works would have been still further advanced. Owing to the very heavy rainfall at the end of September, the River Mersey rose so rapidly as to overflow its banks and wash down the barriers at the end of the cutting near the Barton Aqueduct, thus flooding a long length of the canal. Arrangements were made for retaining the water in the portions of the canal which were finished and pumping out the remainder. Scarcely had these works been completed, when, on the 7th of November, a more serious disaster occurred from the same cause, and the whole length of the canal from Manchester to Warrington was flooded. Fears were entertained on the day previous to the accident that such a disaster might happen, the Mersey waters having risen so rapidly and to such an abnormal height; and at midnight the bank burst and the water rushed with tremendous fury along the cutting of the canal, washing away temporary bridges, culverts, and submerging every description of plant. In a very short space of time there was an average depth of water in the canal of about 25ft. Owing to the timely warning there was fortunately only one life lost—that of the driver of a locomotive, who could not escape in time—but there were some almost miraculous escapes.

The number of men and boys now engaged upon the works is nearly 17,000, and with this manual labour, in addition to the enormous amount of machinery and plant, it is no wonder that the work has progressed so rapidly. The works at Eastham are far advanced, the gates for the series of locks are made, and many of them are fixed in position. The large pumping station for supplying hydraulic power is nearly completed, and the well-boring, for obtaining the water for the pumps, is proceeding satisfactorily, the bricked portion of the shaft having reached the full depth of 60ft. The lock walls are nearly completed, and a good idea of the great capacity of the lock can now be formed. The cutting at Pool Hall is proceeding rapidly, but has received a slight check on account of the percolation of the water through the sandstone into the workings. The piling at Ellesmere Port and the formation of the bank is progressing slowly, but this work is very heavy. The banks along Frodsham shore have been slightly damaged by the storms, but are now being repaired. The works opposite Runcorn, which had been almost at a standstill for some time, are now actively in progress, and the piling for the river wall is far advanced. The inner rubble bank across the Weaver to the sluices has been tipped almost to the masonry of the sluices, the space between being filled with clay. The piling of the jetty from the Frodsham side to the sluice gantry has been commenced, and, when completed, will form a continuous path across the Weaver at any state of the tide. The lock entrance at Runcorn Old Quay is proceeding slowly. At Acton Grange the bridge stone piers are gradually rising, and the swing bridge at Moore Lane is approaching completion. At Latchford great progress has been made, and this is one of the most interesting sections on the canal, on account of the diversions of the railways, and locks. The Grappenhall Road Bridge is completed, and the others near are well advanced, the Cross Lane

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IMPROVED FORESTRY MACHINERY.

CONSTRUCTED BY MESSRS. ARBEY & FILS, MACHINISTS, PARIS.

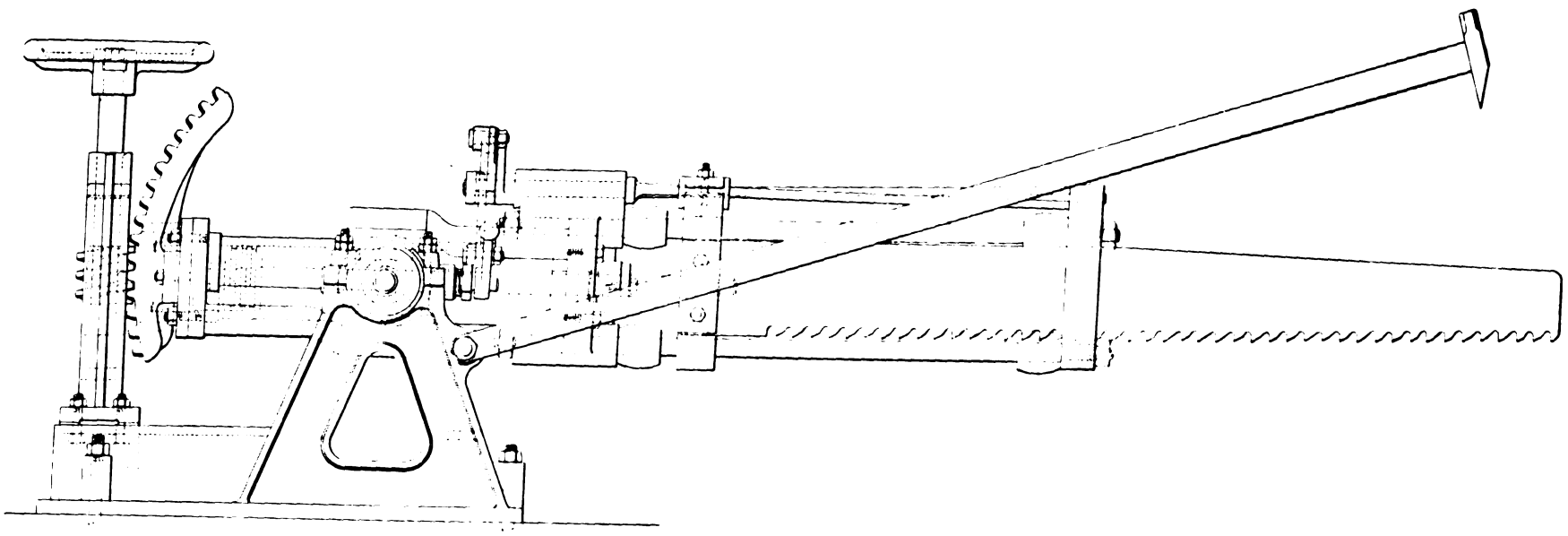


FIG. 4.—SIDE ELEVATION OF LOG CUTTING MACHINE.

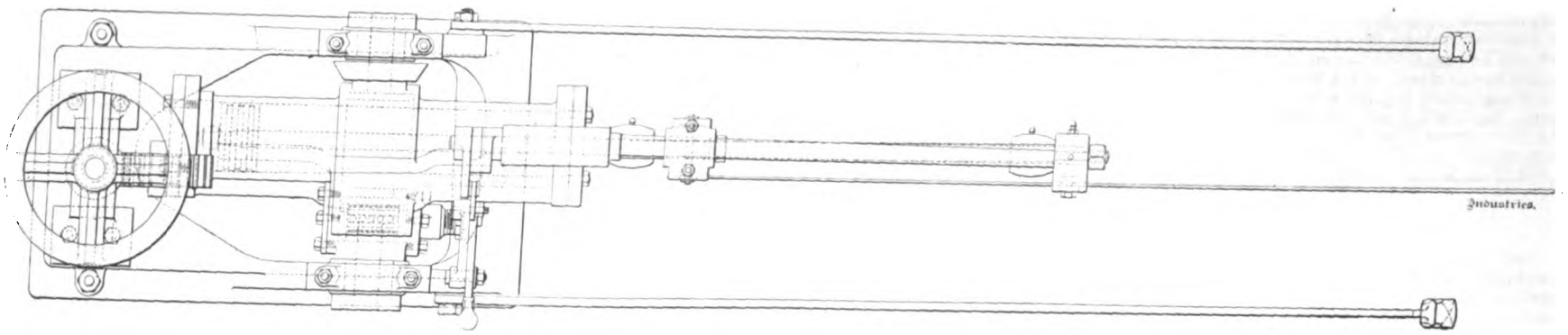


FIG. 5.—PLAN.

Bridge piers—the heaviest piece of brickwork on the canal—being up to their full height. The Irwell Park cutting is excavated to its full depth, and has been a laborious piece of work. The old locks and weir at Irwell are now demolished, and steam navvies are excavating the bottom of the canal eastwards. The arches of the viaduct at Irlam are nearly completed, as also is the girder bridge over the river. The Mode Wheel Locks are far advanced, and the masonry for the sluice piers is well in hand. The piling in the river for the Stretford jetty is well advanced, a third row of piles having been commenced. The pier for the free end of the swing bridge at Old Trafford is being completed, and is now up to the fender course. An American steam navvy is clearing away the face of it, and shortly the proportions of this massive concrete wall will be seen. The walls of the various docks at Pomona and Salford are near completion, and granite steps are being fixed at convenient places. The work throughout is in a very forward state, and great credit is due to the engineer and his staff, who, while working harmoniously with the contractor and his staff, have made such great progress since the work began in the face of so many obstacles.

As regards the financial condition of the scheme, the following statements, made by Sir Joseph C. Lee, the deputy chairman, may be of interest:—He stated that in 1885 the capital of the company was £10,000,000; in 1886, upon a reduction of the borrowing powers, it was £9,812,000; £1,700,000 was paid for the Bridgewater Canal; £5,570,000 for construction; £750,000 for land; interest on shares, £750,000, making a total of £7,250,000, leaving £852,000. After deducting for more land purchase, Parliamentary expenses for the 1885 Act, £450,000 remained for general working. They had to receive of the capital granted by the 1885 Act £2,952,487, and with the borrowing powers of the 1890 Act £600,000, making a total of £3,532,487. Assuming the profits of the Bridgewater Canal to be £300,000, the amount is raised to £3,832,487, and as £704,030 of this amount is already spent, the amount left to complete the canal is £3,128,457.

IMPROVED FORESTRY MACHINERY.

On the previous page and above we illustrate two machines made by Messrs. Arbey & Fils, Paris, for forestry work. One machine is for sawing down trees, and the other for cutting up logs from the felled trees. In Figs. 2 and 3, which represent the former machine, the saw A is attached to the cross-head B, which slides on the bars G. The cross-head is fixed to the end of the piston rod C of a steam cylinder D, and the motion of the piston in the cylinder produces the vibratory motion of the saw. The cylinder is pivoted at H to the frame F, which carries the whole machine. At the end K of the frame F a worm L works a segment M attached to the cylinder, and thus enables the feed to be given to the saw by means of the hand-wheel N. A claw P attached to the frame is inserted in the tree, and the pull of the saw draws it in more tightly. The end of the saw rests upon a piece of wood until it has got fairly started, and when it is half way through the tree wedges are inserted so as to take off the weight. The alternating motion of the piston is produced in an ingenious manner. The steam is admitted to the cylinder through the circular valve E, which is controlled by the lever Q. A twisted bar R of rectangular section is capable of oscillating, in the bearings S, about an axis parallel to its length. The cross-head B is prolonged, and carries brasses T which compel it to turn about its axis and thus oscillate the lever U. This lever is connected by a link with the lever Q which controls the valve. The action of the log sawing machine, shown in Figs. 4 and 5, is practically the same as that just described, except that the saw works in a vertical instead of a horizontal plane—the steam cylinder being supported upon trunnions. Fig. 1 gives a general view of the two machines at work in the forest. The steam is supplied by a vertical boiler on wheels. The steam is conveyed from the boiler by a strong indiarubber pipe capable of standing a pressure of seven atmospheres. 4 h.p. is required to drive this form of saw.

THE STEEL INDUSTRY IN THE UNITED STATES.

Of all the industries in the United States few, if any, show such rapid development as that connected with the manufacture of steel. From a preliminary report on the subject, which was recently issued by the United States Census Office, we learn that the total production of steel in the United States in the form of ingots or direct castings, during the year ending June 30, 1890, amounted to 4,466,926 tons of 2,000lb., as compared with 1,145,711 tons produced during the year ending May 31, 1880, being an increase of about 290 per cent. A few steel works produce blister, cemented, and other miscellaneous steel, but the quantity is small, and may for our present purpose be neglected. The following figures represent the production of the different kinds of ingots for the year ending June 30, 1890, in tons of 2,000lb.:—

Bessemer steel	3,788,572
Open-hearth steel.....	504,351
Crucible steel	85,536
Clapp-Griffiths steel	83,963
Robert-Bessemer steel.....	4,504
Total	4,466,926

About one-half of the total production—namely, 2,036,654 tons—was in the shape of Bessemer steel rails, although the requirements of other departments of industry have been the cause of the increase of the number of steel-producing establishments during the past ten years, as all those existing in 1880 had been designed for the production of steel rails. The great increase in this production has practically led to the discontinuance of the manufacture of iron rails. Although basic steel was produced experimentally in Pennsylvania in 1884, it is only from March, 1888, that its manufacture as a commercial product dates, and since that time it has made considerable progress.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 6th January, 1891.

Iron.—The downward movement which has characterised the iron market of the capital for some weeks past continues, and, if we may judge from the weak tone now prevailing, is likely to bring prices down to the lowest level of last autumn. Bars are now quoted at 128s., and may be bought for 126s. Joists hold their position more firmly; but, though officially quoted at 136s., the actual price is not above 134s. As a matter of fact joists are but little inquired for. The Grenelle works, finding the market for joists insufficient to absorb their production, are about to commence the manufacture of bars. Old rails are offered at 70s. to 72s. Some of the reports from the provincial markets are discouraging. In the Ardennes business is very languid and prices are giving way. The calm in the Nord continues. The market is somewhat languid in the Haute-Marne. In the Meurthe-et-Moselle the situation is unchanged.

Coal.—An important measure is reported from the north with reference to the coal trade. In view of the depressed state of the iron trade, consequent on the difficulties in which manufacturers find themselves as a result, in large part, of the high price of fuel, the colliery owners of the Nord and the Pas-de-Calais have resolved to reduce their price for coal for metallurgical purposes, while firmly maintaining those of other sorts. This laudable act of self-sacrifice will excite admiration when it is remembered that there are no stocks of coal anywhere, and that the present demand is sufficient to absorb the whole of the output of the collieries. The Longwy group of blast-furnace owners have already purchased large quantities of coke in the Nord in consequence of this concession. The market for household coal is very animated.

Metals.—The general tendency of the metal market is unfavourable. Speculation is at a standstill, and the current of genuine business is weak. Nothing is bought that is not required for immediate consumption. Copper is quoted at last week's rates, but the tone of the market is depressed. Tin is unchanged in price, and the market is without animation. Lead, which was stronger a fortnight ago, has lost the little vigour which then made itself apparent. Spelter is quoted at last week's prices, but hardly any business is being done in that metal. Lower prices are probable.

BERLIN, 5th January, 1891.

Iron.—It is yet too early to expect a renewal of business in the iron market. During the last week manufacturers and consumers have alike been occupied in stock-taking, and for many that task yet remains unaccomplished. Still the market opened to-day with a show of life. The amount of business being done is small; but inquiries are numerous and the tone of affairs good. According to a report from Breslau there are good grounds for expecting a speedy return to activity in that district—not the activity of last year, perhaps, which was exceptional, but a moderately strong current of business sufficient to keep matters in their present position, even if no advance in prices become possible. Similar accounts have been received from the Rhenish-Westphalian districts. Altogether the outlook is encouraging. A heavy blow has been dealt at the syndicate system by which the German iron trade is now controlled by the decision of the Prussian Railway Minister to accept the lowest tenders for steel rails, no matter whether from German or from foreign firms. Recently an English firm tendered 15s. a ton lower than the German firms, duty paid. This decision has caused consternation among the German houses. The financial papers here have, however, greatly exaggerated the probable consequences of this measure in overthrowing the "iron ring." The total imports of foreign pig iron in the eleven months ending with November amounted to 370,578 tons, against 292,734 tons in the corresponding period of last year, the exports of German pig for the same periods being 110,188 tons, against 147,155 tons. German wire was exported to the amount of 120,686 tons in 1890, against 146,195 tons in 1889, wire nails figuring as 36,815 tons against 42,724 tons. There has been a heavy falling off in the export trade in bars.

Metals.—The metal market remains inactive. For several weeks past consumers have refrained from exceeding the bare necessities of the moment in their purchases of metal, and there are no indications of a desire to operate more largely. The new year begins with drooping prices. Copper has lost a little in the last week, and tin has receded several points. Lead shows a downward tendency, and spelter is decidedly weak. The spelter market is languid, and seems likely to be further depressed. Antimony regulus is offered several marks a ton lower.

VIENNA, 5th January, 1891.

The International Electricity Company.—This company has been commissioned by the Ministry of Finance to carry out an installation of electric lighting and of a separate plant for the electrical transmission of power for the purpose of working printing machines for the Government printing office at Rennweg. In both cases the transmission of the power will be effected by means of this company's cable system.—On the 31st ult. the electrical plant of the International Electricity Company in Fiume was set at work. With reference to the erection of this plant, the company lately entered into negotiations with the authorities of Fiume, who, however, refused to grant a concession for the erection of a central station by reason of a protest made by the gas company of Fiume. A suitable site was, however, granted to the company for the recent installation carried out on behalf of the Hungarian Government, and the plant, by means of which the railway station in Fiume is electrically lighted, and power transmitted for the working of the lifts of the Hungarian State Railway, will become enlarged into an important central station for these purposes on Government land. The International Electricity Company will also carry out the electrical lighting of the festival room in the School of Arts on the occasion of the artists' festival and exhibition which is held in connection with it, at the approaching carnival.

BRUSSELS, 6th January, 1891.

Iron.—It would be too much to say that the iron trade has improved in the course of the last week; but there are brighter spots on the horizon—at least, in so far as the home market is concerned. The demand remains feeble, but some important orders are in sight, which serve to raise the hopes of the manufacturers. These orders are chiefly for railway material. The export trade continues languid. Prices are irregular, but, on export account, generally lower. At present rates business is unremunerative. On much that is being done losses will be incurred by the manufacturers, who accept fresh orders at these depressed rates merely to keep their works going. There is but little doing in the pig iron market. Several blast furnaces were blown out at the end of the year 1890. The outlook in this direction is discouraging.

New Line of Steamers.—A new line of steamers, to run between the port of Antwerp and Eastern Asia, is projected, and is likely to become an accomplished fact within a short space of time. The necessary capital has, it is said, been in greater part already subscribed. This new competitor with the German Lloyd cannot fail to have an important influence on European trade. The project has made quite a stir in Germany. English commerce will doubtless be in a considerable degree affected by this new means of communication with a part of the world that is becoming an important outlet for the produce of European factories.

DÜSSELDORF, 6th January, 1891.

Iron.—The pig iron market, long in a languid state, is beginning to revive. We are yet too near to the holiday season to expect active business, and nothing like activity exists. But the demand has increased. Forge pig, which has been utterly neglected for some time past, is now much inquired for. Spiegel, too, is in stronger demand. For other sorts the market remains quiet. Prices are unaltered, and the tone of affairs is strong. There is not much change to note in the market for finished iron and steel, but there are indications of returning life. Joists are in fairly good and apparently increasing demand. There is also a steady, if not strong, current of business in plates. There is not much doing in bars. Some manufacturers have booked a considerable amount of fresh orders within the last three or four weeks, but others complain of an almost total absence of fresh business. The export trade in bars continues slack. The quantity exported in the first eleven months of the current year amounted to 128,722 tons, against 155,252 tons in the corresponding period of 1889. The market is quiet for hoops. Diminished activity is now reported from the foundries. The prospect for the iron manufacturers has been somewhat disturbed by the decision of the Railway Minister to accept henceforward the lowest tender for rails, whether made by German or foreign firms. This decision, which is regarded as a blow aimed at the syndicate system, will cause sharp competition on the part of the English houses which are in the habit of tendering for the rail contracts. At the present rates the German manufacturers are likely to be underbid by from 10s. to 15s. a ton.

Coal.—The continued frost has further increased what was already exceptional activity in the coal market. Production is being pushed to the utmost allowed by the carrying capacity of the railways. The lack of a sufficiency of coal trucks is still a serious hindrance. Figures have been published this week to show that the loss of trade in the last five or six weeks due to this cause exceeds that of the great strike in May of 1889. Prices are very firm, with an upward tendency in some sorts. Coal consumers are beginning to complain of the high prices which have been arrived at by combinations among the manufacturers. The Bavarian Government, with a view, it is said, of breaking up the "coal ring" or syndicate system recently extended to the whole of the Westphalian district, is getting coal from Bohemia, whence it is obtained much cheaper than from this locality.

AMSTERDAM, 5th January, 1891.

The Weather and Navigation.—The stoppage of all navigation for some considerable period upon the North Sea Canal, owing to the stress of the weather, has caused much inconvenience to the trade and serious losses to traders. Their complaints about what they consider laches upon the part of the Government, by reason of its declining to keep open the waterway at all times and seasons, have found vent in an address to the Burgomaster, signed by all the leading merchants and shippers of Amsterdam. In consequence of these remonstrances the Burgomaster has called a meeting of the principal firms, to debate and decide upon measures to prevent in the future a recurrence of the total closing of the water traffic which was witnessed at the end of last year.

The Railways and the Public.—The acquisition of the Dutch-Rhenish Railway by the State, and the reorganisation of the entire service between the leading companies, have led to much confusion and vexatious delays in various directions. Railway unpunctuality has become a standing scandal. Goods trains are either not despatched at all, or despatched in a way which would not be tolerated even if a strike were in progress. As for passenger trains, they arrive anyhow, which is shown by a striking table published daily by some newspapers, stating the times at which the trains ought to arrive, and the periods at which they make their appearance, as noted down by special reporters. In consequence of this state of affairs a strongly worded address has been sent to the Minister for the Means of Communication by the Chamber of Commerce at Rotterdam, in which the latter asks the pertinent question of what good it is that Rotterdam can be approached at all times by ocean vessels, even in the coldest winter, if goods arrived in them cannot be carried by the railway companies to their destination. The Chamber quotes numerous instances of serious delay, and points to a well-accredited rumour that the managers of the Holland Railway and the State railways had agreed to request the German Railway Department to stop all goods traffic to Holland—a truly humiliating avowal of their incapacity. The Chamber opines that the two named companies are not sufficiently equipped to cope with the increased volume of business as imposed upon them by the new railway law.

The Telephone.—The Dutch Government has declared in the States-General that a Bill for the better regulation of the telephone service is still under consideration. It is in no hurry to present it, because of an evident tendency abroad to make telephones a government monopoly. The Dutch Ministry considers it a wise plan to await further developments before attempting any legislation.

The New Waterway at Rotterdam.—Mr. Dirkzwager has just issued the seventeenth annual edition of his useful, and (to navigators and traders alike) indispensable, English "Guide to the New Waterway, Maassluis, and the Hoek van Holland for 1891." This book contains all necessary information about pilotage, tuggage, dues of various descriptions, and the maximum depths in the navigable channel. From a table of such depths, also indicated upon a special map—one of five excellent and clear charts added to the book—it appears that the draught in the navigable channel, which was only 43 decimetres in 1875, had increased to 50 decimetres in 1881, to 70 decimetres in 1884, to 81 decimetres in 1886, to 88 decimetres in 1889, and to 93 decimetres in 1890, all at high water. Thus the navigable channel has more than doubled its depth since 1875, and the largest ocean steamers can now comfortably approach Rotterdam. Mr. Dirkzwager also shows that Rotterdam for English traders is the nearest, easiest, and cheapest Continental port of any dimension—a fact worth knowing and stating.

Railways.—The Holland Railway Company has commenced a night service for merchandise, for the first time in its history. This is owing to an enormous increase of business.

STOCKHOLM, 3rd January, 1891.

Nickel Mining.—At Ruda a nickel mine has recently been started. As far back as fifty years ago experimental blastings went on in that locality, but no practical results were obtained at the time. The same man has now, however, half a century afterwards, succeeded in forming a company to start the working, and the affair now looks promising. The mine has been sunk to a depth of about 100ft., and a good-sized lot has already been sent to England. Considerable quantities of ore have been found, containing 8 to 10 per cent. nickel, with some intermixture of iron, copper, and other metals.

The Swedish Norwegian Railway Company.—The negotiations between the Swedish Government and the company are still progressing The Government has not accepted the offer of the debenture-holders in its original shape, but has submitted another proposal on nearly the same lines. There can be no reasonable doubt as to the definite result, as the company is virtually at the mercy of the Swedish Government.

The Large Industrial Exhibition at Stockholm in 1893.—This Exhibition is already attracting much attention, and will no doubt prove a very interesting and important affair. A large number of industrial concerns and corporations have given expression to their great interest in the matter, which will probably be proceeded with at an earlier date than was at first contemplated.

Further Purchases of Private Telephone Companies by the State.—The State Telegraph Department has again made an important purchase of a private telephone concern, viz., the large Haglind telephone installation, which embraces forty central stations in the provinces of Ostergötland, Smaland, and Nerike, and has about five hundred subscribers. The State takes over the thing as it stands, keeps on the old staff, and enters into the same

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obligations as the vendors had. The installation will probably be brought into connection with the large telephonic system of the State telephones, and the State will probably also purchase one or two other private telephone concerns which have been in connection with that of Messrs. Haglind Bros.

Bogie Carriages.—This American type of railway carriages is finding favour in Sweden, and the Stockholm-Vosteros Railway has just ordered six of them.

CHRISTIANIA, 3rd January, 1891.

Sealing and Other Industries.—A number of statistics have already been compiled with reference to various industries in the past year. With regard to sealing, the following particulars may be of interest:—From Tönsberg were despatched eleven steamers, with an aggregate tonnage of 2,748 tons; they brought back altogether 25,876 skins of seals, 5,630 barrels of seal blubber, 353 bottlenoses, 3,700 barrels bottlenose blubber, 24 bears, and 3 walrus; from Moss, one steamer brought back 650 skins of seal, 130 barrels of seal blubber, and 15 bears; from Sandefjord, nine steamers, with a yield of 7,766 skins of seal, 1,455 barrels of seal blubber, 517 bottlenoses, 5,725 barrels bottlenose blubber, and 3 bears; from Arendal, three steamers, with a yield of 14,601 skins of seal, 3,300 barrels of seal blubber, 7 bottlenoses, 100 barrels bottlenose blubber, and 7 bears; from Tromsö, one steamer, with a yield of 841 skins of seal, 196 barrels of seal blubber, and 50 walrus. There were consequently altogether twenty-five steamers engaged in this trade, with a tonnage of 6,342 tons, and hands numbering 1,118 men. The total yield of this industry was consequently about 49,734 skins of seal, 10,705 barrels of seal blubber, 49 bears, 1 norwhale, 53 walrus, 878 bottlenoses, and 9,535 barrels bottlenose blubber. The financial result in this branch of last year's trade cannot be looked upon as satisfactory.

COPENHAGEN, 3rd January, 1891.

The Copenhagen Fire Brigade.—The fire brigade of Copenhagen is about to be considerably enlarged, and its rearrangement has necessitated the acquisition of new plant. A large new central station is in course of erection, and there will also be sufficient accommodation for practice and drill. This station is not expected to be ready till the spring of 1892. The old organisation suffered from various defects, one of them being the fact that none of the officers resided at the stations, so that the first work always had to be done by non-commissioned officers. The basis for the new arrangement is that every point in the town should be reached in ten minutes at the latest from the discovery of the fire, and that a complete extinguishing train should then arrive. The maximum of ten minutes would be used in the following manner:—Three or four for the bringing of the alarm, two for its transmission and for getting ready, and four for reaching the place of fire, calculated at a speed of 800ft. per minute, or rather more than eight miles an hour. According to this arrangement every station is to be the centre of a district with 3,200ft. radius. On the new drill ground will be erected a tower 100ft. high. The force of the fire brigade will, according to the new arrangement, consist of seven officers, twenty-four non-commissioned officers, four machinists, and 160 men, comprising three buglers and twenty-five drivers. The plant will comprise four good-sized steamers with tenders, ten station fire engines (in the meantime, for hand-power), five fire escapes, two carriages, and thirty-four horses.

The Danish Chicory Manufactories.—Amalgamation and co-operation are the order of the day in many Danish industries. The movement has now extended to the manufactories of chicory, delegates from which recently held a meeting in order to bring about some arrangement. Of late years the production has been too great, and an excessive competition has forced the prices down so as not to leave a reasonable profit. It has now been decided to reduce the output and raise the prices. The Eiley manufactory will be discontinued, and will receive compensation. It will be henceforward used only for drying purposes. Only one manufactory, the "Norrejylland," remains outside the arrangement.

MADRID, 5th January, 1891.

Electric Light in Madrid.—The palace of Las Cortes is to be electrically lighted by means of a separate installation, but the lighting of the House of the Senate will be supplied by one of the central stations. Every day some fresh establishments are adopting the use of incandescent lamps, while others which adopted the system a month ago have gone back to the use of gas. This action on the part of customers appears to be justified, as the companies are charging the excessive price of 1s. 3d. per unit, and make their customers pay double or treble the fair price for the fittings. This will probably cause the adoption of small installations with 500 to 1,000 lamps, which will be of a suitable size for the lighting of the blocks of buildings let out in flats.

Improvements of the Harbour at Bilbao.—The corporation, which is entrusted with the improvement works, has issued an important report. Most of the works at the inner port have been completed, and attention can now be devoted almost entirely to the outer port or entrance of the Nervion. The works which have been commenced were contracted for at the sum of £818,000. Up to the date of the report, the 30th June, 1890, the contractors had done little more than organise the work, but rapid progress will now be made. The contractors are two French firms, Messrs. Couvrieux Fils and M. Félix Allard, and the committee and engineers seem perfectly satisfied with the manner in which the work is being carried out. The total receipts of the corporation during the year were about £125,000, and the funds in hand were about £40,000. As eight or nine years will be required for the completion of the works the revenue is quite sufficient for the payment of all expenses, and it will be easy to raise any further amount which may be required, as the credit of the corporation is very good.

Import Duties on Grain, Meat, and Live Animals.—By a Royal decree of the 26th ult. the duties on grain, flour, rice, salted meat, lard, and bacon have been considerably increased, a course for which the Government was authorised by law. The new duties are of a strongly protective character, and were put in force three days after the publication of the decree, those articles alone being excepted which left the port of shipment before the 27th ult. The decree affects the general law according to which reductions were to be made at fixed periods, and all import duties were to be on the basis of a 15 per cent. maximum. While the existing treaties are in force, no alteration can be made, but a commission has been appointed to consider a definitive tariff which is to be adopted on the expiry of all engagements in 1892. The principal articles on which the increase is already in force are—

		Pesetas.	Pesetas.
Cattle—per head,	previous duty	13·80,	now 40
Pigs	" "	8·45 "	40
Salt beef	per 100 kilos, "	2·80 "	11·60
Pork, lard, and bacon	" "	15 "	50
All other meat	" "	5·70 "	18
Wheat	" "	5·70 "	8
Flour	" "	8·25 "	13·20
Other grain	" "	3·10 "	4·40

Should this Government exist until the date of the total revision of the duties, it is to be feared that trade in general will be much inconvenienced.

Sugar Factories.—The erection of factories for the extraction of sugar from beetroot seems to be making progress in Spain. The establishment of a factory at Aranjuez is announced, and there is said to be room for a dozen more factories in this country.

NEW YORK, 27th December, 1890.

The Coal Trade.—The demand for anthracite has increased in consequence of the colder weather, and the retailers are doing a good business. Steam sizes are in demand and scarce. Prices are not very well maintained. There is considerable interest in the next meeting of the representatives of the trade, as it is expected that they will allot for the month of January not less than 3,000,000 tons, on the expectation that there will be a large increase in tonnage during the coming year.

The Tinplate Industry.—The preparation for the manufacture of tinplate in this country is progressing rapidly, and the first of the year will see several large plants in process of construction. The latest is being erected at Cleveland, Ohio. Mr. Britton, of the Britton Iron and Steel Company, of that city, having disposed of his interest in that concern, has purchased a tract of eleven acres of land on the Lake Shore and Michigan Southern Railway, running 1,000ft. north of Lake Erie. They have already under cover a building 160ft. by 130ft., in which there is a plate and sheet mill, which will be in operation by the 1st January, 1891, and are preparing to erect other buildings in which the mills will be used for the production of galvanised sheet and tinplate. It is expected that the mills will be able to put tinplates on the market by the 1st of July. Mills have also been projected and contracts signed for the machinery and equipments for tinned plate mills for St. Louis, Chicago, and Demier and Apollo, Pa., and plans and estimates are being considered for several concerns situated near the iron centres.

Nickel Steel.—The first attempt to produce nickel steel was made recently at the Homestead Steel Works, near Pittsburgh. The experiment was made with a five-ton "heat" in a Bessemer converter. Part of this steel was rolled into ¾in. plates, from which specimens were tested. In two samples the elastic limit was 59,000lb. and 60,000lb., and the breaking resistance 100,000lb. and 102,000lb. The elongation was 15¼ per cent. in each specimen, and the reduction in area 29¼ and 26½ per cent. The steel contained 3·16 per cent. of nickel. Within the next ninety days this firm expects to deliver to the Navy Department their first armour plates, of which some will be all steel and the rest nickel steel.

A Large Failure.—The Lorillard Brick Works Company, of New York and Keyport, N.J., has been placed in the hands of a receiver. The company had in its possession about $200,000 of real estate and builders' paper, and was short of ready cash. Their works at Keyport are said to be the most complete in the United States. Their property include 270 acres of clay-bearing land and buildings covering eight acres fully equipped with labour-saving machinery. The liabilities of the company will amount to upwards of a million dollars, but the assets are enough to fully meet all the debts and leave a considerable balance.

Failure of a Steel Firm.—A receiver has been appointed for the Henderson Steel Company, of Birmingham, Ala. The liabilities are $23,000, while the assets are appraised at $85,000. The company lost $12,000 by the recent failure of the Bessemer Rolling Mill Company, as the latter company had contracted for the entire output of the steel company for twelve months. The Henderson Company had after much experimenting succeeded in making steel from the phosphorus-bearing ores of the district by a new basic process, and were about to increase their plant and put up a rail mill, when the receiver was appointed.

PHILADELPHIA, 26th December, 1890.

Railroad Contest.—A sharp fight is looked for between the Pennsylvania Railroad and the Baltimore and Ohio and the Western Maryland Railroads, concerning the extension of the last-named road to connect with the Baltimore and Ohio at Cherry Run. The Pennsylvania has secured a charter to construct a road from Shippensburg, on the Cumberland Valley road, to a point on the Bedford division of the Pennsylvania near Mount Dallas. This road will be sixty miles long, and has a capital stock of $2,500,000. By the alliance of the Baltimore and Ohio, Reading, and Western Maryland roads, the Reading Company obtains a western outlet, and is nearer the bituminous fields. The Pennsylvania hopes to neutralise the benefit derived from this alliance by securing to itself the traffic of the coal regions, as it now delivers most of its soft coal traffic into the hands of the Reading Railroad, thus enabling the latter company to make large profits out of Pennsylvania tonnage.

The Issue of Patents.—The Attorney-General has given an opinion which will have an important effect on the issue of patents. The practice of inventors has been to indefinitely postpone the taking out of letters patent by neglecting to pay the final fees within the required six months, and then, before the expiration of the two years allowed by law, to apply to have the application renewed. This process in some cases has been repeated for many years, thus materially extending the life of the patent beyond the seventeen years specified in the statutes. The Attorney-General holds that a patent cannot be allowed on an application for renewal if such application is not filed within two years after the allowance of the original application.

Forts and Great Guns.—The Fortification Appropriation Bill for the next fiscal year will carry an aggregate appropriation of $4,498,803, or $3,005,520 less than the estimates. The principal items are—Torpedoes for harbour defence, $216,000; gun and mortar batteries, $1,000,000, for the defence of Boston, New York, San Francisco, Hampton Roads, and Washington; sites for fortifications, $500,000; armament for fortifications, $1,790,460, of which $1,000,000 is for forgings for the Waterwhet Gun Factory; for completing buildings and plant at the gun factory, $750,343; and for tests and experiments, $100,000. The total capacity of the gun factory when completed will be twelve 8in., fourteen 10in., and twenty 12in. guns per year.

Naval Vessels.—The "Newark" went out again on the 20th inst. for its trial under Government auspices. Two attempts had already been made, but the breaking of a pin in the valve gear has on both occasions postponed the trial. Tenders were opened on the 20th inst. at the Navy Department for the construction of a harbour defence ram, and the torpedo boat "Number Two," similar to the "Cushing."

Rapid Transit.—As the time for election of members of city councils draws near there is considerable activity about the question of rapid transit. The Reading Railroad has for a long time been trying to obtain permission to carry its lines into the centre of the city, and under the pressure of the next election an ordinance has been passed to permit the proposed road. Better facilities are essential if the Reading Railroad proposes to occupy a first place in the scheme of rapid transit, and it serves a very large territory, which in a few years would become thickly settled if proper transportation facilities were provided. During the construction of the terminal and other stations there is not likely to be very much paid to holders of its non-obligatory securities, as large sums will be required to carry on the work of construction. The Belt Line Road is also likely to become a reality, as the ordinance has been passed by councils and is now in the Mayor's hands. This will give excellent facilities for reaching the wharves from any of the roads now entering the city, and will add largely to the rapidity with which freight in transit can be handled. The great need of rapid transit in reaching the residential portions of the city is likely to be met in a very short time by the construction of an elevated road from Market Street Ferry on the Delaware River westward to the county line, with branches running north and south. The formation of a committee of fifty of the most prominent citizens to oppose the re-election of those members of councils who are against rapid transit has had much to do with the probable satisfactory outcome of the question.

General Strike Threatened.—A general strike of the switchmen, firemen, and trainmen in the neighbourhood of Pittsburgh is threatened. A demand has been made for a reduction in hours from twelve to eight hours a day and an advance in wages of 15 per cent. The officials of the Pennsylvania, Baltimore, and Ohio and Lake Erie lines are considering the demands, but no answer has yet been made.

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THE "UNIVERSAL" EMERY GRINDING MACHINE.

CONSTRUCTED BY THE BROWN & SHARPE MANUFACTURING COMPANY, PROVIDENCE, RHODE ISLAND, U.S.A.

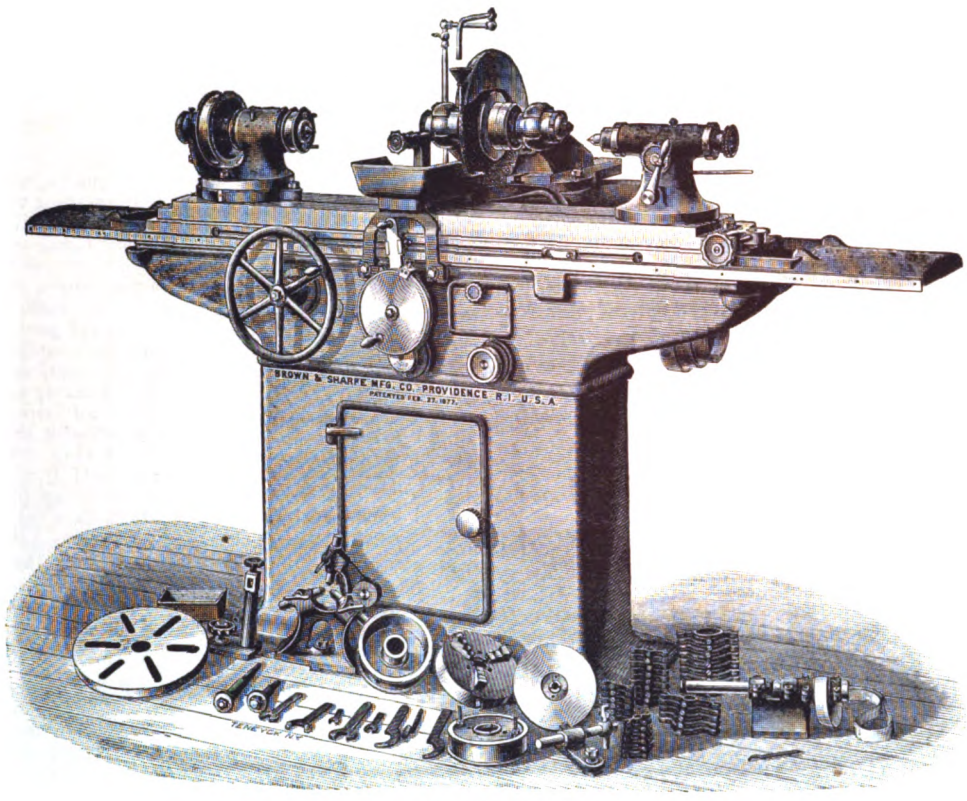


FIG. 1.—FRONT VIEW.

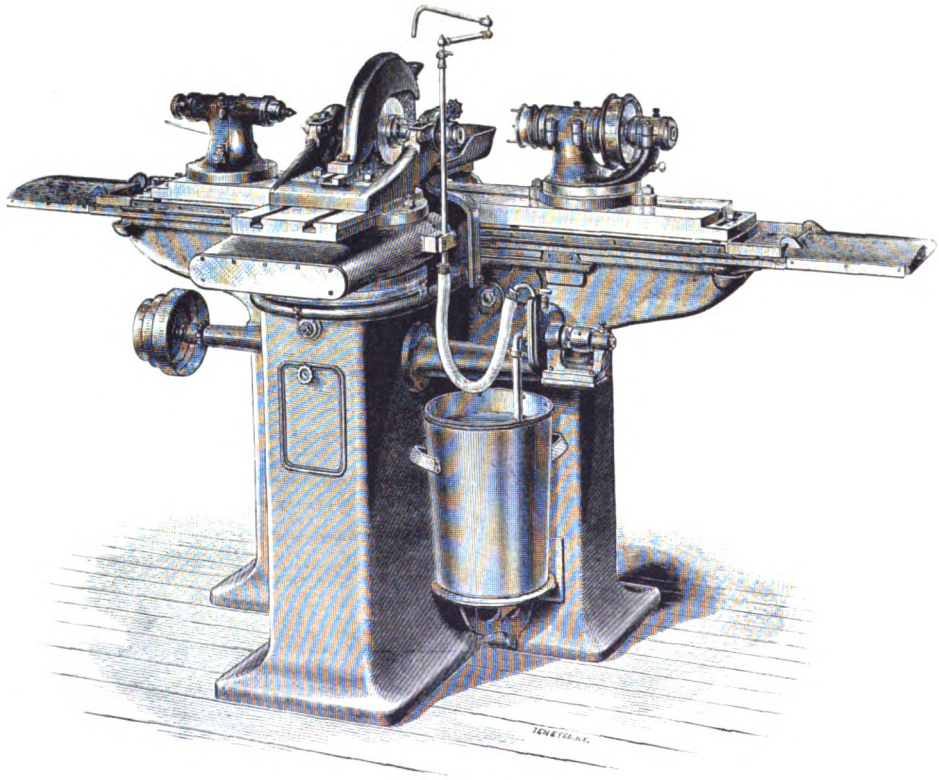


FIG. 2.—REAR VIEW.

THE "UNIVERSAL" EMERY GRINDING MACHINE.

THE above engravings, Figs. 1 and 2, represent a front and rear view respectively of a very useful emery grinding machine, capable of treating both parallel and taper, and external and internal surfaces. The accuracy and uniformity of the work produced are rarely approached by this class of machinery. It is made by the Brown & Sharpe Manufacturing Company, of Providence, Rhode Island, U.S.A., whose reputation on both sides of the Atlantic is a sufficient guarantee for the excellence of their workmanship. The machine which we illustrate is extremely rigid, and has large bearing surfaces, improved reversing mechanism, and a transverse feed capable of delicate adjustment. The feed gearing is enclosed in the bed, and dust caps protect the spindle bearings of the head and foot stocks and wheel carriage from particles of dust. In order to allow the grinding of taper bodies without throwing the head and foot stock spindles out of line, a swivel table with automatic and hand-feed mechanism is provided, which turns on a centre pin on the sliding table, while a graduated scale shows at a glance the amount of taper imparted to the body in degrees and inches per foot. The foot-stock spindle is adjustable by means of a lever, and a spring is provided to allow for expansion through heat produced by friction of articles being ground. The machine illustrated will accommodate between the centres work 12in. diameter and 30in. long, and is provided complete with all the necessary tools and overhead gear.

SHIPBUILDING IN THE ROYAL DOCKYARDS DURING 1890.

THE extent of the tonnage launched from the Royal Dockyards during the past year is small. If, however, the original programme, as laid down by the authorities at Whitehall, could have been adhered to, the output would have been materially increased. The "Centaur," first-class cruiser, which was intended to have been launched at Portsmouth in November last, will not now be put into the water till next month, and the "Hawke," a similar vessel on the stocks at Chatham, which has been practically ready for launching for some time, will not now leave her berth till well on in this year. The launching ceremony of the second-class deck-protected cruiser "Apollo," built at the last-mentioned establishment, has also been deferred. As it is, only eight vessels, having an aggregate tonnage of 22,520 tons, were added to the navy from the five Royal Dockyards. Of this number Devonport contributed three, one first-class cruiser and two second-class cruisers; Sheerness, two torpedo gunboats; while Chatham, Portsmouth, and Pembroke each contributed a second-class cruiser. The "Edgar" is by far the largest and most powerfully armed of these additions to the navy, and is the first of a special type of first-class protected cruisers which are being built under the Naval Defence Act. She is 360ft. in length, 60ft. in extreme breadth, with a mean draught of water of 23ft. 9in., the normal displacement being 7,350 tons. The engines, which are of the vertical triple-expansion type, have been supplied by the Fairfield Shipbuilding and Engineering Company, and are capable of developing 12,000 h.p. with forced draught, and 7,500 h.p. with natural draught, which is estimated to realise sea speeds of 18 knots and 20 knots respectively. The "Edgar" was laid down in June, 1889, and launched on November 24th, up to which date fully 2,800 tons of material had been worked into her structure. She is the largest vessel ever launched from Devonport Dockyard, and has been built at a cost of £327,000.

Next in point of tonnage is the fast cruiser "Andromache," which was launched at Chatham on August 14th. Her first keel plate was laid in May, 1889, and before leaving the slipway not less than 1,300 tons of her substance had been fixed in position. She measures 300ft. between perpendiculars, 43ft. in extreme breadth, and will have a displacement, when fully equipped, of 3,431 tons on a mean draught of water of 16ft. 6in. The engines, which are of the triple-expansion type, have been constructed by Messrs. Earle & Co., Hull, and are estimated to develop 9,000 horse-power under forced draught, and to give the vessel a speed of 20 knots. The "Andromache" has been built of steel throughout, with a protective deck of a minimum thickness of 2in., and a maximum thickness of 5in. over the engine hatch, at a cost of about £179,100.

The second-class protected cruiser "Pallas," which was laid down on July 1st, 1889, was floated out of No. 4 Dock at Portsmouth on June 30th. On the following day a sister vessel, the "Phœbe," was launched at Devonport, while the "Pearl" and "Philomel," two other vessels of the same class, left their berths at Pembroke and Devonport respectively, the former on July 28th, and the latter on August 28th last. Each of these vessels has a length of 260ft. between perpendiculars, a breadth of 41ft., and a load displacement of 2,575 tons on a mean draught of 15ft. 6in. They are built of steel throughout, and fitted with a protective deck running right fore and aft, the thickness in wake of machinery spaces ranging from 1½in. to 2in., and varying at the extremities from ¾in. to 1in. Their propelling machinery consists of two sets of triple-expansion engines, the estimated horse-power being 7,500 under forced draught, and 4,500 under natural draught, the resulting speeds being estimated at 19 knots and 16½ knots respectively. In these vessels the normal displacement is made up roughly as follows:—Weight of hull, 1,030 tons; weight of engines, 540 tons; weight of stores, armament and equipment, 705 tons; and coal capacity 300 tons, a quantity estimated to ensure the vessel covering a distance of 4,800 knots at a 10-knot

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speed. The "Pearl" and "Philomel" have been engined by Messrs. Earle & Co., Hull; the "Pallas," by Messrs. Hawthorn, Leslie, & Co., Newcastle-on-Tyne; while the machinery of the "Phœbe" has been constructed by the Government employés at Devonport. The average total cost of these vessels is about £142,000.

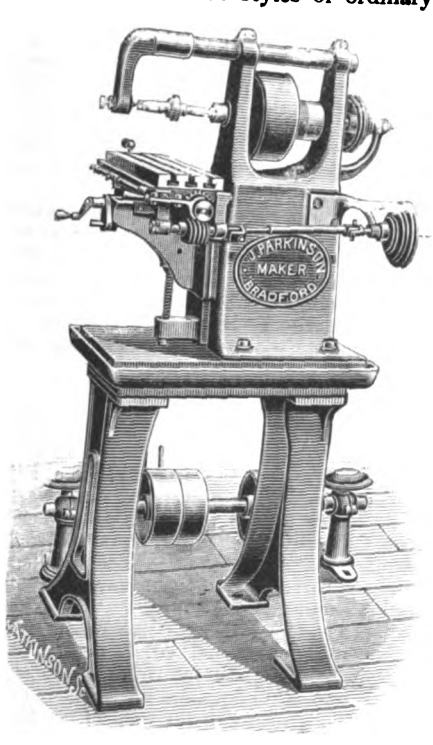
The other two ships included in last year's output are the "Gossamer" and "Gleaner," which were commenced at Sheerness Dockyard on January 21st, 1889, and launched on January 9th, 1890. They are built on similar lines and of similar scantlings to the "Sharpshooter," and are officially designated first-class torpedo gunboats. They are 230ft. in length between perpendiculars, 27ft. in extreme breadth, and have a displacement of 735 tons on a draught of water of 8ft. 3in. They are provided with machinery of a powerful character, the estimated horse-power being 4,500 under forced draught, and 2,500 with natural draught, while the speeds expected are 21 knots and 18·5 knots respectively. The engines are of the triple-expansion type, designed by the Admiralty engineering staff, and constructed in the engine department at Sheerness Dockyard. The average cost of these vessels is £54,450. The "Gossamer" is at present awaiting her trials at Sheerness, and special interest will attach to them, as her engines are the first constructed in the Sheerness establishment, the machinery of all previous vessels built at the yard having been supplied by contract.

SUMMARY OF LAUNCHES.

Name.	Displacement.	H.P.	Where Built.	Engined by
"Edgar"	7,350	12,000	Devonport	Fairfield Co.
"Phœbe"	2,575	7,500	Devonport	Admiralty.
"Philomel"	2,575	7,500	Devonport	Earle & Co.
"Pallas"	2,575	7,500	Portsmouth	Hawthorn, Leslie, & Co.
"Pearl"	2,575	7,500	Pembroke	Earle & Co.
"Andromache"..	3,431	9,000	Chatham	Earle & Co.
"Gossamer" ...	735	4,500	Sheerness	Admiralty.
"Gleaner"	735	4,500	Sheerness	Admiralty.

A MINIATURE MILLING MACHINE.

THE illustration below represents a small milling machine as constructed by Mr. J. Parkinson, machinist, Bradford. It has been devised for dealing with light work, and it is claimed for it that it is easier to manipulate and capable of yielding a greater output than a larger machine. It is fitted so as to fulfil all the requirements of the various styles of ordinary milling.



Its capacity may be seen from the following dimensions: The table has an automatic horizontal longitudinal travel of 11in., a transverse horizontal travel of 3½in., and a vertical travel of 6in. The automatic travel arrangement will move the top slide in any position, and is provided with a regulating feed stop to throw the feed out of gear when desired. The general appearance of the machine is neat, and the parts well designed.

WE have received from Messrs. Atkinson & Philipson Northumberland Carriage Manufactory, Newcastle-on-Tyne, a revised edition of their "Rules for the Preservation of Carriages and Harness." The rules are printed upon stout highly glazed cardboard, suitable for hanging in coach-houses, harness-rooms, &c., and contain some very useful hints.

Notices of Meetings.

THIS WEEK.

MANCHESTER ASSOCIATION OF ENGINEERS.—Saturday, January 10th, at 7 p.m. Presidential Address by Mr. John West, M.Inst.C.E.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Saturday, January 10th, at 6 p.m. Paper to be read: "Mechanical Aid to the Investigation of Experimental Curves," by Mr. J. D. Young. Discussion on Mr. Hök's paper on "The Unsinkability of Cargo-Carrying Steamers," and on Mr. Cummins' paper on "Increased Boiler Pressure and Increased Piston Speed for Marine Engines."

SOUTH STAFFORDSHIRE INSTITUTE OF IRON AND STEEL WORKS MANAGERS.—Saturday, January 10th, at 7 p.m. Paper to be read: "The Round Oak Iron and Steel Works," by Mr. R. Smith-Casson.

SHEFFIELD SOCIETY OF ENGINEERS.—Saturday, January 10th, at 7.30 p.m. Lecture on "The Microscopic Analysis of Iron and Steel," by Dr. Clifton Sorby, F.R.S.

NEXT WEEK.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, January 12th, at 8 p.m. Sessional meeting. Announcement of award of prizes.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, January 13th, at 8 p.m. Ordinary meeting. Paper to be read: "Auxiliary Engines in Connection with the Modern Marine Engine," by Mr. W. H. Allen, A.M.Inst.C.E. Monthly ballot for members, and, at 9 p.m., the first of a series of monthly receptions.

SOCIETY OF ARCHITECTS.—Tuesday, January 13th, at 7.30 p.m. Ordinary meeting.

SOCIETY OF ARTS.—Wednesday, January 14th, at 8 p.m. Paper to be read: "Steam Lifeboats," by Mr. J. F. Green.

INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, January 15th. Presidential Address by Mr. W. Crookes, F.R.S.

DUNDEE INSTITUTE OF ARCHITECTURE, SCIENCE, AND ART.—Thursday, January 15th, at 8 p.m. Lecture on "Some Architectural and Other Notes on Portugal and Spain," by Mr. Campbell Douglas.

PRICES CURRENT, 7TH JANUARY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 0 0	.....	6 10 0	f.o.t. wks.
" Angles	5 17 6	.....	6 7 6	"
" Plates	6 0 0	.....	6 10 0	"
Staffordshire Bars	7 0 0	.....	7 10 0	London.
" Angles	7 5 0	.....	7 15 0	"
Crown Sheets	7 7 6	.....	7 17 6	"
" Hoops	7 7 6	.....	7 17 6	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 2 6	"

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£23	5	0	to	23	10	0
Copper: British Cakes and Ingots	58	0	0	,,	59	0	0
" Chili Bars, G.O.B.'s	52	5	0	,,	52	12	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	52	5	0	,,	52	12	6
" Manufactured (strong)	66	0	0	,,	67	0	0
Lead: Common Pig	13	15	0	,,	14	0	0
" English Sheet	14	10	0	,,	14	15	0
Tin: Straits	91	7	6	,,	91	17	6
" Australian	91	15	0	,,	92	5	0
" English Ingots	95	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER continues inactive, small business taking place. Owing to the slack demand values of raw copper are receding, Chili bars being quoted to-day £52 5s. to £52 12s. 6d. cash, with flat market.

Stocks increased about 1,480 tons during the second fortnight in December, the total stock at December 31, 1890, being returned as about 65,360 tons. Manufactured quoted £66 to £67, "strong."

TIN has improved somewhat during the week, values of foreign having advanced about £1 per ton.

LEAD: Quiet, without change in values.

SPELTER continues very stagnant, the galvanising trade being very slack and demand altogether small.

PIG IRON.

Middlesbro' Warrants, No. 3.	.....	42/-	Cash.
Scotch Warrants, m/n	.....	46/6	,,
Hematite Warrants, m/n	.....	53/-	,,

Stocks in Stores.	Scotch	584,751—Dec. for week	2,974	Tons.
	Middlesbro'	118,464—Inc. ,,	3,615	,,
	Hematite.....	209,900—Inc. ,,	1,015	,,

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.	
Coltness	... .	...	f.o.b. Glasgow.
Gartsherrie	... .	...	,, ,,
Langloan	72/-	60/-	,, ,,
Summerlee	68/-	58/6	,, ,,
Glengarnock	... .	...	,, ,,
G.M.B. ex Store	47/-	46/9	,, ,,

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
" Liquid	gal.	0 1 0	—	.....
" Citric	lb.	0 1 4½	—	.....
" Oxalic	,,	0 0 3½	—	.....
" Sulphuric	ton	1 12 0	—	.....
" Tartaric	lb.	0 1 3	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	22 15 0	—	.....
" " (White)	,,	26 10 0	—	.....
" Sulphate	,,	10 15 0	—	10 17 6
" Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	,,	6 12 6	—	.....
Bisulphide of Carbon	,,	13 10 0	—	.....
Borax	,,	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 8	—	.....
" (50/90 %)	,,	0 3 7	—	.....
Copper Sulphate	ton	18 10 0	—	.....
Copperas	,,	2 0 0	—	.....
Kieserit	,,	.....	—	.....
Lead: Nitrate	,,	21 10 0	—	.....
" White Sugar	,,	24 0 0	—	.....
" Brown "	,,	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
" Caustic	ton	22 0 0	—	.....
" Carbonate	,,	20 0 0	—	.....
" Chlorate	lb.	0 0 5½	—	.....
" Prussiate (Yellow)	,,	0 0 9½	—	.....
" Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 9	—	.....
" White	,,	0 3 9	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	,,	3 15 0	—	.....
" Glauber	,,	1 10 0	—	.....
Sulphur: Sublimed Flowers	,,	9 0 0	—	.....
" Recovered	,,	5 0 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
" Caustic (White 70%)	ton	11 5 0	—	11 7 6
" " " 60%)	,,	10 5 0	—	10 7 6
" " (Cream 60%)	,,	9 5 0	—	9 5 6
" Crystals	,,	3 0 0	—	.....
" Bicarbonate	,,	7 10 0	—	.....
" Hyposulphite	,,	6 5 0	—	.....
Solvent Naphtha	gal.	0 1 10	—	.....
Tartar, Cream of	cwt.	4 13 0	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Business is resumed but slowly after the holidays, and there is little of interest to report. Carbolic acids, crude and crystal, are very dull, but prices are about stationary; liquid carbolic is, however, in better tone. Sulphate of copper also is quiet, sales being small and mostly of second-hand parcels Copperas is still in demand, and prices tending further upwards Lime salts are steady, but only small business doing. There is more disposition to purchase sulphate of ammonia, but buyers do not see their way to the higher prices that are asked, this spurt being caused by the reports of a possible combination amongst nitrate of soda producers.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	33 10 0
" Ceylon	,,	29 0 0
Cottonseed	,,	18 5 0
Cod	,,	23 0 0
Lard	,,	34 0 0
Linseed	,,	21 10 0
Palm, Lagos	,,	26 0 0
Rapeseed: English	,,	28 5 0
Seal: Pale	,,	25 0 0
" Brown	,,	.....
Sperm	,,	47 0 0
Whale	,,	22 0 0
Turpentine	per cwt.	1 9 6
Coal	per gal.	.....
Petroleum (Refined)	,,	0 0 5⅛
Spirit		0 0 8

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HOME INDUSTRIES.

LONDON, 8th January, 1891.

The Money Market.—The release of the Government dividends on Monday has flooded the market with money, for which there is scarcely any demand, and rates have given way completely. The apprehension that the issue of the new French loan on Saturday would disturb the money market has been allayed, and with considerable arrivals of gold at the Bank there seems every prospect of a long period of cheap money. The stock markets have been idle and dull all the week. The growing cheapness of money has produced an improvement in Consols and gilt-edged securities, but it has not extended to other departments. Operators in home railways are inclined to pause until the declaration of the earlier dividends, the first of which are due at the beginning of next week, give an idea of the extent to which the increased working cost during the half-year has affected net earnings. The prolongation of the strike in Scotland has also an adverse effect. Americans, though distinctly disposed to improve, hang back, and move in rather a feverish way. Foreign securities have been steady, with few changes, though the Paris market was weakened by a rather trying settlement, at which money rates were high. In the miscellaneous departments there has been no general feature, but there has been a good deal of activity in some of the minor speculative specialties, owing to the collape of several extensive operators.

Traffic Receipts.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending 28th December amounted, on 16,244¾ miles, to £1,218,288, and for the corresponding period of 1889, on 16,146 miles, to £1,255,179, an increase of 98¾ miles, or 0·6 per cent., and a decrease of £36,890, or 2·9 per cent.

Great Northern Telegraph Company.—The traffic returns give the receipts in December, 1890, as £23,600. The receipts from 1st January to 31st December, 1890, were £280,000, those for the year 1889 being £274,800, and for the year 1888 £272,200.

Institution of Mechanical Engineers.—The annual general meeting of this Institution will be held at 25, Great George Street, Westminster, on the 29th and 30th inst., at 7.30 p.m., the President, Mr. Joseph Tomlinson, being in the chair. On the 29th inst. the annual report of the Council will be presented to the meeting, and the annual election of the president, vice-presidents, and members of council will take place. The following papers will then be read and discussed :—"On some Different Forms of Gas Furnaces," by Mr. Bernard Dawson; "On the Mechanical Treatment of Moulding Sand," by Mr. Walter Bagshaw; and the "Fourth Report of the Research Committee on Friction: Experiments on the Friction of a Pivot Bearing."

The Metropolitan Outer Circle Railway Company.—This company, which was formed in the year 1888, with a share capital of £1,600,000, has two Bills in Parliament, the first of which asks for an extension of time for purchasing land until August, 1894, and for the completion of the line until August, 1896. The second Bill relates to a line which would connect all the trunk railways in London by means of a railway, over eighteen miles in length, from the Great Western and Metropolitan District Railways at Ealing, passing through Kingsbury, Hendon, Finchley, and Colney Hatch, to the Great Eastern Railway at Tottenham. According to the preamble of the Bill, no part of the capital has been created or issued, and permissive powers to abandon the scheme are asked for.

Proposed Electric Railway.—A Bill for the construction of an electric railway between South Kensington and Paddington has again been deposited in the House of Commons. The measure, which was introduced last Session, and afterwards withdrawn, has since been somewhat modified. According to the present scheme the line will be about 1¾ miles long. One terminus will be near the Exhibition Road, Kensington, and the other near the Bishop's Road bridge of the Great Western Railway. The capital of the company will be £276,000, with power to raise a further sum of £92,000.

The Strike of Post Office Clerks.—It is stated that the Postmaster-General will grant an interview to-day to the Post Office clerks in response to their application, which was suggested by Sir Arthur Blackwood on the 5th inst. At this season of the year, when the pressure of work is great, the clerks are expected to work overtime, but at ordinary times permission to work overtime is applied for voluntarily by the men.

Stanger's Laboratory and Testing Works.—Mr. W. H. Stanger and Mr. Bertram Blount, of the Broadway Laboratory Testing Works, Westminster, desire to correct a rumour which has become prevalent, by stating that the Mr. William Fox, who is at present associated with them at the above address, is a Member of the Institution of Civil Engineers and not a practising analyst.

Price List.—Messrs. G. Bailey Toms & Co., of 7A, Laurence Pountney Hill, London, E.C., have issued a well-illustrated and very complete revised price list of their productions, which include portable railway plant, locomotives, rolling stock, cast-iron pipes, columns, &c. There is also a complete list of 2,000 sizes of iron and steel joists, channels, angles, tees, and fancy sections, rolled and kept in stock.

Diaries.—We have received from Messrs. Appleton, Burbey, & Williamson, 91, Queen Victoria Street, London, E.C., specimens of a new form of perpetual diary, which is made in porcelain, and, being combined with a tablet for memoranda, seems especially well suited for its purpose.

MANCHESTER, 8th January, 1891.

The Ship Canal.—The greater part of the various sections of this work, which were flooded a few weeks ago, have now been practically cleared of water. The chief delay from this cause took place in the masonry and concrete work connected with the aqueduct at Barton and the various locks. The work, however, has for some time been resumed, and the water is being rapidly pumped out of all the cuttings. The rate of pumping can be estimated when it is stated that in one section, 3¼ miles in length, the level was reduced at the rate of 2ft. per day. This implies an immense volume of water, and shows that the same resource is being exhibited by the contractor as in the Severn Tunnel, where a good deal of this work had to be done. Owing to the exceptional weather, the works between the Weaver estuary and Eastham have been somewhat delayed, and the opening of that section will not take place for a few months. As an instance of the probabilities of local traffic arising, a specially constructed steamer has been launched at Belfast, designed for the direct Manchester and Belfast traffic. Until the opening of the canal she will ply to Liverpool.

The Engineering Trades.—The holidays in this district are so protracted that it is difficult to form an opinion as to the state of trade or its prospects. So far as can be judged, however, there is not so much doing as there has been. There is a certain dulness in business, which, although it may be only temporary, is somewhat strange. At the same time, there is plenty of work in hand, and probably by the time this is exhausted new orders will be in the market. Generally engine builders, boiler makers, and millwrights are well occupied, and the same remark applies to machine tool makers, who, as yet, do not experience any falling off in orders. In spinning machinery there is still a brisk demand, and it is computed that the mere supply of the machines necessary for replacements is sufficient to keep the existing works well occupied. In all, about 4,000,000 spindles per year, with the preparation machinery, is wanted, on an average, for renewals, and this quantity closely approaches the productive capacity of existing works. There is work enough in hand now to last several months, and no uneasiness exists in this department as to the immediate future. The loom trade continues to be steady, without any pressure existing, and there is also a fair amount of work in the ironfounding business.

The Linen and Jute Trades.—There has not been much business done this week. Stocks, it is understood, are not heavy amongst the small dealers, and there will most probably soon be a revival in the trade. One wholesale concern has already held its first special sale, and in a short time others will follow suit with a view of giving an impetus to the market. Prices in the low Irish end are decidedly firmer, even roughs occupying a stronger position. The last-named goods are not appreciably higher in the lower numbers, but in the higher ranges the position is more clearly defined, and there is no disposition to make any concessions to buyers, who, in fact, are willing enough to purchase at old prices. Where customers refuse to take the range, sellers ask higher prices for the low numbers. There is nothing fresh to report concerning the linen thread trade, except that one of the leading agents in the business has transferred his services to Messrs. Ainsworth, of Cleator, and will undertake the control of their London home trade and shipping business. The rumoured combination between Barbours and Finlaysons (the largest firms in the business) has not been confirmed. Much inconvenience continues to be caused by the Scotch strike, many consignments of goods for this city having been seriously delayed. In the case of Dundee products the goods are being sent through the Caledonian Canal to Glasgow, and thence by sea to Liverpool, or are transported to an East Coast point, whence they reach Manchester by rail. Jute goods are quiet. Wholesale houses make no change in quotations, although they themselves are constantly being affected by the fluctuations in the price of raw material.

Brewers and the Water Supply.—An interesting point has been raised in Oldham with reference to the supply of water for brewing purposes. The reservoirs from which the town of Oldham is supplied with water are situated in different valleys, and, although the water in each case is fairly pure, there is a little difference in the chemical composition of the salts in solution. It is the practice to change the source of supply periodically, and the brewers of the town complain that when this is done without notice the quality of the brewing is changed. It was remarked by the Town Clerk that brewing was now a chemical process, and that the change of supply from one source to another entailed a good deal of trouble. It was finally agreed by the Town Council that, if possible, a day or two's notice should be given when it was intended to change the supply.

GLASGOW, 8th January, 1891.

The Railway Strike.—The strike, in spite of the assertions to the contrary in most of the daily papers, shows no sign of collapsing. The passenger service on the various lines is being conducted with comparative regularity, though with many mishaps, and not without serious risk. The places of a large number of the men on strike have been filled by inexperienced men who have neither the skill nor the knowledge to work the lines properly. New signalmen do not understand their duties, and new engine drivers do not know the road. The situation is altogether full of peril. Meanwhile the men are confident, and hold fairly well together. They allege that in spite of the defection of the Glasgow and South-Western Railway men, they still number upwards of 8,000 strikers. Their hopes during the past few days have been concentrated upon the expectation that the railway companies, barely able to cope with the passenger traffic during the holidays, would be quite unable to deal with the goods and mineral traffic when the works, especially in the western district, resumed this week. This expectation has undoubtedly been largely justified. The public works in the Glasgow district are practically still closed, notices being posted on the gates that, owing to want of coal, the machinery cannot be set in motion. Although the railway companies have been doing their utmost to cope with the traffic, they have been utterly unable to do more than deal with a small part of it. The evictions of railway strikers from houses belonging to the Caledonian Railway Company at Motherwell doubtless mark a distinct phase in the struggle. Although the agents of the company, with the support of a large body of police, succeeded in evicting some dozen tenants without any actual resistance being offered to the legal proceedings, the town and district of Motherwell were in a state of ferment. The Riot Act was read, and the people were charged repeatedly by the police. The roof of the railway station and two signal boxes were damaged, the whole of the glass and all the lamps being broken. Negotiations promoted by shareholders and by large traders have been taking place with the railway officials on the one hand, and with the leaders of the men on the other; but no prospect of bringing these together has yet appeared. Mr. John Walker, manager of the North British Railway, who is generally regarded as the most considerate man among the administrators of the Scottish railways, had, it was rumoured, resigned. This rumour led on Monday to a rapid fall in North British Railway stock. Since the first symptoms of the strike appeared this stock has suffered heavily. A week prior to the strike it stood at about 56, now it stands at between 49 and 50, a fall of between 12 per cent. and 14 per cent. The shareholders are undoubtedly getting alarmed, the fall on Monday having been 37s. 6d. Meetings of the directors have been held this week, and a meeting of the shareholders of the North British Railway is also said to be contemplated. The trades unions generally are supporting the strike, and the men are in no want of money. The issue before the country and the railway companies is, therefore, very serious, and must be dealt with in a much more statesmanlike spirit than has as yet been manifested by the railway boards. The situation promises to be still further complicated by a strike of the carters in Glasgow. A considerable amount of the inconvenience due to the stoppage of goods transit by railway has been modified by the fact that horse traction was still available. Contractors, indeed, have been extremely busy, and goods have been carted long distances—even thirty miles—for shipment at Glasgow. If the carters also should strike, the general public will be still more inconvenienced.

Engineering.—A meeting of the shareholders of Messrs. Goodwins, Jardine, & Co., Limited, was held at Glasgow recently, under the presidency of Sir Edward J. Reed, the chairman of the company. It was decided that a committee of the shareholders be empowered to confer with the directors as to the present position of the company and the reconstruction of the board. Pending the report of this committee, the directors are empowered to close the Coats works temporarily, and to continue the Motherwell and Ardrossan works.—It is reported that Mr. Walter Neilson, Clydebridge Steel Works, has discovered a method of making steel castings direct from the cupola furnace.

La Plateuse Flotilla Company.—The adjourned meeting of the shareholders of this company was held on the 6th inst., when it was resolved that application be made to the Court of Session for liquidation, subject to supervision of the Court, with the understanding that if a substantial improvement in Argentine affairs took place the liquidation should be suspended.

Coal Supply.—The railway strike has overshadowed everything in the district. There is no coal to be had except at prices which are prohibitive. The whole of the industries in the West of Scotland are seriously hampered, if not altogether paralysed, by the want of raw material on the one hand, and by the impossibility of conveying away finished material on the other.

(From our own Correspondents.)

LIVERPOOL, 7th January, 1891.

The Timber Trade.—The imports during the past month have been moderate, and, as the deliveries have been seriously interfered with by the recent severe weather, the stocks are not so heavy as they appear to be, for large portions are already sold, and are only awaiting the advent of fine weather for delivery. There is very little change in values. The delivery of yellow pine from Canada has been small, and the stocks are ample; sales of square pine have been at low prices, and there is no improvement in waney. The stock of red pine is ample, and there are few inquiries

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even at the present low prices. The stock of pine deals is too heavy, the imports having been large. There have been no imports of Quebec spruce, and the stocks are excessive. The stock of New Brunswick and Nova Scotia spruce deals is very heavy, although the imports have been light—the consumption has been small and the prices exceptionally low. The stock of pitch pine is still excessive; the consumption has been small, and there have been no imports of hewn timber. The consumption of sawn timber has been fair, and stocks are reduced, as there have been practically no imports.

SHEFFIELD, 7th January, 1891.

Iron and Steel.—The usual Christmas holidays at the iron and steel works here have this year been much curtailed, and all the works have shut down only for necessary repairs. The demand for iron and steel in the ingot and as a finished product promises to be sustained. The success of Messrs. Vickers' all-steel armour plates, which were tested for the Russian Government, has resulted in that firm receiving an order for the belt plates of two gunboats, the "Gremyastchy" and "Otvagny." It will be remembered that the plates tested were so elastic as to throw back with considerable force the shot fired at them. Although Sheffield has lost the chance of supplying armour for the United States navy, the district is indirectly benefiting by its manufacture in America. The contractors have been obliged to employ Sheffield men to show them how the steel was to be made and rolled. Having guaranteed to deliver 6,000 tons in a given time they find it impossible to machine the plates, and have now under construction in Leeds massive planers for this purpose. Some idea of the massive proportions of these machines may be gathered from the fact that the moving table alone weighs over 20 tons. In the manufacture of guns Sheffield is likely to have a formidable competitor shortly in Messrs. Palmer, of Jarrow-on-Tyne, who are now erecting the necessary plant and machinery for this purpose. The demand for steel castings has fallen off considerably during the last month or two. This is more particularly the case with marine work; small castings for hydraulic cylinders, locomotives, and colliery purposes are in fair request.

Coal.—The coal market is exceptionally brisk all round, and great efforts have been made to induce the miners to commence work again after a short stoppage for repairs to winding tackle.

Pictet Ice-making Plant.—Messrs. Baxters, Limited, Sandiacre, near Nottingham, are now busily engaged in laying down new machinery for the manufacture of the Pictet ice-making plant, of which they are the sole licensees for the United Kingdom and Colonies.

NORTH STAFFORDSHIRE, 7th January, 1891.

The Iron Trade.—There is no improvement to report in connection with demand or prices, and some anxiety is felt as to the results of the quarterly meetings this week. Ironmasters are not hopeful as to the immediate prospects of trade, and, on comparing present prices with those of twelve months ago, and taking into account that the cost of production has materially increased in the interim, there is little to encourage them. Bars, which were then over £8 per ton, are now selling at about £6 to £6 5s. Pig iron has fallen £1 per ton, and other prices in proportion. There is nothing in the great consuming industries to warrant a belief in any considerable increase of demand, and no immediate prospect of cheapening the cost of producing the raw material.

The Coal Trade.—Owing to the abnormal severity of the weather, there has been a large demand for coal for household purposes at remunerative rates, and colliery proprietors have been unable to supply their customers' requirements. In many cases this is not for want of "working face" in the pits, but from the irregularity in the attendance of the workmen.

The Pottery Trade.—Correspondence between the operatives and the Manufacturers' Association as to the selection of arbitrators continues, but no settlement has at present been arrived at.

CARDIFF, 7th January, 1891.

Iron and Steel.—The pig iron trade is dull, notwithstanding the depletion of stocks in Scotland. Steel rails find a small market, but Bessemer tinplate bars are active at £5 15s. to £6 per ton. In the iron ore trade a few small contracts have been made for delivery in this channel, but buyers are not so eager to make large contracts as they were last year. Nevertheless, good ore is exceedingly difficult to obtain, and those mine owners in Bilbao and elsewhere who have reliable ore to dispose of find no difficulty in disposing of their output. Rubio ore is quoted at 14s. 3d. to 14s. 6d. c.i.f. Cardiff and Newport, 14s. 9d. Swansea, 15s. Porthcawl, 15s. Britonferry, 15s. 3d. Port Talbot, on the basis of 50 per cent. iron as received. Freights from the ore ports are low, but as owners are laying up a proportion of their tonnage the tendency is upwards.

Coal and Coke.—The steam coal trade has resumed its accustomed activity after the holidays. The present engagements of colliery owners are sufficient to keep them going for the next two months, even if no orders should come to hand in the meantime. Second and third class qualities have advanced relatively more than first-class, which can be accounted for by the economy of buyers. Prices are somewhat irregular, as each colliery proprietor is guided by his own engagements in making quotations, but the following will indicate the figures at which business has been concluded during the week:—No. 1 quality, 15s. 6d. to 15s. 9d.; No. 2 quality, 14s. 9d. to 15s. 3d.; No. 3 quality, 14s. 3d. to 14s. 6d.; No. 4 quality, 13s. to 13s. 9d. The demand for household coal is exceptionally strong, prices for best ranging from 15s. 6d. to 16s.; ordinary, 15s.; and No. 2 Rhondda, 13s. 9d. to 14s. 3d. Coke finds a better market, prices being 19s. 6d. to 20s. 6d. furnace, 22s. to 23s. foundry, and 25s. special foundry.

The Electric Light.—The electric lighting committee of the Swansea County Council reported at the recent monthly meeting that, after consideration of a report from Mr. Preece on lighting some of the main streets of the town by electricity, they had decided to accept the tender of Messrs. Crompton to erect twenty-three arc lights of 2,000 candle-power at a cost of £25 each per annum, the increased charge for which over gas would be £171 per year.

BARROW-IN-FURNESS, 7th January, 1891.

Hematite.—Less business is being done in hematite pig iron. Orders are not being liberally given out, and buyers are not apparently anxious to place orders for either prompt or forward delivery. Business in iron to a great extent depends on the activity of the steel trade, and this is more apparent year by year as the Bessemer and the Siemens-Martins departments of trade are developed. Prices this week are easier at 52s. 9d. per ton for warrants net cash, and 53s. 6d. for Bessemer parcels in mixed numbers net f.o.b., while forge and foundry iron is quoted at 52s. 6d. The additional furnace which has been lighted, making fifty now in blast, has resulted in increasing the output, and also in an increase in warrant stocks for the first time for several weeks. These stocks have increased 393 tons during the week, and now stand at 211,398 tons. The stocks held by makers now represent about 40,000 tons of metal.

Steel.—There is less activity in the steel trade, as well commercially as industrially. Orders for rails are in the market, but are not of large dimensions. In the Barrow district the mills are busy, but in West Cumberland they have been indifferently employed for a month. Prospects are, however, rather better. Prices are at £4 17s. 6d. for heavy sections, £5 17s. 6d. for light sections, and £7 for colliery rails. Tinplate bars are easier in demand and lower in price at £5. Other departments of the trade are fairly but not briskly employed.

Iron Ore.—There is a steady market in iron ore at 11s. 6d. to 12s per ton for average qualities. There is more business being done in native qualities of ore than for some time past.

Shipping.—There is less activity in shipping. The exports of pig iron from West Coast ports during the week amounted to 11,378 tons. There were no steel exports. Last year the combined exports of pig iron and steel represented 20,096 tons, a decrease of 8,718 tons.

The Vulcan Steel Forge Works.—The rumour is again current that the Tubular Frame Waggon Building Company, Limited, have purchased the Vulcan Steel and Forge Works, at Barrow, which have been idle for some time. It is reported that they are about to put down the necessary plant, as they have secured a large amount of colonial and foreign orders which require early attention. The rumour, however, has not received official confirmation.

MIDDLESBROUGH, 7th January, 1891.

Pig Iron.—The quarterly meeting of the North of England iron trade was held yesterday on 'Change. There was a good attendance, but the amount of business done was not much. The ironmasters' returns had come like a blight and withered the hope of a revival. No. 3 G.M.B. drooped to 42s., and even 41s. 9d. per ton, whilst warrants were sold as low as 41s. 7½d. East Coast hematites are quoted at 55s. per ton.

Shipments of Pig Iron.—The shipments for the past week have been very poor, owing to the holiday time and the severity of the weather. The shipments for December as a whole have turned out much better than was expected. They amounted to 57,552 tons, as against 45,172 tons in the previous December. Of the 57,552 tons, the foreign amounted to 20,092 tons, against 26,782 tons the previous year, and the coastwise to 37,460 tons, against 18,390 tons the previous year. The year's shipments amounted to 804,208 tons, against 959,311 tons the year previous.

Manufactured Iron and Steel.—Both of these are very dull, and prices have become poorer than ever. Iron ship plates are quoted at £5 15s.; angles, £5 10s.; common bars, £5 15s. per ton; steel ship plates, £6 2s. 6d. (and 2s. 6d. less in some cases); and steel rails, £4 17s. 6d. per ton. The shipments of manufactured iron and steel for the past year amounted to 506,271 tons, against 527,358 tons for the previous year.

Ironmasters' Returns.—There are 101 furnaces in blast, against 103 in November, the two blown out being in hematite. The make of December amounted to 240,328 tons, against 235,849 tons in November, being an increase of 4,479 tons. Stocks have increased by 30,877 tons. The make of pig iron for 1890 amounted to 2,846,089 tons, against 2,771,180 tons the previous year. Stocks on the 31st December, 1890, stood at 256,262 tons, against 262,385 tons on 31st December, 1889, being a decrease of 6,123 tons.

SUNDERLAND, 7th January, 1891.

Shipbuilding and Marine Engineering.—The work of the past year has been generally satisfactory, both as to extent and in other respects. Local marine engineers have been more able to cope with the work of supplying the engines and boilers to all the vessels built on the river during 1890. Eighty-one marine engines, together with the requisite boilers, were constructed locally, including one or two "conversions," as against 85 steam vessels launched on the river. In the previous year, out of 99 steamers built at Sunderland, only 68 were engined on the river. The North East Marine Engineering Company, Limited, South Dock, has had the greatest output for 1891, viz., 23 marine engines from the Sunderland works, and 29 from the Wallsend works, or a total of 52 engines, of 48,500 i.h.p. Messrs. Geo. Clark, Limited, Southwick Engine Works, rank next in number of engines constructed, viz., 22 (including 1 "conversion"), of about 25,600 i.h.p. Mr. John Dickenson, Palmer's Hill Engine Works, constructed 18 engines, of 30,300 i.h.p; Messrs. Wm. Doxford & Son, Pallion, constructed 9 engines for new vessels, of 19,320 i.h.p., besides converting the engines of the "Alphonse Parrau"; and Messrs. Wm. Allan & Co., Scotia Engine Works, constructed 9 marine engines, of 7,680 i.h.p. The engines constructed here in 1890 were triple expansion, except three, which were of the "quadruple" type.

The Shipping Trade.—A serious depression is being experienced by shipowners. Local owners are taking the wise course of "laying up" their vessels rather than of working them at a loss, and already forty steamers belonging to the port are idle on the Wear and the Tyne. The tonnage afloat being so enormous, the prospects of steamers with compound engines appear very dubious. The coal shipments fell last week to 55,598 tons. In other departments the falling off was not so marked.

NEWCASTLE, 7th January, 1891.

The Coal Trade.—The opening of the year is marked by a slight improvement in the coal trade, the demand for both gas and manufacturing qualities being somewhat better than it was a month ago. The stoppage of pits for the holidays has brought the quantities held in stock considerably below the normal standard, and this circumstance is also helping to stimulate business. Steam coals are in less request, but the falling off in this branch is fully counterbalanced by the quickened demand for household coals caused by the present severe weather. The shipments of coal and coke at Tyne Dock during the week ending on the 3rd inst. amounted to 81,600 tons. This, though exceeding by 5,676 tons the shipments for the corresponding week last year, is much below the average of recent weeks.

Shipping.—Owing to the unremunerative state of the freight market, local shipowners are now finding themselves under the necessity of laying up some of their steamers, and already there are no less than twenty-six vessels, representing a carrying capacity of nearly 50,000 tons, laid idle in the Tyne. It is stated that arrangements are being made for the immediate laying up of a further number of vessels, the aggregate tonnage of which will exceed the figure stated above, so that, by the end of the month, at least 100,000 tons of shipping will be laid up between Newcastle and Shields. The shipowners have doubtless been compelled to resort to this expedient to save themselves from a greater loss than is involved in the mere laying idle of vessels, but it is a policy which they are usually very slow to adopt. There is reason to believe that, on the present occasion, its adoption has been precipitated by the aggressive tactics of the trade unions.

Tinplate Workers' Wages.—The tinplate workers of the district are taking steps to secure such an advance of wages as will bring the weekly rate up to 32s. Efforts are also being made to increase the membership of their union.

BELFAST, 7th January, 1891.

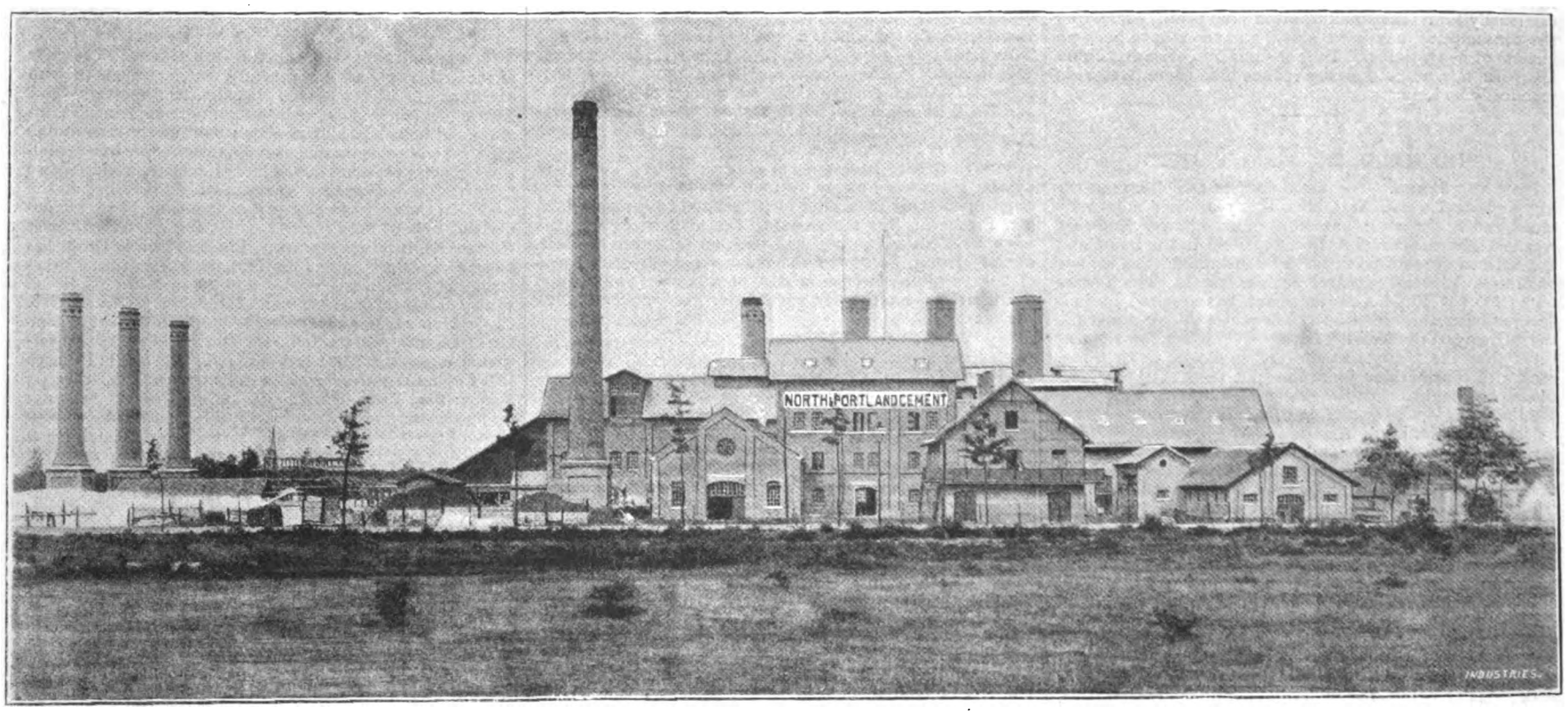
Shipbuilding.—Work after the Christmas holidays was resumed at the beginning of the week. A large number of vessels in hand are in a forward condition, which will serve to make up the tonnage for 1891. The output for last year was rather below that of the previous year, but when the class of vessels launched is considered, and compared with that of other yards showing a large tonnage, Belfast yards will be found to take a very high position.

Engineering.—Machine and tool makers are fairly busy, and some good foreign orders are in hand. Marine engineers are fully employed, and some firms are working overtime. Ironfounders are very busy, but in many cases the men have not returned to their work after the holidays.

Linen Trade.—Stocks of yarns are now low, and business will improve. Line wefts are in good demand, and bring 3s. 6d. per bundle, while rather more is asked for prime quality. Prices of tows remain firm, and producers have sold well ahead of them. Hand-loom cloth is in good demand, but the sale of power-loom is small. Prices, however, remain firm.

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THE MANUFACTURE OF CEMENT IN BELGIUM.



General View of the Beerse Cement Works near Antwerp.

THE MANUFACTURE OF CEMENT IN BELGIUM.

The recent progress of the cement industry in Belgium is well known. Its latest developments may be witnessed at the Beerse Cement Works, near Antwerp, on the Canal de la Campine, the property of Colonel North. The clay found here was formerly used for the manufacture of bricks. It was M. Alexis Mols who first entertained the idea of turning it to a better use. After consulting Dr. Michaëlis, one of the greatest authorities on the subject, M. Mols received from that expert so favourable a reply that he immediately commenced operations, and, with the aid of Colonel North's energetic support and capital, in less than a year erected the factory, which we illustrate above, and which, when the extensions now in course of construction are completed, will be almost without a rival.

The materials employed in the manufacture of the cement are the clay, of which we have already spoken, and chalk. To ensure regular proportions in the composition, the limestone and the natural clay are carefully weighed before being placed in the wash-mills. The slurry is then drawn off and milled wet by means of heavy millstones, after which it flows automatically into a large reservoir, where it is finally mixed. The importance of this part of the process has been duly recognised by M. Mols, and it is not too much to say that, after passing the wet-mills and the mixing reservoir at Beerse, the paste is absolutely homogeneous. We may note here, in passing, that throughout the process manual labour is reduced to a minimum. After mixing, the slurry is pumped on to the drying plates, where it loses almost all its moisture, and from the drying shed it is raised by elevators to the drying kiln. The kiln used is Dietzesch's continuous kiln. The dried slurry is charged at the top, and is heated by the gases escaping from the fire. The fire is situated half-way down, and the space between the fire and the bottom of the kiln, whence the clinkers are extracted, is such that, by the time they reach the bottom, the clinkers have so far cooled that they can be held in the bare hand. The process of extracting the clinkers at the bottom and charging the dried slurry at the top is repeated, and the working of the furnace is thus continuous.

Among the advantages of this process may be noticed the following:—The cold air coming from the bottom of the kiln, while serving to cool the cement-clinker, gradually warms as it approaches the fire, and there is no loss of heat. In this way the necessity for a separate cooling chamber is abolished, and, as the imperfectly burnt cement is sorted out immediately on its extraction from the kiln, a great saving of labour is effected. After the most careful sorting, the clinkers are reduced to a coarse powder by means of stone-breakers, and then raised by elevators to the mills, where they are ground so fine that, at the final sifting, only 5 per cent. of refuse is left on a sieve of 75 meshes to the inch. To ensure absolute purity, all clay after extraction is washed, and then run into reservoirs, where the clay and sand deposit themselves in separate layers. The washing machinery, though at some distance from the works, is driven from the central motive power by means of cables.

After grinding, the cement is transported by endless screws, and left for three weeks or a month, after which it is packed, for inland sale in sacks, and for export in barrels. A cooper's shop capable of turning out 3,000 barrels a week is an instance of the completeness with which the works have been constructed. The whole is lighted by electricity. All repairs are done on the premises in completely fitted-out repairing shops. The result of this completeness is that the cement can be offered for sale at the lowest possible price.

In a well-appointed laboratory experiments may be witnessed which give conclusive evidence of the excellence of the cement. Two samples of mortar, composed each of three parts of sand to one of cement, the one after seven days, the other after twenty-eight days, give respectively tensile strengths of 170lb. and 398lb. per square inch, whereas the conditions for Government contracts only require 113lb. and 213lb. Two samples of pure cement, after the same periods, are found to give 569lb. and 880lb. per square inch, Government conditions demanding only 355lb. and 640lb. under the same circumstances. These tests are made with the testing machine invented by Dr. Michaëlis. Due consideration has been given to the fact that a quick-setting cement is useless when exposed to sea water. North's Portland cement is so composed that the setting is not complete for three hours.

A quay of more than 980ft. in length along the canal, now in course of construction, will complete a handsome frontage. M. Mols, the managing director, has a house adjoining the factory. The post of resident engineer is competently filled by Mr. J. W. Brough, Assoc.M.Inst.C.E.

COAL DUST IN MINES.

A study of the record of the most disastrous coal mine explosions shows that some of the most terrible of them have occurred about this time of year, a fact which was supposed to be due to the great and frequent changes of temperature and the consequent sudden outbursts of gas. The minute by the Secretary of State for the Home Department, which has been forwarded to Her Majesty's Inspectors of Mines, is issued, therefore, very opportunely, and will be carefully studied by all interested. Mr. Matthews says that his attention has for some time been directed to the effect which the presence of coal dust in mines may have in originating or in propagating explosions, and that two disastrous explosions have occurred in the course of the past year, at the Llanerch and the Morfa collieries, which have given fresh prominence and importance to the question. Both of these explosions were made the subject of careful investigation by competent men, and various theories were put forward to account for their origin and course by the presence of gas, but those theories were not considered to be sufficient, and it was thought that there were many of the explosions which were extended and assisted, if they were not caused, by coal dust. Mr. Matthews felt the great importance of arriving at further information and more certain conclusions on this subject, and he sanctioned the proposal of Mr. Hall, Her Majesty's Inspector of Mines, to conduct experiments for the purpose of ascertaining whether an explosion can be caused by blasting operations when coal dust is present, and in the entire absence of gas or fire-damp, a point on which he and other inspectors of mines had previously expressed positive opinions—which, however, only met with partial acceptance. The conclusion which Mr. Hall deduced from his experiments is that a blown-out shot may, in the presence of coal dust, and in the entire absence of fire-damp, cause explosions of great violence, often accompanied by volumes of rushing flame travelling considerable distances, and possibly so far as the supply of coal dust continues. Mr. Matthews points out that these experiments do not by any means exhaust the field of inquiry which he proposes to pursue with the best scientific assistance he can obtain. He, however, considers it to be his duty to lose no time in bringing before colliery owners, agents, and managers the results already obtained, and the serious dangers to which the presence of dry coal dust in mines may not improbably give rise. While, of course, he insists on the necessity of the provisions in the Coal Mines Regulation Act, 1867, with respect to shot firing in dry and dusty places, being rigidly observed, he is of opinion that prudence requires more than those provisions enact. He, therefore, strongly urges upon colliery managers that in every mine of at all a dry and dusty character the accumulation of dry coal dust should be prevented by removing the dust and watering workplaces and roadways (roof and sides as well as floor); and further, that shot-firing with gunpowder should only take place when all the workmen have been withdrawn from the seam. He does not think that any fresh legislation can be usefully attempted until the subject, both of the danger which coal dust may cause and of the means by which that danger can best be met, has been fully investigated by competent scientific men.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 9TH JANUARY, 1891.

THE INVESTMENT OF ENGLISH CAPITAL IN AMERICAN INDUSTRIES.

SINCE the passing of the McKinley Tariff Act special attention has been paid in this country to the advantages which the English capitalist might obtain by the investment of his money in the development of American industries. In the autumn of last year some of our contemporaries gave glowing accounts of Pittsburgh and Baltimore, and pictured them as the chief seats of the future American tinplate industry, while pointing out the prejudicial effect that such a development would have upon the manufacture of tinplate in South Wales. Now that a reaction has set in against the Republicans in the United States, there is some ground for believing that the excessive tariffs may be reduced, and this should cause manufacturers here to hesitate before making so radical a change as the complete transference of their industry to a country with a rapidly varying commercial policy. During the last few years many of the American industries have undergone a process of recapitalisation, and have passed out of the hands of the original owners, who have sold their concerns to English capitalists. Many leaders of English industry have also found it to their advantage to start factories in the United States on an extensive scale. For example, some of the large breweries in the American towns have passed into the hands of the English capitalist within a comparatively short period, and it seems as if other industries of an allied nature will speedily be developed in a similar manner. Shortly after the passing of the McKinley Act it was stated that new tinplate works, costing from $1,000,000 to $5,000,000 each, were to be built immediately in Baltimore, Pittsburgh, Chicago, Colorado, and Alabama, and that tinplate manufacturers from this country were concerned in these projects. These statements seem to have originated in part from overtures made by the Pittsburgh Chamber of Commerce to some of the Welsh tinplate makers, with a view of inducing them to erect plant in that city. Tinplate iron has been made for some time in a few of the rolling mills in the United States, and the American manufacturers would have tried before now to introduce this particular industry, even without the advantages of the increased tariff, had a supply of tin been available. At the present time tin has to be imported into the States, and, as it has not been exempted from duty, a tinplate manufacturer at the outset starts at a disadvantage, for which the present tariff may not sufficiently compensate. The cost of sheet iron manufactured in the United States is also increased by the extra cost of nearly everything connected with its production, and this renders the possibility of the industry being a profitable one still more remote. No doubt in time the vast mineral resources of California, Dakota, and other tin-yielding districts in the United States, will yield sufficient tin to supply any demand of this kind; and, when such a home supply becomes available, the tinplate industry will be possible in that country. In the returns of our metal exports to the United States tinplates form a most important item. During the year just completed tinplates exceeding £4,600,000 in value were shipped from this country, but under the new tariff the duty will be increased from 34 to 76 per cent. *ad valorem*. It must, however, be borne in mind that a considerable portion of this amount is used for package, and that buyers for this purpose will be able to obtain a drawback from the revenue authorities on a declaration to that effect. Recent advices show that that the United States Iron and Steel Company, of Demmler, and an important firm at Apollo, intended to commence this manufacture at an early date, but in all probability the industry will remain a tentative one until the modifications of the present tariff law by Congress are fully known.

Although we do not believe that the industry just referred to would have been created in the United States as the result of the recent tariff alterations, even if their permanence had been assured, still there are many existing metallurgical industries in the States which seem likely to be developed by the employment of English capital in the near future. This development seems to us to be not only independent, in a large measure, of the McKinley Act and future modifications of it, but dependent upon what we may term a general and a special reason. The general ground on which we base this belief is to be found in the fact that the rate of interest in this country differs from the rates in the new towns of the United States. In London a 5 per cent. rate of interest may be regarded as a satisfactory return on invested capital, while much larger rates obtain in the American cities. A Chicago owner, for example, accustomed to receive 10 or 12 per cent. on his capital, can be easily induced to part with his business if a price which is considerably above the amount of money he has sunk in it be offered. The English buyer can afford to pay such increased price if he can be assured that the undertaking is a sound one, as he will still be able to receive a rate of interest equal to, and in many cases higher than, that which he has been receiving at home. The *Chicago Economist*, in a recent article on this subject, compared capital held at different rates of interest in parts of the world remote from one another to two bodies of water standing at different levels. As soon as a connecting channel is made they immediately assume a common level, and as soon as the genuineness of any American enterprise has or can be ascertained by the investing public, there is no reason why the business of recapitalising American industries and selling the securities should not go on indefinitely until the two countries give an equal rate of interest upon investments. A special reason why this transference should take place in American metallurgical industries has been supplied by the visit of the Iron and Steel Institute to that country in the autumn of last year. In fact, Sir James Kitson, when visiting Washington, is reported to have said, in conversation with the President, "The gentlemen of our party have come to the United States to ascertain where they can invest their money profitably. There are wonderful resources all through the South, which must be developed, and British capital will undoubtedly find an outlet there, and with gratifying returns for the investors. This is the consensus of opinion of our party, 350 in number." Such an expression of opinion from Sir James Kitson, as spokesman of a body of metallurgical

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experts, cannot be without great significance, and those of our readers who have followed our recent articles on the mineral wealth of the Southern States will not fail to realise that the visit of the members of the Iron and Steel Institute to that part of the country must tend to hasten the development of American metallurgical industries, and cause a large influx of British capital into the United States.

It should not, however, be forgotten that foreigners are at a disadvantage in carrying on industrial work in other countries. In most countries there is a disposition, more or less pronounced, to regard such persons as intruders, and in some cases there are legal and other impediments to fair trading. In the United States there are indications of this spirit apart from their Protectionist policy. At the present time there exists an Alien Land Act, which restricts the holding of land in the United States by foreigners, and a Bill is now under discussion to extend the existing Act to all limited liability corporations other than railway companies. In the event of the Bill becoming law, the companies holding land in the States will be placed on a similar footing to the private individual, and many of the large ranching companies, brewery corporations, and other bodies, whose capital has been found in this country, and who are now trading as American firms, will be considered as aliens, and will thus be handicapped in their competition with non-alien enterprise.

DYNAMO BRUSHES.

The weakest part of a dynamo, taken as a machine, is the commutator, with its brushes, and no part has undergone so little improvement. Our American contemporary, the *Electrical World*, holds that a direct current dynamo must be made without a commutator. A method of making an alternating current machine without even a commutator in its exciting circuit, by exciting the fields by means of a leading current in the armature, has been proposed; and if the armature is stationary, and the field rotating, such an alternating machine would have neither commutator nor collector in its construction. Apart from its exciter, an ordinary alternating machine must have collecting rings for its armature, or field circuit, and so the alternating dynamo is in the matter of commutators rather behind the "unipolar" direct current machine. The unipolar machine cannot, however, be made to give more than one or two volts. Such a generator with many armature turns is, of course, an impossibility. It would involve an electric circuit so arranged that "lines of induction" could continually cut into it without cutting out again. They would have to accumulate these indefinitely. The *Electrical World's* prophecy may come true all the same in some unexpected way. A self-exciting alternator with no magnet coils does not at present sound very possible.

In the meantime, however, direct current machines need commutators and brushes. A great many things have been tried. The old machines had bundles of hard copper wires, which were allowed to get twisted and tangled till they resembled little birch brooms. They were permitted to wear down the commutator as fast as they would. Now, however, machines are made so that, with care, the commutator is worn down very little, but with varying loads there is still great trouble. Is it possible that the problem has never been dealt with from the right point of view? Copper was probably chosen for the commutator and for the brushes with some vague idea that its high conductivity was important. From an engineering point of view, however, no one would run copper on copper and expect good results. Then, again, tangent brushes must tend to increase any unevenness, because it sets them in a state of vibration. Tangent brushes are seldom, if ever, used now, except on "open circuit" commutators, and the end-pressing arrangement is much better. Even then the brushes act to some extent like a lathe tool, and it is important to make them collect without "seizing" or cutting. An engineer, untrammelled by electrical notions, would never run a copper commutator with copper brushes. Copper on copper, or even brass on brass, runs notoriously unsatisfactorily. He would choose some very hard material, like steel, for the commutator, and use brass for his brushes. Steel or iron was used in the earlier dynamos, and has been used more recently by Ferranti for the collecting ring in alternating current machines, but when employed in the commutator the sparking was excessive. Now that that vice is almost non-existent, it would be interesting to see if iron or steel could be used. If not, there are many very hard and durable alloys that might be employed. Messrs. Crompton & Co. have made considerable use of aluminium-bronze. Of course, one important point is, that the commutator sections must be easily cast or drawn. In America, where stock types of machine are always used, the case is not quite the same as here, where the dynamo maker has to make each dynamo to order to suit some particular consulting engineer. Brushes have been made of all sorts of arrangements of brass or copper, but of little else. Professor Forbes used carbon in his experimental unipolar machines, and carbon has come into use extensively in the United States, especially for motor work. Probably the reasons why it works well are that it does not "seize" on copper or phosphor-bronze, and that its resistance is so high that the current dies down when a commutator section is being uncovered. The area of carbon contact becomes smaller, so there is a resistance inserted which reduces the current in the same way as Dr. Hopkinson and others some years ago sought to reduce it, by using several brushes with resistances in their circuits. A carbon collector is apt to make the commutator hot. In America it is frequently used in conjunction with copper brushes, the carbon being put farther forward, so as to reduce the spark, while the copper collects the main current. Copper gauze was recommended and used a few years ago, and it has again come to the front. It seems to be soft enough to fit the commutator closely, and its fibres can yield and follow any unevennesses in the commutator without making the whole brush and its holder vibrate, thus causing "flats." To secure this springiness the brushes are made by what ladies call "cutting on the bias"—that is, cutting the gauze so that the meshes are always presented diagonally to the commutator. A similar principle underlies a form of brush used in the United States. It is made of fine wires, but instead of being laid side by side, they are plaited into cables, several of the cables being used for each brush. Some of the aluminium alloys have been tried for brushes in England without much advantage; so, also, has German silver. There is no need to mention the various arrangements that have been proposed to lessen the effects of varying loads by automatically shifting the brushes or by the use of reversing pole-pieces. The commuting arrangements of direct current machines, especially motors for varying loads, are worthy of the most serious attention.

THE "P. & O." COMPANY.

The honour of Knight Commander of St. Michael and St. George, which has been conferred on Mr. Thomas Sutherland, M.P., the Chairman of the Directors of the Peninsular and Oriental Steamship Company, has not only been universally recognised as well deserved, but also has recalled the remembrance of the fact that on the last day of the year, fifty years ago, the company received its Royal Charter, and marked an interesting date in the history of steam navigation.

In 1835 the company was started in a very small way by a firm of brokers in London, and was intended at first to carry on trade between this country and Spain and Portugal. In a very short time it saved the Government a very considerable sum per annum by superseding the Government packets to Lisbon and Gibraltar, and hence the origin of the first part of the company's name. But the Peninsular has long since been dwarfed almost into insignificance by the Oriental share of the business, while that, on the other hand, is being equalled by the Colonial—a fact which is brought out by the Chairman receiving an honour which is always conferred only for services to the Colonies. The company soon extended its service to Egypt, again superseding another set of Government packets, and justifying the addition of Oriental to its original name. The development of steam navigation naturally led to a desire for steam connection with India, and hence the evolution of the "P. & O." In 1840 the company secured a Royal Charter, by which they agreed to establish steam communication to Calcutta within two years, the East India Company undertaking to pay premiums on a certain number of voyages per annum, with a maximum of £20,000.

The progress which has taken place in shipbuilding and marine engineering since those days, and which has been so well maintained by the P. and O. Company, has been very striking. Their first steamer was built of wood, and was only about 200 tons burthen. She was propelled by side paddles with engines of 60 horse-power, working with about 7lb. pressure of steam, but, being rigged as a schooner, she depended more on her sails than on her engines. When the voyages were extended to Egypt the "Great Liverpool" was built, of 1,311 tons and 464 horse-power. The new Indian traders were larger, the first, the "Oriental," which was built in 1840, and the "Precursor," in 1841, being about 1,800 tons, and in these and their successors the old side lever engines were developed to a stately style of architecture. The first iron ship built for the company was the "Pacha," in 1842, and three years later wood was altogether abandoned. The screw propeller was first adopted in the "Shanghai," in 1857. The making of the Suez Canal and the development of the compound marine engine have done much to revolutionise the trade of India and the Colonies. In 1842 a monthly mail service was started between Calcutta, Madras, Ceylon, Aden, and Suez, and two years later the company entered into a contract with the Government to carry the mails on to Singapore and Hong Kong, for which purpose they had steamers built averaging about 1,000 tons and about 450 horse-power. The next development was a service to the Australian Colonies, and from that time the size of the ships has gone on increasing, all the most recent additions being about 5,000 tons burthen and with triple-expansion engines.

The effect of all these improvements has, of course, been a great reduction in freights. To go no further back than 1869 goods to Bombay were charged from £10 to £12; to Madras and Calcutta, £16 to £20; and now the rates vary from 20s. to 30s. per ton. To China, Australia, and Japan the reduction is much more marked.

THE INSTITUTION OF CIVIL ENGINEERS.

The Institution of Civil Engineers is now the most important engineering society in the world, and its Proceedings are the most valuable records of engineering progress in existence. At its meetings everything of importance in the engineering world is passed in review, and the discussions which take place afford a most useful school for all classes of engineers, old as well as young. It is felt, however, that even engineers can have too much in the way of stiff scientific material to be good for their intellectual development, and that an occasional round of something lighter and less formal would aid in the digestion of the heavier materials. With the view of making the proceedings of the Institution a little more varied in character, the Council have arranged that in future the first meeting in every month shall be got through quickly, and the remainder of the evening spent in conversazione style, when opportunities will not only be given for a certain amount of social intercourse, but also for the examination of exhibits of various kinds. An attempt will be made as far as possible to confine each of these special evenings to the same department of engineering. Thus, on the 13th inst., Mr. W. H. Allen, will contribute a paper on "Auxiliary Engines in Connection with the Modern Marine Engine." In connection with the paper will be shown specimens and models of various appliances. There are, therefore, likely to be found examples of air, circulating, and feed pumps, fans for ventilation and forced draught, refrigerating and distilling apparatus, reversing and turning gear, and electric appliances of all kinds. The idea is an excellent one, and will not only popularise the meetings, but give opportunities to the members to become personally acquainted, and thus benefit them intellectually, and no doubt, in many cases, commercially, more than if the whole evening had been spent in formal discussion.

THE CHICAGO EXHIBITION

The President of the United States of America has now formally recognised the great Exhibition which is to be held in Chicago in honour of the fourth centenary of the discovery of America by Columbus, by issuing a proclamation calling upon all engaged in industries to support the undertaking, and inviting foreign Governments to assist the project. Copies of this document will be sent to foreign Governments, and until replies have been received it will be impossible to say to what extent the Exhibition will be international. No doubt other nations will be guided to a very considerable extent by the action of Great Britain in the matter. As we have already pointed out, there is considerable doubt whether the matter will be taken up very enthusiastically in this country, as our manufacturers have little or nothing to gain by it, and might possibly be involved in a great deal of expense. Moreover, it is doubtful whether our Government will take up the matter officially, for although the Exhibition has been recognised by the United States Government, and assisted financially and otherwise by the Government and the State authorities, it is a private project in itself. It is to be hoped, however, that our

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Government will take the initiative in such steps as will show, at least to the people of the United States, that it wishes the undertaking all success, and is willing to do something to forward that success. The resources of the United States are no doubt very great, and sufficient to make a most attractive and instructive show, but it will be a great disappointment to the Americans if they fail in their desire to make the Exhibition a real World's Fair.

THE INSTITUTION OF ENGINEERS IN JAPAN.

Some idea of the progress of engineering and engineering education in Japan will be formed when it is stated that the Institution of Engineers in that country now contains 11 honorary members, 353 members, and nearly 1,000 associate members. The President is Viscount Yamou Yoso, who was for a good many years Acting Minister of Public Works. The honorary members consist of nine Japanese of high office or scientific attainments, and two foreigners—Henry Dyer, M.A., D.Sc., the first Principal of the Imperial College of Engineering, and his successor in that office, Dr. Edward Divers, F.R.S., who is still in Japan. The list of members includes all those who are actively engaged in superintending the numerous engineering works and manufacturing industries all over the country, while the associates are connected directly or indirectly with those works. When it is remembered that it is only seventeen years since the Engineering College was founded, and only a little over ten years since the Institution was organised by the first graduates from the College, it will be seen that astonishing progress has been made.

Letters to the Editor.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

To the Editor of "Industries."

Sir,—The question at the head of this letter occurred to me after reading your review of Professor Cotterill's book on "The Steam Engine Considered as a Thermodynamic Machine," which appeared in your last issue. I had previously read a considerable number of other notices of the book, and had, moreover, tried to make myself acquainted with the book itself. If the author of such a treatise places any weight on the opinions of his critics his mind must be in a very unsettled condition at the present time with regard to the merits of his book, and, in fact, of the use of a great deal of his daily work, for which he is paid a good salary by the British Government.

It seems to me that your notice is the fairest of all that have appeared, as it points out clearly the scope of the work and the class of men to whom it will be useful, while it also indicates some improvements which might be made upon it. You point out that the book treats of what may be called the physics of the subject, and explains the phenomena which occur in the use of steam, without, however, bringing the results into the shape immediately useful for practical calculations—that is to say, it is an educational book, which while it leads in the direction of practical applications, is intended primarily for the purpose of elucidating phenomena. The notice in *Nature* concluded by saying "that from the point of view of the student of physics, the book forms a most valuable supplement and corrective to the necessarily abstract discussions which form the substance of treatises on theoretical thermodynamics."

The notice which has puzzled me, however, is that which has appeared in your contemporary *The Engineer*. While admitting that the book will interest the closet philosopher, the man who takes delight in pretty problems and hypotheses, however useless; and also the man who—like some of the old mathematicians—would not consider his thermodynamic abstractions any the less important because they cannot have any practical application, the writer concludes by saying that engineers, upon whom this great steam engineering nation depends for all that is done by the splendid engines of all kinds to-day, would waste their time if they tried to gain anything from this book; and further that "the progress made since 1877," of which the author speaks, has been made in spite of the teaching of the first edition of the book, and of the teaching of others of the same kind. Of course I know some of the peculiarities of your contemporary when treating the subject of Professor Cotterill's book, but surely statements of this sort should not be allowed to pass without contradiction and without demonstration of their incorrectness. Those of your readers who are at the same time practical engineers and students of thermodynamics would confer a great favour on the younger members of the profession if they would give their opinions on the subject.

Yours, &c.,
Student.

Glasgow, 3rd January, 1891.

THE EFFICIENCY OF STEAM JACKETS.

To the Editor of "Industries."

Sir,—Your interesting article on Professor Thurston's historical paper upon this subject will, I hope, produce some comments or experiments from competent engineers.

When we consider how easily steam jackets are misunderstood, and how often misapplied by making them into air or water jackets, such an inquiry may be expected to reveal a great variety of results and much want of uniformity. We find in the above paper many kinds of piston speeds, with various strokes, cylinders of different diameters and in different positions, vertical or horizontal. The pressures of steam, expansions, pressure in the jackets, supply to the jackets, and the quality of the steam also vary much in the different engines.

Few people fix a steam gauge on their jackets to check the pressures and temperatures, and to ascertain whether the steam supply to the jackets is large enough. A cock at the highest and lowest points of the jacket should also not be omitted, to test for steam or water.

The "quality" or dryness fraction of the steam used in the engines has, no doubt, as you say, a considerable influence, but unfortunately there is much difficulty in testing the steam, since no reliable instrument at a moderate price has hitherto been offered to the public.

Further, there is the important question of the temperature of the cylinder walls, and of all the internal parts exposed to the working steam. All these have a marked effect on the hot steam. These walls should be kept generally at the highest temperature available, and certainly hotter than the initial steam. With the same quality of steam, and with walls at two different temperatures, the hotter wall will doubtless yield the most economical results. Where the walls are of the same temperature, and working with steam of different qualities, the dryer the steam the better will be the result. My experiments show that the temperatures of cylinder walls are some 30° F. hotter with steam in the jacket than without. An economy of 31 per cent. due to the jackets was obtained with a small fast-running single-cylinder condensing vertical engine. For every pound of water deposited in the jackets about 5lb. were economised in the cylinder.

With vertical cylinders it is not difficult to divide the barrel-jacket water into two parts, and collect the water separately from the two vertical cylindrical surfaces of the jacket space—that is, from the inner and the outer surface. It is only the former which represents the useful heat going through the metal walls and keeping them hot; the latter shows simply the loss due to useless radiation, which should be reduced to a minimum.

Lately I have had an engine working (1) with steam in the jackets, (2) with hot water, and (3) with hot air in the jackets. The results are interesting and instructive. Of course, the air and water were, in each case, allowed to acquire their normal temperature before commencing, all other conditions remaining the same. The very different results obtained with jackets of steam, of water, and of air were afterwards compared.

Yours, &c.
Bermondsey, 3rd January, 1891. Bryan Donkin, Jun.

CHEAP FOOD OR WANT?

To the Editor of "Industries."

Sir.—Want or semi-starvation for the masses, the impoverishment of many capitalists and manufacturers, and agitations leading possibly to riots, appear to threaten, unless cheap, healthy, abundant food is speedily secured for our poor and comparatively poor.

Man by labour or inherited labour called wealth must get fed regularly and fed cheaply. His digestion requires a wide and varied diet. In our cold, damp climate, where sunshine is comparatively rare, every man should obtain at least one daily meal of fish or meat. Owing to faulty distribution and preservation, much of the fish and meat consumed by the poor is often wretchedly inferior and exorbitantly dear. Hence, perhaps, their excessive tendencies to alcoholic drinks and tobacco, which at least please their palate.

The producer provides cheap excellent frozen meat, poultry, and game, which too rarely reach the consumer except when sold as and at the high prices of home-bred, fed, and killed animals. Legislative interference should prohibit such fraudulent trading. Our fresh food markets, whose charters and existence were granted to bring the producer and public together, are now usurped by a handful of capitalists who have cleverly "cornered" the public markets and their entire fresh food supplies so as to sweat the producer, semi-starve the masses, and overcharge the classes. Cobden's Free Trade principles have been so engineered that the producer gets no profit because the middlemen gain all.

As regards fish the Billingsgate "ring" excludes the public, the fishmongers, and the costermongers, from purchasing except from the "ring," who cling to perpetuating bacterial Billingsgate, with all its avoidable abominations and augmenting abuses. Hence stale fish continues at famine prices instead of cheap, fresh, imperishable fish.

Every day of the year 2lb. of bled, gutted, cleaned, dry-air frozen (imperishable) fresh herrings (about six fish) could be profitably retailed by costermongers for one penny, or 2lb. of sprats for one halfpenny.

The Billingsgate "ring," by a shrewd system of cruel crushing mortgages on the uncaught and caught fish, enslave and impoverish the indebted fishermen. According to Cahill's evidence before the Corporation, 1881, Fish Enquiry, "The practice in Billingsgate Market is that its 'ring' realises the highest price it can and returns the sender *what is expedient*, or what may be agreed on among its members. This 'ring' very often after agreeing on the price to the senders so distrust each other that they exchange account sales enclosed in open envelopes, so that 'A.' reads, seals, and posts 'B.'s' sales, and *vice versâ*."

To keep up the price of fish much is destroyed by the "ring," who ruin our national fisheries and fishing industries. Our manufacturers will soon be unable to compete with foreigners, who obtain cheaper labour because of cheaper food. Hence the land, buildings, and plant of the British manufactories will suffer increasing depreciation, their labourers and those dependent upon the earnings of the labourers will find their occupation gone.

With our large pauper, police, prison, and asylum establishments, and an expensive army and navy fed by the public purse, dear food means increased taxation. Hence the question of cheap, healthy, abundant food should be carefully considered by Parliament and the County Councils. By means of retail stores, and costermongers for the poor, the producer should sell fresh food direct to the consumer.

Yours, &c.,
J. Lawrence-Hamilton, M.R.C.S.
17, Burlington Street, Brighton,
5th January, 1891.

OUR BIG GUNS, AND HOW THEY ARE MADE.

To the Editor of "Industries."

Sir,—I have read Lieut. R. R. Gubbins' letter in your last issue with considerable interest, but I must beg to draw his attention to a letter that I addressed to your contemporary *Engineering*, of October, 1886. In this letter the following explanation is given of what I consider to be the fatal defects of built-up guns:—

"With a rather considerable experience in the use of metals subjected to elevated temperatures, and knowing that metals of varying densities and chemical constitution had varying degrees of dilatancy and varied in their heat conductivity, or had variable diathermaniac characteristics, it seemed to me that, given an inner tube of a gun of a certain metal having a definite chemical constitution and physical density, surrounded with heavier coils shrunk thereon and of different chemical constitution, degrees of dilatancy, and diathermancy, and given that a certain quantity of heat were applied to the inner surface of the inner tube, the resultant action would be that the circumferential dilatancy of the inner tube, beyond the elastic limit, would be prevented by the heavy and cooler shrunken coils, and a surface fracture of the inner tube by compression would be very probable.

"To show the quantity and intensity of heat that could be accumulated in heavy guns, it was stated by Mr. Robert Wilson that the heat had been found sufficient to account for the melting of the soft particles of metal in bronze and cast-iron guns. Consequently, it was not unreasonable to conclude that the several local pressures acting upon steel tubes exposed to a higher temperature were sufficient to start the surface cracks in the steel tubes of large guns, and that neither the shrinking on of coils nor the coiling of wire would prevent the formation of these surface cracks. The degree of residual heat left from each charge must be considerable—even although the interval of time is so short as $\frac{1}{10}$th part of a second.

"The effect of continuous firing on some of these heterogeneous structures, unless adequate means of cooling were adopted, could hardly fail to be disastrous to the soundness of the inner tube, and the suggested increase of chase hooping, if the theories advanced are acceptable, would not be in the least a remedy."

Soon after this letter appeared the Elswick people abandoned the wrought-iron hoops and adopted mild steel instead. This is, so far, good; but what about the great number of guns on the old Armstrong principle of construction, spread over our centres of defence, and which are intended to protect many of the elements constituting our navy? Not one of these guns can be said to have the full confidence of our gunners.

Even with the shrunken hammered steel hoop, the guns are still radically wrong in their principle of construction, because the hoops have a different physical density to that of the tubes. The factors of diathermancy and dilatancy will vary, though not in the same degree as before.

What is required is a system of cast-steel guns, cast on a similar principle to that adopted by the illustrious Rodman, whose system of cast-iron centrally cooled guns decided the fate of the issue between the North and the South.

Yours, &c.,
B. H. Thwaite.

Liverpool, 5th January, 1891.

THE PHENOMENA OF THE DEPTFORD MAINS.

By J. Swinburne.

I.

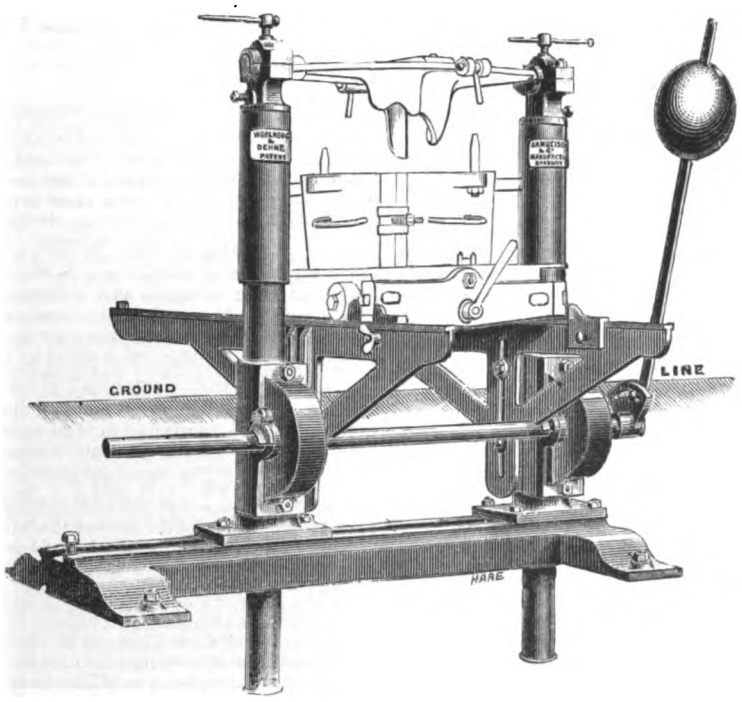
In a paper on condensers, read at the Physical Society on the 12th of December last, I gave what I believe to be the true explanation of the phenomena observed in connection with the high-pressure mains from Deptford to London. This gave rise to considerable discussion at the meeting, and the matter has been still further investigated in the pages of the *Electrician*.

The contention in my paper was that the rise of pressure observed is not due to any sort of electrical resonance, as commonly supposed, but to armature reactions in the dynamo. I gave as my reasons against the resonator effect, that with the capacity of the cables, the frequency employed, and the actual self-inductions in the circuits, such effects cannot take place. I by no means denied that, under certain conditions, electric resonance can take place, neither did I deny that condensers, choking coils, and resistances can be combined in ingenious ways to give curious results; all I said was that the resonator effect could not occur in this particular case. The armature reaction theory seems to account for the phenomena, and I described an experiment made with a condenser, a transformer, and a dynamo which bore out my theory.

The resulting controversy is, to some extent, unsatisfactory. To invalidate my theory or to establish another, it is necessary, first, to show that armature reactions will not account for the phenomena at Deptford, and preferably that they do not account for the effect in my own experiment; and secondly, that such phenomena as those produced at Deptford can be obtained by electric resonance, or by combination of capacity and inductance, not taken at random and called L and K, but agreeing at least approximately with those existing in the particular case under discussion. I do not for a moment deny the great scientific value of the discussion in the *Electrician*, calling attention, as it does, to many curious and interesting results obtainable by coupling up appa-

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IMPROVED MOULDING MACHINE.



General View of Machine.

ratus in particular ways; I merely say that it neither shows any error in my explanation of the rise of pressure in the Deptford mains, nor is any other given.

Before going farther into the question, I should say that I have for some time past abandoned the notion of "self-induction" in an armature of an alternating machine, and considered the questions of armature reactions only. In 1887 an alternator was designed for parallel running according to this theory, and it is referred to in some papers on electrical measurement contributed to the *Electrical Review* in that year, and reprinted in book form.* A patent for alternating motors, of February, 1889, depends on this theory. In the discussion on Mr. Mordey's paper on "Alternate Current Working," Sir William Thomson explained the action of the armature currents most clearly on the same principles.†

The orthodox method of dealing with alternating dynamos and motors is to treat them as if they had an "impressed electromotive force" which is independent of the load, and a coefficient of self induction. The coefficient of self-induction L of a dynamo is generally taken, so that $Ldc/dt = E$, the instantaneous back electromotive force which has to be deducted from the instantaneous impressed electromotive force to give the terminal electromotive force. This involves a confusion of thought. If, to use the orthodox expressions, the rate of cutting the lines of force gives the electromotive force, any alteration of the magnetic field due to the armature current, even if completely localised in the armature, merely alters the rate of cutting lines, and, therefore, the electromotive force. The idea of self-induction and electromotive force in the same moving armature depends on two distinct ideas of the same thing. The self-induction is treated as "electric inertia," and the pressure as cutting lines of force. We might imagine a dynamo with enormously powerful fields, so that one turn would give the output, and a small choking coil, with a constant coefficient of self-induction, arranged in series. This would be the analogue of the conventional alternating dynamos met with in discussions containing mathematical symbols. It must be admitted that, according to my armature reaction theory, the cross-induction makes the armature current lag as the load increases, and the back induction lessens the pressure, so that the effect looks like that of self-induction in the armature circuit. Like "magnetic resistance," the expression "self-induction of the armature" is convenient in speaking in a loose and qualitative way, and I have often so used it; but when quantities are dealt with "self-induction of the armature" will not explain the action of dynamos and motors on one another. I hope to discuss this subject more fully at some future date.

Turning to the main subject of this paper, my first critic is Mr. Kapp. At the discussion on my paper he referred to an experiment of his own. A dynamo fed the primary of a transformer. The secondary, wound for 14,000 volts, was connected to sparking points, which sparked $\frac{13}{16}$in. A cable was then put on, and the sparking distance increased to 1in. without any rise in the terminals of the alternator. The capacity of the cable was not given. Assume, as an outside figure, half a microfarad. Then, if the pressure rose from 14,000 to, say, 15,000 volts, with a frequency of 80, there must have been a self-induction of no less than half a henry somewhere between the sparking points and the transformer. It must have been outside the transformer, for the secondary pressure did not alter. I can only suggest that Mr. Kapp has here been misled by some rough experiments. The spark is not an accurate enough test of pressure. The existence of such a self-induction between the spark points and the transformer—that is to say, in the experimental connections—is quite impossible. This experiment was described by Mr. Kapp in the heat of a discussion, and may not, therefore, be representative of his views on these points.

Mr. Kapp has, however, contributed a long article to the *Electrician*, which, though addressed to the younger readers of that journal, refers to my paper and criticises the part dealing with the Deptford mains. He says that I am wrong in assuming that electrical resonance only occurs at one particular frequency. He does not appear to know what I meant by electrical resonance. On looking up Dr. Hopkinson's paper, referred to by Mr. Kapp, I find he also uses the term in connection with the effect of a condenser and self-induction in series at any frequency. This seems to me an inaccurate use of the term. To show what I mean, a rough analogy will suffice. Imagine a large watch-balance with a hair spring. The moment of inertia of the balance corresponds to the self-induction, the weakness of the spring to the capacity, the friction to the resistance, the force applied by the spring to the pressure, and the angular velocity to the current. Suppose, first, that there is no moment of inertia, the spring will give, so that its force exactly counterbalances that of the impulse, and never becomes greater. If the wheel has inertia, however, on applying an impulse it will first be opposed by the spring and inertia together, but towards the end of the movement the inertia will help the impulse to wind up the spring. The pressure of the spring is thus greater than if there had been no inertia; the movement of the wheel is also greater. Suppose that the frequency of the impulses is altered till it corresponds exactly to that of the balance, instead of vibrating through a few degrees the wheel will vibrate through an increasing angle, and this angle will grow till it becomes infinite, if there is no friction. This is the resonator action, and it only occurs when the frequency of the impulses corresponds with that of the balance. It is in virtue of this action that such a very small power can keep a large clock pendulum going. If two pendulums of slightly different lengths were connected to one scape wheel, it would take incomparably greater forces to drive them. If the balance has friction, its vibrations will not become infinite, but only large enough to absorb all the power supplied by the impulses. If the friction is very great—for instance, if the balance be immersed in a liquid—it will absorb so much power with a small movement that resonance will not show much. Mr. Kapp has, in his example, immersed the balance in treacle. Take, instead of fancy figures, the capacity, pressure, and frequency at Deptford, and see the effect of a variation of speed with the critical self-induction in circuit. Take the case of no load, and assume the dynamo and transformer to give 10,000 volts at Deptford. Take the capacity of a seven mile cable at 2·5 microfarads, and the resistance at 2·27, the frequency being 67. These last figures are from Dr. Fleming. Call E the maximum value of the pressure on the condenser or cable. As the capacity is distributed along the resistance, it may be taken as 1·14 ohm outside the condenser. Assuming the harmonic law, as is indeed permissible when rough results are alone wanted, we have

$$E_1 = E \cos 2\pi n t,$$

where n is the frequency. The current into the condenser is then

$$C = -K E 2\pi n \sin 2\pi n t,$$

and the electromotive force on the induction coil is

$$E_2 = -L K E(2\pi n)^2 \cos 2\pi n t.$$

The critical value of L is then found

$$L = \frac{1}{K(2\pi n)^2},$$

and is 2·37 henries.

The dynamo giving 10,000, E can be found from the following equation—

$$10{,}000 = \sqrt{\left\{E - L K E(2\pi n)^2\right\}^2 + (rK E 2\pi n)^2},$$

when there is resonance,

$$L K E(2\pi n^2) = E,$$

$$\text{so} \quad E = \frac{10{,}000}{rK\ 2\pi n} = 10{,}450{,}000.$$

With resonance then, instead of a rise of a few hundred volts over the normal pressure, we have a pressure of ten million and a quarter volts, which might even discourage Mr. Ferranti. This can only happen at the exact frequency of 67. Mr. Kapp thinks I was wrong when I said an alteration of 5 per cent. would stop the effect. Let us try a much smaller alteration of speed, say one-tenth of 1 per cent. This gives five million volts. Instead of altering one-tenth per cent., let the speed vary 1 per cent., the pressure falls to half a million volts.

(*To be continued.*)

* "Practical Electrical Measurement," pp. 134 to 136.
† Journal Inst. Elec. Eng., XVIII., p. 667.

IMPROVED MOULDING MACHINE.

The accompanying illustration represents an improved form of sand moulding machine (Woolnough & Dehne's patent) manufactured by Messrs. Samuelson & Co., Limited, Britannia Works, Banbury. The machine consists essentially of two vertical columns resting on a bed-plate, the distance between which is capable of adjustment according to the size of the pattern plate. In the columns are two spindles which carry the pattern plate in bearings, and are raised and lowered in the columns by means of a hand lever. The pattern plate can be turned completely round in its bearings, and the moulding boxes can be firmly attached to it by means of split keys or screws. The bottom box is first fixed to the plate and the sand rammed up; the whole is then turned completely over and the box lowered until it rests upon the table; the plate is then unfastened from the box and fixed in its bearings by the set screws, and, by means of the hand lever, is raised from the mould. This operation leaves the bottom box ready for use. The process of moulding the top box is exactly the same as for the bottom, taking, of course, the impression from the other side of the plate.

The makers claim that the accurate vertical lift and the raising of the pattern plates equally on both spindles prevents the breaking off of the corners or the cracking of the sand, thus completely avoiding the troublesome application of water and the "mending up" of the mould. The construction of the lift, we are informed, is so accurate that little or no taper is required in the pattern, an advantage where a deep lift is necessary. It is further claimed that the joint is accurately made, that no fin is left, and a highly finished surface is obtained by lifting the pattern from the sand by means of the hand lever, dusting the mould with blacking, and replacing the pattern in the mould; by this means the surfaces are easily and rapidly sleeked and made exceptionally smooth. A labourer can work the machine, as beyond ramming up the sand no skill is required.

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THE PROGRESS OF ELECTRICAL ENGINEERING IN 1890.

I.

The year which has recently closed has, perhaps, been the most active that electrical engineering has yet seen. Nearly every firm has been so busy that work has been considerably behind promised delivery. Many of the electrical works have resorted to overtime, and considerable difficulty has been felt in getting skilled labour in various departments, owing to the general briskness of work.

Perhaps the most important event of the year was the opening of the City and South London undergronnd electrical railway. This is remarkable, not so much for any new departure in electrical engineering—as there are no special novelties in the design—as for the perfect confidence deservedly shown in electrical engineering. Not only is this railway an important piece of electrical engineering itself, but it will, doubtless, be the beginning of a general waking up to the knowledge of the fact that the electrical engineer can actually handle the transmission of power—even of large powers—very much better than is commonly supposed. Electrical engineers are so accustomed to look upon the transmission of power as perfectly easy, that they are apt to forget that the ordinary mechanical or civil engineer does not yet fully realise what an electromotor is.

Central Stations.

The growth of central station supply during the last year has been most remarkable. The Deptford Station has been advancing slowly, but surely, towards completion. The engineers have had, as might be expected, to deal with many unforeseen difficulties; and, as might also have been expected by those who know the engineers, the difficulties have been met with skill, courage, and dogged perseverance.

The various London companies have been rapidly developing their business. As a rule the demand for lamps has exceeded the supply, and the field for central station work seems to be unlimited.

The Metropolitan Supply Company have been developing their various stations, and gradually increasing their output.

The Notting Hill Electric Light Company are not yet supplying current, but soon will be. Most of the mains have been laid, and the first of their stations is nearly complete.

The West Brompton Central Station, belonging to the House-to-House Company, has been increasing its output, under the able management of Mr. Hall. Mr. Hall has now been succeeded by Mr. Gay, who has recently been identified with Brighton.

The Kensington and Knightsbridge Electric Light Company have been putting down more plant, including four large Gramme-wound dynamos by Crompton & Co. Their new switch board is in working order, and the bare copper strip conductors are giving the greatest satisfaction. According to Mr. Miller, the engineer, the lamps fixed number 25,000, and the output is about 300 kilowatts as a maximum.

The Westminster Electric Supply Corporation now have a permanent station at Millbank Street, with four Goolden dynamos of 45 kilowatts each, and two Mather & Platt machines of 112 kilowatts, and a 500 ampere hour Crompton-Howell battery. This station is also connected to a special Crompton-Howell battery placed in the Houses of Parliament, and used for its circuits alone. This station has already reached an output of over 1,000 amperes. This company has a temporary station at Dacre Street, with two 45 kilowatt dynamos coupled to Willans engines and a 500 ampere hour Crompton-Howell battery. These two stations together supply nearly ten thousand 8 c.p. lamps. Another permanent station is in progress in Eccleston Place; two boilers and dynamos are being put down, the chimney is nearly built, and it is hoped the station will be supplying power this month. There is a fourth station in course of completion in Davies Street, and dynamos, engines, and boilers are ready for erection. About fourteen miles of streets have already had mains laid in them. These stations use Babcock-Willcox and Davey Paxman boilers, Willans & Paxman engines; Crompton, Goolden, Mather & Platt, Electrical Construction, and Siemens dynamos; and Crompton-Howell batteries. This company is fortunate in securing Professor Kennedy as engineer-in-chief. Mr. Foster acts under him as resident engineer. The whole of the architecture, which is a matter of no little difficulty, has been in the hands of Mr. C. Stanley Peach.

The Chelsea Company have been fully employed. They use direct current with batteries and a system of automatic mechanisms designed by Mr. F. King. This company have their main station at Draycott Place, and charge three battery stations from it direct, and also employ dynamotors.

The Electricity Supply Corporation have a station near the Strand. They supply direct currents, and already use 600 horse-power.

The St. James and Pall Mall Electric Lighting Company have been one of the most prosperous. Direct currents without batteries are used. The output has already exceeded 4,000 amperes. Babcock boilers, Willans engines, and some very fine Latimer Clark and Siemens dynamos are used. The whole of the electric work is under Mr. S. D. Dobson. They have never yet had a stoppage of supply.

The Brighton Electric Light Company have been struggling against the threatened competition of the Corporation of Brighton, and have adopted the bold policy of cutting off any consumers who will not sign a three years agreement with them. About three-quarters of their customers have agreed to this, so it would seem that their policy may be successful.

The Eastbourne Electric Light Company continue to develop their high-tension alternate current system of distribution, and, like many other companies, find they cannot cope with the demand for light. They are putting down another Elwell-Parker 70-kilowatt alternate current dynamo, and another high-pressure locomotive type boiler. About 5,000 lamps are in use. The mains, as is well known, are all underground, and have given no trouble except at some of the joints, which were rubber-covered and then coated with guttapercha. A few bad joints have since been vulcanised, and Mr. H. W. Wilkinson, the engineer, anticipates no further difficulty. The sliding-scale system is about to make way for a uniform charge of tenpence per kilowatt hour.

The Sheffield Telephone Company have two Mordey alternators in use and Mordey transformers. One dynamo is driven by a Brush engine. The lighting here is of a specially remunerative nature, as it has been mostly taken by shops, so that the dynamos need not run during the day, and full load comes on early in the evening.

The Exeter Electric Light Company have only just begun to supply power. The whole work has been carried out during last year. Two Mordey 75-kilowatt alternators are used, and two Thomson-Houston 30-light arc machines. Two Fowler compound horizontal and two Westinghouse 25 horse-power engines are used. The Babcock & Willcox boiler is employed. Space is left for two more large engines and the necessary dynamos. The wiring is overhead, and where it crosses a street a No. 10 steel wire is arranged above to act as safety guard. The whole is in charge of Mr. T. P. Wilmshurst.

The Newcastle-upon-Tyne Electric Light Company are increasing steadily. The firm have sufficient confidence in electric lighting plant to arrange to supply power at an exceedingly low price. Of course, it must be remembered that gas is cheap in Newcastle, as coal is cheap; but cheap coal does not reduce the price of electric power in anything like the proportion it reduces the cost of gas. Two Robey engines are used, with trip gear of the Corliss type. Mordey dynamos and Mordey and other transformers are in use. The leads are chiefly, if not wholly, underground. Mr. R. C. Jackson is engineer, and he has the benefit of Mr. A. W. Heaviside's extensive experience of underground wirework.

Messrs. Hammond & Co. are carrying out some very extensive central station work in Madrid. They have just completed a central station there of the same type as that at West Brompton, but twice as large. There is a specially good opening for central station work in Spain, for gas is dear.

The Woking Electric Light Company opened their station on the 1st of November. Kingdon dynamos are used, and hedgehog transformers. Some of the leads pass under a river, and the Fowler-Waring cables stand this strain perfectly.

Fareham was the third town in England lighted wholly by electricity. Overhead wiring is adopted throughout, long poles being used to comply with the Board of Trade regulations. The two chief streets are lighted with twenty-one Thomson-Houston arc lamps, the other streets of the town are provided with 20 candle-power incandescent lamps. Okonite wire is used for the arc circuits. The station has boilers and engines by Messrs. Ransomes, Sims, & Jefferies, which work with great steadiness. The engine is of their 30 horse type, fitted with patent automatic gear. Thomson-Houston dynamos and transformers are used.

The Liverpool Electric Supply Company have, during the last twelve months, increased their supply from six to ten thousand 16-candle lamps. They have now three central stations in operation, and a complete system of underground mains. A continuous supply at 110 volts is kept on day and night. The electric light is very highly appreciated in Liverpool.

(To be continued.)

THE LONDON SMOKE AND FOG PLAGUE:

ITS ORIGIN AND DANGERS, AND A PROPOSED SOLUTION FOR ITS REMEDY.

By B. H. Thwaite, C.E., F.C.S., A.M.Inst.C.E.

I.

One of the most striking characteristics of this mammoth city of London—with its five millions of population—in the eyes of foreigners, is its depressing and sombre atmosphere; an atmosphere that has no parallel, and, it may be safely asserted, one that would not be endured by any other civilised community in Europe. Some of the enterprising citizens of this giant metropolis are ever and anon erecting costly structures, many of them adorned with beautiful and artistic workmanship which for a few months are a joy to passers by, but the destructive atmosphere soon commences its begriming work of defacement, reducing the beauty of stone and marble to a mere caricature of its first and unsullied appearance.

The most unobservant cannot have failed to notice that at early morn, before the workshops are opened, and domestic and restaurant fires are lighted, London has a clear and pure atmosphere occasionally as bright even as that of Paris, and always far more bracing and vigorous, but this clearness is dispelled at the beginning of the clang and clink of hammer and shovel, and the jar and rattle of the wheels of industry and the expedients of domestic work. Why should this be? To ask this is like a cry of interrogation in the wilderness. It should, however, be the duty of every citizen to ask this question and demand an answer, but that which is every one's duty is too often accepted as meaning no one's, and so it is that year after year the same conditions of atmospheric gloom prevail, and year after year architectural beauty is ruthlessly destroyed, and internal art decoration in all its forms is more or less sullied and disfigured, and the labour involved in maintaining domestic cleanliness is enormously increased. But all this inconvenience and the destruction of domestic comfort and the loveliness of art is overshadowed as a damning indictment by the more serious one, which declares that no contagion has a more destructive influence on the well-being and stability of men's lives than the smoke-laden fog of London. Let us analyse the causes constituting this latter characteristic. The sun is the source of life, and under its radiant influence life becomes brighter and all nature is glorious, but the smoke layer intervenes between the dwellers of the metropolis and the solar source of light and life, and this absent invigorator means death for many a delicately constituted life.

How many frail threads of life have been broken by sheer abandonment of effort, because life has no natural stimulus to defeat the effects of nervous depression, God alone knows. "Only a stray sunbeam! Yet it cheered a wretched abode, gladdened a stricken heart." Further, the absence of this external stimulus which the sun gives drives men to seek nervous encouragement in that liquid invigorator which surely destroys, whilst it increases for a transient period, animal and nervous vitality.

A glance at a graphic mortality diagram is more impressive than the mere recapitulation of numerals. It will be seen that a sudden rise of the death line occurs during the period when the full effect of the smoke production of London is more directly felt, or when the barometric change of pressure and the change of temperature produce what is known as the "London fog." The average weekly rate of mortality during the prevalence of fogs is nearly doubled, whilst the deaths traceable to diseases of the respiratory organs are far more than doubled. Of course the effects of the smoke-laden fogs are more marked in the case of persons of advanced age. Mr. E. Hart, editor of the *Sanitary Record*, stated before the Select Committee of the House of Lords on Smoke Abatement and Prevention in 1887, that in a fortnight of heavy fog in 1886 the mortality rose to 40 per 1,000, a rate equal to that of the great cholera year. The fog lately prevailing in the metropolis, although not abnormally dense, gave sufficient evidence of its deadly effect. The mortality rate, which attained the figure of 17·4 for the previous week, rose to 20·5, the average rate of the few weeks before being only 16·6. In more salient figures this means an increase of 269 deaths in the previous week, and of 399 deaths per week on the average of the five weeks. The death record of a single day in the metropolis owing to an ordinary smoke fog may be estimated at between 170 to 200. If a railway accident produced an equivalent disaster, what an outcry there would be for means of prevention and what determined legislative action would follow!

It is the aged who demand our fostering care, and who suffer the most. Their lungs are not sufficiently vital to withstand the combined effects of the frozen aqueous vapour and its accompaniment of sulphur and carbon in

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atomised form; consequently a lowering of the animal temperature and vitality, followed by a reduction of the work of oxidation of the blood, soon brings the enfeebled life to its close, a life that in many instances is precious to the nation, and often deserving the tenderest care for the good it may have done. The increased weight of the vaporous particles due to the addition of carbon and sulphur increases *pari passu* the specific gravity of the particles of frozen aqueous vapour, and they fall to the breathing level with constantly increasing density, and it is not at all improbable that some day an abnormal condition of the atmosphere may produce such a dense condition of fog as to endanger the lives of all those who are unfortunate enough to be enveloped in its deadly embrace.

At present, and as already shown, in London alone during the fog days the increased death-rate is in numbers equivalent to the sweeping away each day of the inhabitants of a rural village, but even this serious death number in such a vast collection of mortals is not more noticeable than the removal of a cartload of sand from the sea shore.

Besides the killing effect on the lives of men traceable to the London smoke fog, there is its destructive effect on the moral stamina, an effect unfortunately not so easily measurable, except by the increased cases of drunkenness during the fog days. "Cleanliness is next to Godliness"—so said sturdy Charles Wesley. It is proved beyond question that this law has an inverse application, and that dirtiness is akin to devilishness, and that the darker and dirtier and more smoke-begrimed the parts of a city, the greater its proportion of crime in proportion to the population. The smoke, grime, and dirt attributes of a great part of London town are in a great part due to the smoke-laden atmosphere, which is the indirect cause of an untold number of crimes and of misery, and it is a black plague of as destructive a character as that London Plague of 1666.

Some salient figures may demonstrate the physical proportions of this modern London plague. A scientist who has given considerable attention to the subject calculates that the daily fog hanging over London weighs 300 tons, 50 tons of this amount being carbon and 250 tons hydrocarbon. This, converted into sterling value, is equivalent to an annual loss of £2,000,000 sterling, or, in other words, London citizens pay £2,000,000 sterling for the privilege of possessing this deadly and daily accompaniment of their lives. What a satire on our industrial, scientific, and sanitary progress!

The principle of the conservation of energy is in no instance more profoundly or more impressively expressed than in the connection between the animal and vegetable world, and the intermediate action of oxidation which is involved in this connection. In animal life the oxidation of the carbon produces carbon-dioxide, the carbon of which is absorbed by the leaves of the vegetable elements. The oxygen is returned to the atmosphere, to be again absorbed by the animal world; the carbon and nitrogen forming the structure of the plant or vegetable is also absorbed in fruit form by the animal world, which gives these elements back again to the vegetable and plant life, the carbon in gaseous form as carbon-dioxide, the nitrogen in liquid form as ammonia or in solid form as nitrogenous matter. In the flame combustion of the vast stores of coal once constituting primeval forests the same action of oxidation goes on as if the vegetable elements had been consumed by animal absorption; and if the flame combustion was as perfect as it is by the animal action, the result of this combustion would be the separation of the nitrogenous results from the carbonaceous ones, and both would be separated for fertilising the vegetable world in a liquid, solid, or gaseous condition for the ultimate benefit of animal life. Thus the two lives, animal and vegetable, are dependent upon each other for mutual continuance of existence. To realise the full majesty of animal life one has to see the jungles of the equatorial forests, where the two kinds of life in magnificent proportion mutually foster each other; but are these natural conditions of mutual interchange in existence as they should be in our artificial methods of life? Our modern Babylon has not the wondrous hanging gardens of its mighty and ancient prototype. Yet London was not always the city of sombre hue; not very many years ago prize roses were grown in Camberwell. That colour of all others so natural and refreshing to human eyes, the verdant green, in all its lovely varied tones and shades, cannot now be seen in London in its pristine purity; a dirty caricature of the exquisite hue is all that can be seen. It is indeed strange that even this parody of natural beauty of colour exists. Nature, however, is so persistent that if there is a vestige of chance it is taken.

In place of the gaseous form of carbon-dioxide and the collected nitrogen, the products of our combustion arrangements in the metropolis are constituted partly of an oxidised and gaseous character such as carbon-monoxide and carbon-dioxide, and partly of carbon in a solid form, in an atomised or finely divided condition as soot or smoke, the nitrogenous and sulphurous constituents of the coal being partly drawn off as ammonia vapour and sulphurous acid, and atomised sulphur. The carbon and sulphur atoms are deposited either on the surface of buildings, destroying their architectural beauty and depreciating their value, or it settles on the leaves of plants, choking up their pores and impeding the natural series of connecting inter-actions that unite the animal and vegetable world.

The carbon in its partially oxidised condition as carbon-monoxide is a gas of combustible value, inodorous and poisonous to organic life. This gas is the intermediate constituent between atomised carbon or smoke and the carbon-dioxide of perfect combustion. Had the carbon-monoxide another equivalent of oxygen it would be in a condition suitable for assimilation by the vegetable world, but, minus this equivalent, it is actually destructive of both vegetable and animal life. Another constituent of our imperfect methods of combustion is carbon-bisulphide, a most obnoxious compound, and one that is responsible for damage to articles of value and silver plate.

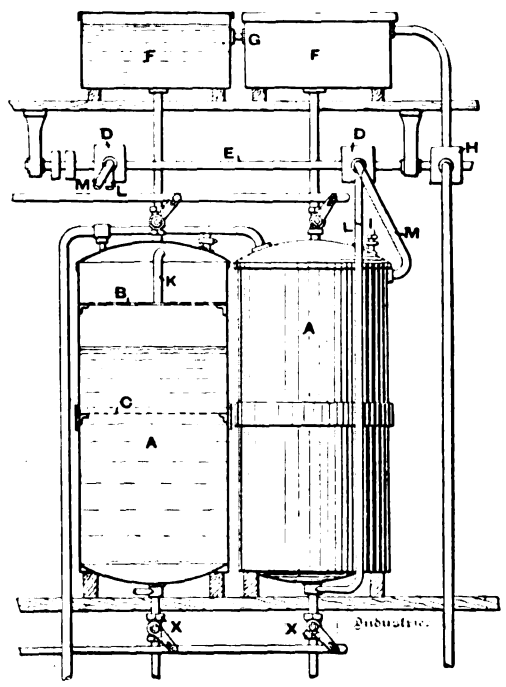
The nitrogen constituent in its combination with hydrogen as ammonia vapour forms no inconsiderable proportion of the products of imperfect methods of using fuel, and this valuable fertilising agent is lost in that great inter-action involved in the mutual work of sustenance proceeding between the two forms of organic life. The nitrogen is, however, far from lost in its ruinous characteristics, and if the measure of its baneful action could be taken a surprise would be in store for our economists and scientists.

During the lowering of the temperature or barometric reduction the frozen aqueous vapour constituents of the atmosphere provide surfaces for the deposition of the carbon and sulphur atoms, and thus explain the cause of the dark yellow and murky hue of the London fogs. In the country the change of atmospheric conditions produces a white and, in some instances, beautiful mist, which does not so seriously irritate the bronchial tubes and impede the action of the aëration of the blood, but the atoms of carbon and sulphur arising from the imperfect fuel combustion arrest or impede the interflow or diffusion of the gases in the lung action, and produce in the case of a delicate-chested man loss of vital temperature, followed too often by loss of life.

(To be continued.)

MECHANICAL MATURING OF SPIRITS.

There was recently shown at 83, Leonard Street, Finsbury, London, E.C., an apparatus for maturing spirits by subjecting them to the action of compressed air, the spirits, while being matured, being kept in continuous circulation in a highly subdivided state. The object is to produce the oxidation of the essential oils in the spirits, and to promote their conversion into their ethers.



We illustrate above the apparatus employed. The system consists of a closed cylindrical vessel or vessels A, having a perforated partition B, and a lower partition of wire gauze C. This vessel is charged with the liquor to be treated, and compressed air, after being filtered through water, is admitted by a suitable pipe. The taps having been closed, the liquor is, by means of rotary pumps D D on the shaft E, taken from the bottom by pipes L and forced into the top of the vessel by the pipes M, and is kept in constant circulation, passing down through the perforated partition B in the form of a fine shower. When it falls on the gauze partition C it is broken up into spray, each portion of which is acted upon by the compressed air. The compressed air rises through a pipe K and collects in the top of the cylinder above the liquor, so as not to interfere with the steady flow of the shower, and a slight circulation of the air is thus also effected.

At the end of the process the liquor is run into casks from the taps X X, and the air remaining is allowed to escape by the cocks I.

The liquor can be supplied either direct from barrels or casks, as is the case in the plant shown, or reservoirs may be used as shown at F, connected at a given level by pipes G, and filled by a rotary pump H. The Mechanical Spirit Maturing Apparatus Company claim that by this method they can, in twenty-four hours, effect similar results upon spirits which are otherwise only brought about by keeping them in casks for ten years.

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

On Monday, the 5th inst., a paper was read by Mr. Percy C. Gilchrist, on "The Basic Process as Applied to Copper Smelting," in which the author gave details of the experiments which he undertook with the endeavour to obtain similar advantages in copper smelting to those which had resulted from the replacement of the ordinary silicious linings of steel melting furnaces by a lining composed of basic material, and now well known as the author's basic steel process. The two processes are not, however, identical, as in ordinary copper smelting with acid-lined furnaces the loss is due to the formation of copper oxide and its removal in the slags rather than to the incomplete removal of arsenic and antimony from the metal. It was, therefore, rather in the direction of lessened oxidation, and therefore increased yield, that the author expected improved results by the use of basic linings and more calcareous slags in copper smelting.

Arsenical metallic bottoms, however, are advantageously converted into blister copper containing less than 1 per cent. of arsenic by the use of basic roaster furnaces. The removal of the arsenic is accompanied by a largely increased yield of "blister," and there is a further advantage, that the bottom of the furnace when basic-lined does not wear away with the same rapidity as when lined with sand. A very considerable gain in output is also obtained when white or "pimple" metal is treated in a basic roaster furnace, being in some cases as much as 34 per cent. in favour of the basic process. Analyses of various samples were cited to show that there is no practical difference between the refined copper produced from the basic blister and that produced from acid blister when an acid-lined refinery was used. When making ordinary tough cake, however, it is doubtful whether the extra cost of the initial basic lining and of the current repairs are compensated for by the slightly increased yield, but the saving in making "best selected" copper from ordinary arsenical blister is considerable. The basic refinery has hitherto been used chiefly for making best selected copper from B. S. precipitate only, but pure blister or blister containing 1 per cent. of arsenic also yield good results. The most important applications of the new process seem to be that of working down blister rather high in arsenic into B. S. ingots and the treatment of highly arsenical material tapped from the smelting furnaces.

In the discussion which followed several speakers expressed regret that engineers were in the habit of limiting, in their contracts, the percentage of arsenic to be allowed in the copper for ordinary work, although at present no data were available for proving that the presence of arsenic in small quantities was injurious, except when used for electrical purposes. Professor Roberts-Austen also pointed out that the removal of bismuth from copper was essential when used for gold coinage, and expressed the opinion that probably copper might exist in different modifications similar to Osmond's α and β forms of iron.

In replying Mr. Gilchrist pointed out that the high price of copper rendered the question of yield of greater importance than time and labour, and that the loss attending a Bessemerising process applied to copper smelting would probably be too high to make the method economical. Open-hearth steel is rapidly becoming as cheap as that made in a converter, and if this is the case with steel, an open-hearthed basic process will, no doubt, soon become general for copper smelting.

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THE PROGRESS OF CHEMICAL INDUSTRY IN 1890.

It is impossible so early in the new year to produce the annual statistics which summarise the progress of the various chemical industries during the past year, although many returns which have already come in might warrant our giving an approximation of the actual figures which will soon be presented to the public. Notwithstanding the absence of the official returns, it is possible to survey the work of the past year and contrast the position of the several industries with their previous records in this and other countries. We do not, however, anticipate that there will be any serious complaints from any of the more important chemical centres when the accounts for the year are balanced, as the Board of Trade returns clearly show that the industries to which we refer have fully maintained their position in this country, and that English manufacturers, with some few exceptions, are still able to compete successfully, not only with the German chemists, but with those countries which produce the raw materials upon which the more important chemical industries are dependent. The increase in the volume of trade which is indicated in nearly every direction is not, however, an index of the profit which has fallen to the several undertakings. The rise in prices which took place in the latter part of 1889, and which has, for the most part, been maintained during the past year, has been to a great extent counterbalanced by higher wages and the increased price paid for raw materials and fuel.

We believe, however, that the statistics for the past year will show that there has been a slight falling off in the value of raw materials used in the chemical industries and imported into this country; and this might indicate a diminution in our manufacture, were it not for the fact that we have during the same period exported chemicals and medicines of greater value than for 1889. The diminution in the value of the imports of raw material for the production of chemical products will therefore probably point to the fact that manufacturers have found it to their interests to discontinue the production of those articles which yield only a small return on the capital invested, and have restricted their operations to the manufacture of goods which are more remunerative and fetch higher prices in foreign countries. Our imports of finished chemicals and dyestuffs are also likely to be less for 1890 as compared with 1889, and here again we do not think we have cause for alarm, as in many directions we find that the English manufacturer is successfully competing with his foreign rivals, and the diminution in imports may therefore be attributed to the public beginning to realise that English productions are equal in all respects to German imported goods.

In the alkali industry, the event of the year is the formation of the union of chemical manufacturers under the title of the United Alkali Company, to control the price and output of alkali, hydrochloric acid, and bleaching compounds. The capital proposed for this undertaking was £8,500,000, but considerably under this amount was subscribed. About fifty of the leading firms are directly interested in the success of the scheme. Practically the whole of the Leblanc manufacturers have joined the new company, and their several businesses are to be concentrated and arranged so as to save the cost of transit from distant parts of the United Kingdom by completing orders in those districts which are nearest to the buyers. We have on more than one occasion expressed our views on the disadvantages to trade which combinations of this character usually produce, and whilst the collapse of the copper "ring" is still fresh in the memory it is surprising that any new venture on a similar scale should be again attempted. We are told that the Union does not aim at inflating the prices of the chemicals which they control higher than those which will secure their combination a fair return for the capital invested, but we are glad that the majority of the investing public have refrained from putting their money into the new union, mainly on the ground that, although it may be true that the works and plant acquired cost what is stated, little attention has been paid to the fact that much of this plant has had its day, and that newer processes have been and are being devised which attain the same results by quicker and cheaper methods—the stagnation which has been observable to most people in the larger Leblanc works in the Newcastle and Widnes districts being due in the past, not so much to competition among the rival makers, as to the fact that the Leblanc process has been for some time past on its last legs. Chance's sulphur recovery process and allied improvements can only have the effect of bolstering it up for a time, and as bleaching powder is gradually replaced by improved methods of bleaching with sulphite, oxygen, ozone, hydrogen peroxide, or by the electrolysis of chlorides, the new union will find its dividends gradually diminish, and its works one by one require dismantling. In the Articles of Association, however, the company is described as formed to carry on most industrial enterprises connected with chemistry, electricity, and engineering, so it is possible that the company may, by turning its attention to fresh fields of enterprise, succeed in utilising the properties acquired when they cease to be remunerative as bleach or alkali factories.

The monopoly caused by the formation of this union has naturally affected the prices of the commodities which they produce. It will be remembered that bleaching powder was at about its lowest figure—viz., £4 12s. 6d. to £5—in December, 1889, and during the earlier part of last year it remained at about £5. In September the price had increased to £5 10s., and during the last month it has risen to £6 10s. and £7, and is now not far short of the price that was ruling in 1888. In soda ash and caustic the rise in prices has been still more marked. In January, 1890, 70 per cent. caustic was quoted at £7 2s. 6d. per ton; in March, £8 10s.; in June, £8; in September, £10 17s. 6d.; and in December last, £11 5s., with a tendency to go higher. This value is nearly double that of two years ago, and is far in excess of the legitimate increase due to increased value of sulphuric acid, salt, coal, and labour. Soda crystals also show an increase of nearly 50 per cent. in price, from £2 7s. 6d. to £3 5s., and bicarbonate a gradual rise from £5 to £7 per ton.

We have little to record with regard to improvements in manufacture. The Chance's sulphur recovery process, to which we alluded in our last annual report, has fully maintained its reputation, and there can be little doubt that so long as the Leblanc process exists it will be found a valuable adjunct in its economic working. The sales of recovered sulphur during the year have been steadily increasing, but the new United States tariff of eight dollars per ton is likely to seriously interfere with the "Union's" export trade to that country. In a recent issue we have drawn attention to a new chlorine process devised by Wilde and Reychler, which bids fair to replace the Weldon and Deacon methods of working, but which, as we have already pointed out, requires additional plant, and is, therefore, unlikely to be employed by the Union so long as their monopoly lasts. It is not easy to predict what effect the combination will have upon our export and import trades. In the time of the Bleach Association in this country, the high price of bleaching powder did good service to our German competitors, as it enabled them to partially counterbalance their losses on alkali, and now that the price has again an upward tendency it seems probable that the German manufacturers will once more benefit at our expense. The bleaching powder now being made from the Stassfurt magnesium chloride will probably find a market in this country, and as Stassfurt potassium chloride is also being used by an electrolytic process to furnish an additional source of bleaching powder, which is already in the German market, there is an additional ground for believing that manufacturers will have to face German competition. In any case, the fact that Germany is now producing bleaching powder from these sources will tend to diminish our exports to that country. In 1887 Great Britain sent to Germany 2,978,700 kilos. of bleaching powder; in 1888, 4,081,900; and in 1889, 3,391,000, showing that our export had already begun to diminish, even when bleaching powder was selling at £5 per ton, and we imagine that the past year will show a further shrinkage, and it is not unlikely that, with the Union prices, Germany will refuse to buy any of this commodity from us during the current year. We believe that bleaching powder and the allied products will, therefore, fall into the same category as aniline dyes, tar colours, alizarine, ultramarine, white lead—viz., chemical industries which were formerly English, but from various causes have, of late years, shown a distinct shrinkage in this country, and an increasingly greater German import. It is interesting also to notice that, although the alkali products already mentioned have risen in price, chlorate of potash has not altered in value, notwithstanding the fact that this country is almost the only producer of this compound.

The ammonia soda process may be credited with about one-half of the world's production of alkali, and at the present time there are six Solvay works in operation in this country, and Messrs. Brunner, Mond, & Co.'s, at Northwich, still stands ahead of the German and French firms. In England, as pointed out by the Chief Inspector of Alkali Works, the proportion which falls to the ammonia soda process is gradually becoming larger. In 1887 it commanded 21·55 per cent. of the trade; in 1888, 26·60 per cent.; and in 1889, 27·29 per cent., whilst the year just ended is expected to show upwards of 30 per cent. The following table shows the amount of salt decomposed by both processes in the United Kingdom:—

	1884.	1885.	1886.	1887.	1888.	1889.
Leblanc process.	578,874	598,096	584,323	577,381	585,498	584,203
Ammonia soda	89,759	115,032	137,220	158,636	212,181	219,279
Total...	668,633	713,128	721,543	736,017	797,679	803,482

The production of sulphate of ammonia is also rapidly increasing, and offers a partial explanation of the maintenance of the price of sulphuric acid notwithstanding the increased imports of pyrites and the development of the Chance's recovery process. We find that 113,896 tons of this fertiliser was manufactured in 1887, 122,785 tons in 1888, 133,604 tons in 1889, and about 150,000 tons for the year just completed. Farmers in this country still allow the great bulk of this fertiliser to be exported to France and Germany, where it finds favour with the beet-root sugar producers. Its price, however, has not been maintained during the year, as a ton brought in the spring upwards of £12, and at the present time only about £10 10s.

The nitrate industry, as we predicted in our last annual report, is now suffering from the folly of over-production, and the several companies have within the last few weeks determined to follow the example set in other industries similarly situated, and have agreed to combine as far as possible with a view to restrict the output. All the English companies have intimated their adhesion to this scheme, and if the local producers can be induced to join the combination, the "ring" so formed will shortly be in a position, if it so desires it, to create a famine in this particular article of commerce. Although the chief use of nitrate is that of a fertiliser, and as such has to compete against sulphate of ammonia in price, 30 per cent. is consumed in the manufacture of nitric acid, nitroglycerine, dynamite, and gunpowder, so that a rise in price would seriously affect several lesser industries.

The following table shows the consumption and shipments in tons during the last three years, ending with December:—

	1888.	1889.	1890.
Consumption.....	694,000	750,000	885,000
Shipments	764,000	930,000	1,028,000
London spot price on Dec. 31st, per cent.	11s.	8s. 4½d.	7s. 7½d.

The production of salt in the United Kingdom is so intimately connected with our chemical industries that we must note in passing that the Salt Union, whilst maintaining the price, has not secured the additional trade which it expected. The relations of our trade to and from Germany in this commodity illustrates in a striking way the advantages and disadvantages of a control in one commodity. Our exports to Germany show a falling off, as follows:—

	1887-1888.	1888-1889.	1889-1890.
Tons	24,072	25,265	22,741

Whilst in Germany, where a combination also exists, but apparently is managed so as to develop trade, we find that the home trade is supplied more completely with the home produce, and prices admit of a development of the export trade.

German Salt Statistics.

	1887-88. Tons.	1888-89. Tons.	1889-90. Tons.
Inland consumption of home manufacture ...	722,314	734,623	770,850
Export	125,748	134,171	192,258

The German Stassfurt potash salt industry is also making slow but steady progress, notwithstanding the falling off in the consumption of potassium nitrate owing to the introduction of the "smokeless" gunpowder. The syndicated manufacturers now include eight of the leading firms, and amongst the number is the German Solvay Company in Bernburg. About a year ago additional works were opened at Thiede. Prices, for the most part, have been maintained during the year, although potassium chlorate, as already mentioned, is still exceptionally low. Amongst improvements in manufacture it may be mentioned that the Engels patent for the preparation of caustic potash by means of magnesia is now being worked at the Salzberg works at Neu-Stassfurt.

The space we can give to this review does not usually admit of our noticing the year's progress in metallurgical chemistry. We have from time to time drawn our readers' attention, in our "Notes on Alloys," to the rapid progress which is being made towards establishing the physical behaviour of the various compound steels which have recently been introduced, and Osmond and Roberts-Austen and their co-workers have left on record for the present year valuable information, which, although at present, perhaps, of only scientific interest, cannot fail in the near future to have an important influence upon our larger metallurgical industries. The Annapolis trials of nickel steel for armour plating, and the great public interest shown in the United States and this country, has brought nickel prominently to the front as one of the most important metals for this special use, and the discoveries at Sudbury, in Canada, warrant the belief that in time the complex minerals which abound there may be economically reduced, and so afford an abun-

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dant supply of this valuable element. The patents for the making of nickel steel are now in the hands of a syndicate in this country, and we understand it has also secured the more important nickel mines in which the ore is in an easily worked condition. The syndicate does not propose to manufacture, but to grant licences to existing steel masters, so that for the present, at any rate, there will be no impediment towards a rapid development of the use of this new material. There is little new to record concerning aluminium. Glowing accounts have, however, reached this country of the perfection of the electrolytic production of this metal by the Pittsburgh Reduction Company. The success which has attended this venture seems to be due to the happy thought of employing a mixture of cryolite and fluor spar, or triple fluoride of aluminium, sodium, and calcium, as a solvent for the alumina to be electrolysed. Aluminium cast ready for rolling is made by this process at less than ½ dollar per lb., which is considerably lower than that made by any of the rival processes. The works at Pittsburgh were started in 1888; in 1889 they were turning out 50lb. per day; in 1890, at the time of the visit of the Iron and Steel Institute, an average of 375lb. per day; while during the present year the company will have ready plant for making five tons per day. In a recent issue we drew attention to the scarceness of the metal platinum, and pointed out that the growing demand for this element for electrical work has induced fresh capital and energy to be thrown into this old-fashioned and steady-going mining industry.

The Russian naphtha industry has had a highly satisfactory year, and both the production and export of Baku oil products continues to grow. During the first five months of 1890, according to the report of the Russian Minister of Finance, 22,720,000 poods of naphtha were exported, or 7,560,000 more than in the corresponding period of last year. The Wladikawkas-Baku railway is in process of completion, and a further important development of this industry is expected to ensue therefrom. The Rothschilds are also erecting at Baku works for the manufacture of benzole from naphtha residue, owing to the success which has been experienced in the manufacture of benzene and anthracene at Schibajeivs oil works in the same district. In Galicia, where the industry has been stagnant, American tools have been introduced for boring with considerable success, and it is hoped that capitalists will now be induced to further the development of this industry. Reports from Peru announce the discovery of very important petroleum wells in the department of Poina, which will, it is hoped, be the means of creating a new source of prosperity for that country.

In gaseous fuels we notice that the gas companies are giving serious attention to the utilisation of carburetted water gas as an adjunct to their several enterprises. The excitement over the water-gas question having abated, it has been demonstrated that, although alone it can only have a minor and local value, yet when converted into an illuminant it can furnish a gas of higher illuminating power than that furnished by ordinary coal, and as an "enricher" is more economical than the employment of cannel coal for the purpose. The incandescent lighting at Harrogate was discontinued in the autumn of last year owing to several causes, but we imagine that such a method of utilisation, although unsuccessful at present, may eventually be adopted, as it would obviously be of advantage that the same supply pipes should furnish the consumer with a source of heat which could be also utilised for lighting purposes. A very exhaustive *résumé* of the present position of gaseous illuminants in this county has recently been given by Professor Lewes in the Cantor Lectures at the Society of Arts, to our reports of which we must refer our readers.

In oils and tar products the past year has been marked by steady trade and little alteration in prices. The coal tar colour industry in this country is still in a low condition, owing to the keenness of German competition, where higher profits, due chiefly to increased production, have been obtained. The progressive nature of the German industry is shown by the following average dividends of the leading firms:—

1885.	1886.	1887.	1888.	1889.	1890.
7·05%	9·94%	13·25%	15·44%	17·50%	19·00%

These profits, however, are not due solely to the colour trade, as most of the foreign firms have combined with their business the production of antiseptics, pharmaceutical preparations, and, in some cases, the manufacture of alkali products. A leading firm in this country has amalgamated with one of the prominent German companies, but we are of opinion that English manufacturers, if they widen their business so as to include photographic and pharmaceutical preparations, will again resume their former position. Many new colouring matters, some of great value, have been manufactured, and especial progress has been made in the chemistry of azo compounds. Dr. Perkin, at the Leeds meeting of the British Association, gave an admirable *résumé* of the present position of this important industry, and Professor Hummell's paper will do good service in removing the prejudice which still exists amongst dyers in this country of using these colouring matters for their work. Alizarine colours have been especially active, and it looks as if artificial indigo will soon be manufactured economically. Dr. Henmann, of Zurich, suggests that the manufacture of this dyestuff can be readily executed by first preparing phenylglycocine from monochloracetic acid and aniline, and then treating the product with caustic potash. If this process is successful on a commercial scale, the indigo districts of India are likely to share the same fate as the madder fields of France.

In photographic and pharmaceutical products, although an increasing business has been done, and the influenza epidemic gave a heavy demand for quinine, antipyrin, phenacetine, and antifebrin, yet the higher prices for raw materials, and the keenness of competition in these branches of technical chemistry, have prevented manufacturers from realising the large profits of a few years ago. The manufacturers of pharmaceutical substances and allied chemicals have been but slightly affected by the McKinley Tariff Act, and on many substances the duties have been reduced. The principal reductions are those on tannic acid, refined camphor, chloroform, nitrous and sulphuric ether, glycerine, iodine, iodoform, morphia, strychnine, several potash salts, whilst mercurials, phosphorus, and chromates have been increased.

The Inland Revenue report draws attention to the increased consumption of methylated spirit in this country, 3,188,306 gallons having been consumed in the official year, or 227,402 gallons in excess of the previous twelve months. Considerable agitation still exists in Germany as to the desirability of the Government allowing manufactures duty free pure spirit, and there can be no doubt that in Great Britain such a "drawback" would be an immense boon to pharmaceutical chemists and to many industries in which this article is required.

The manufacture of inorganic colouring matters is making good progress in this country, although there appears to be room for improvement and development in many of the minor colours. We have previously urged that attention should be paid to the manufacture of ultramarine in this country, and we believe that if the energies which are now being devoted to white lead and its manufacture were diverted to other channels, many of the inorganic pigments would offer a remunerative investment.

Our space does not permit us to more than point out that the soap industry in this country still maintains its important position, and shows signs of still further development. The manufacture of explosives, to which we referred at some length last year, is undergoing a great change, the new smokeless powders and various forms of "nitro" compounds in use for blasting purposes having almost entirely replaced the old-fashioned gunpowders containing sulphur and potassium nitrate. Many of the companies have done good work during the year, and have proved the efficiency of their products for special work; but time and further research alone will differentiate the good from the bad, and decide what compositions are likely to have a long future.

Notes.

TRADE AT PANAMA

A Foreign Office report states that business at Panama is in a stagnant condition, owing to the stoppage of the canal works. Many firms have been compelled to close, and others have become bankrupt. Many improvements have, however, been carried out during the past few years. An electric lighting company, having a concession from the authorities of the town of Panama, has started operations, there being 43 arc lamps for street lighting and 300 glow lamps in houses. A tramway is under construction, and a waterworks company has been organised. At the town of Cartagena two tramways have been built on the Decauville system. A contract has recently been made with an American syndicate to connect Cartagena with the River Magdalena. Another syndicate proposes to build a railway from Cartagena to Cucuta.

SPARKLESS ELECTROMAGNETS.

Among the numerous points of interest in Professor S. P. Thompson's Cantor Lectures on "Electromagnets" is a discussion of sparkless electromagnets. Among these he mentions the double-wound, or differential, electromagnet. This, we believe, was invented by Dr. Thompson himself, but the theory given seems inaccurate. According to the learned lecturer, there is no spark on making the circuit because the magnet is magnetised already, and none on breaking because there is then no magnetism. This is inaccurate, because the spark does not depend on the magnetism, but on its rate of change. If the current in the second wire were kept constant, there would be a spark on breaking the first. As it is the second wire acts as a secondary, and the current in it is reduced by the increasing magnetisation. If a second single-wound magnet were put in this second circuit, so that any variation of the current would be opposed by its self-induction, a spark would be produced on breaking the first circuit. A simple and effective way of making a sparkless electromagnet is to put some voltameters, made of lead plates in dilute sulphuric acid, in shunt to the break. These act as condensers of enormous capacity, and run down completely on short circuit. Professor Thompson is, apparently, writing an exhaustive historical and practical encyclopædia of electrical engineering. The articles on dynamos, transformers, arc lamps, influence machines, telephones, mercury pumps, storage batteries, and electromagnets are now complete. We wait for those on primary batteries, permanent magnets, incandescent lamps, central stations, steam engines, chimney construction, boilers, and a few minor subjects.

EMIGRATION TO THE COLONIES.

In a circular issued from the Emigrants' Information Office, 31, Broadway, Westminster, S.W., it is stated that there is no demand in Canada for men during the winter. Emigrants should not arrive before April, when there is likely to be a demand for farm hands, carpenters, masons, and others in the building trade. Female servants are always in demand. The chief demand in Australasia is for female servants, farmers, miners, navvies, farm hands, dairymen, ploughmen, gardeners other than fancy flower gardeners, bushmen, general labourers, and men who are well up in working land, pruning fruit trees, shearing, and nursery work. Such men and women will, under certain conditions, get free or reduced passages to Queensland and Western Australia. There is no demand for mechanics in Queensland, South Australia, or New Zealand, and but little in the other Australasian Colonies, though the general strike is now over; but good workmen will generally find employment. In South Africa carpenters, masons, bricklayers, and other useful mechanics, navvies, farmers, men accustomed to work on the land, and female servants are in demand in Cape Colony and Natal, and may, under certain conditions, obtain reduced passages there.

THE COTTON TRADE.

The results of the quarterly stocktakings of the twenty-three joint-stock cotton spinning companies given below are considered encouraging. Most of the companies have declared dividends to the extent of 10 per cent., and carried moderate sums forward to reserve funds. The prospects of the trade are, on the whole, favourable, but the margin between yarn and cotton is not quite so wide as a fortnight ago, for cotton has recently advanced ⅛d., and yarn has not moved upward at all. At present there are eighteen cotton mills in course of erection. These mills will hold 1,315,000 bales. American cotton crop estimates are again to the front, the *Financial Chronicle*, of New York, having given out 8,000,000 bales as the probable yield.

QUARTERLY STOCKTAKINGS.

	Capital.	Spindles.	Profit.
Moorfield	£73,693	£72,036	£1,131
Clough	40,743	42,656	840
Astley	101,184	84,024	1,325
Quickedge	35,726	29,868	203
Guide Bridge	170,890	150,240	2,400
Staleybridge	81,556	75,420	1,320
Milburne	49,000	63,528	400
Longfield	52,160	20,760	256
Equitable	84,200	78,780	1,152
Albert	42,041	22,262	345
Dowry	70,682	66,760	1,514
Duke	84,548	70,380	1,547
Grosvenor	7,966	11,220	189
Oak	119,226	109,362	1,531
Ivy	46,556	34,656	750
Parkside	47,830	49,194	1,395
Ridgefield	104,526	69,072	1,267
Rochdale	81,551	70,672	1,615
Royton	63,280	68,436	955
Stanley	64,845	48,480	501
West-end	117,000	118,540	2,100
Hollinwood	75,024	75,024	1,257
Hathershaw	106,600	77,424	1,071

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

22nd December, 1890.

18869A. Gutensohn, A. ..... Apparatus for preparing metal plates for annealing and for coating with tin or other metal. (21st November, 1890.)

27th December, 1890.

19370A. Scholes & Scholes ... Self-measuring and registering taps. (28th November, 1890.)

22nd December, 1890.

20849. Dickson & Kilburn ... Milling machines for textile factories.
20851. Smith, D. W. ..... Shuttle checking appliances of looms.
20854. Cooper, J. ..... Slide valve.
20855. Frew, J. ..... Equilibrated valves.
20856. Reid, W. ..... Looms.
20863. Quéry, F. ..... Machinery for the manufacture of earthenware pipes.
20867. Williams, P. H. ..... Turbines.
20872. Pearsall, H. D. ..... Meters.
20874. Pearsall, H. D. ..... Hydraulic rams.
20880. Lilleyman, G. ..... Ejector mechanism of drop-down guns.
20881. Mellor, T. K. ..... Excavating machines (*Mahlstedt*).
20882. Lake, H. H. ..... Axle lubricators (*White*).
20883. Meyer, C. ..... Lubricator for steam engines.
20888. Holt, H. P. ..... Gas, oil, or other vapour engines.
20899. Bucherer, J. M. ..... Rotary engine.
20901. Holthaus, W. ..... Jacquard and similar looms.
20902. Wells, C. ..... Steam engines.

23rd December, 1890.

20913. Thom, J. ..... Steam engines.
20943. Keats & Keats ..... Rotary cutters.
20947. Konegen, W. ..... Horizontal bolting mills.
20953. Hambelton, W. F. ..... Safety railway carriage coupling.
20957. Boult, A. J. ..... Motors (*Larcheveque*).
20961. Gribben, W. ..... Feed regulators.
20970. Wells, C. ..... Combined steam and soda engine.
20971. Gilmore & Clark ..... Liquid meter.
20975. Stark, D. ..... Feed water heater and purifier.
20988. Fowler, C. W. ..... Elevators. (13th August, 1890.)
20990. Dasher, H. D. ..... Railroad ties. (14th August, 1890.)
20993. Hewett, E. ..... Oscillating slide-valve for steam cylinders.

24th December, 1890.

20994. Barnett, H. T. ..... Hot-air engines.
21002. Richards, G. ..... Single-acting engines.
21005. Fairweather, W. ..... Automatic stokers (*Pratt & The Babcock and Wilcox Company*).
21010. Birch, G. ..... Lathe chucks.
21011. Barker, R. W. ..... Car couplings (*Seley*).
21016. Maw, J. R. ..... Boilers.
21018. Taylor & Challen ..... Power presses.
21045. Walton, F. ..... Apparatus for armouring insulated electrical conductors.
21046. Colebrook, C. T. ..... Packing rings for pistons, &c.
21047. Vernay, C. ..... Machinery for making bottles.
21060. Sheppard, C. ..... Steam pump.
21065. Burrell, F. J. ..... Pneumatic guns.
21067. Gardner, H. ..... Apparatus for surfacing and truing spheres in metal (*Fischer*).

27th December, 1890.

21084. Lejeune, A. ..... Carding machines.
21086. Brüggemann, A. ..... Pulsometer.
21092. Whitfield, C. ..... Machine rollers.
21093. Barr, J. ..... Hydraulic cylinder and piston motors.
21094. Murrie, J. ..... Motive power engine.
21095. Donaldson, J. (of the Firm of J. I. Thorneycroft & Co.) ..... Machinery for bending tubes.
21096. Castelnau, F. M. ..... Ore crushers.
21113. Ingham & Spencer ..... Looms.
21114. Heppenstall, Sykes, & Sykes ..... Machinery for dyeing wool, cotton, &c.
21126. Foord, W. S. ..... Printing machines.
21127. Lake, H. H. ..... Steam boilers (*Platt*).
21128. Hooker, J. ..... Type-setting machine.

29th December, 1890.

21140. Pilot & Jeyes ..... Automatic lubricator.
21145. Allison, H. J. ..... Hydrocarbon injectors for the furnaces of steam boilers (*Jones*).
21155. Deweppe, F. ..... Looms.
21161. Lawson, G. ..... Steam engines.
21163. Boot, J. ..... Loom shuttles and their cop spindles.
21165. Lentz, Czermak, Streitmann, & Bergl ..... Gas engine.
21166. Comings & Righter ... Metal presses.

30th December, 1890.

21176. Lindsay & Lindsay ... Looms.
21187. Burlingham, S. ..... Machinery for pressing bricks, &c.
21201. Royston, E. R. ..... Heat engines.
21218. Neate, P. J. ..... Grinding mills.
21221. Bohm, W. D. ..... Apparatus for the separation of gold and silver from ores.
21228. Ellinwood, A. E. ..... Match-making machinery.
21229. Ellinwood, A. E. ..... Match-making machines.
21231. Ensinger, G. W. ..... Furnaces.

31st December, 1890.

21243. Lake, H. H. ..... Apparatus for heating the feed-water of boilers (*Burpee*).
21252. Sleat & Skelton ..... Compound steam engines.
21268. Gill, D. ..... Ball valves and other water taps.
21271. Laidlaw, J. ..... Mechanical tube scrubber.
21273. Croll & Hohn ..... Steam boiler furnaces.
21282. Haensel, G. (of the German Confectionery Company) ..... Hoists.
21288. Sandwell, W. D. ..... Cranes and other hoisting machinery.
21292. Lane, F. R. ..... Propellers.

ELECTRICITY.

23rd December, 1890.

19272A. Carpenter, C. E. ..... Electric soldering irons. (26th November, 1890.)

22nd December, 1890.

20896. Gay & Hammond ..... Apparatus for regulating electric currents.
20898. Leigh, H. H. ..... Dynamo-electric machines (*Desroziers*).

23rd December, 1890.

20936. Wyckoff, A. B. ..... Signalling apparatus.
20940. Beck, W. H. ..... Indicating apparatus for range-finding instruments (*American Range Finder Company*).
20983. Hurrell, M. H. ..... Electrically-controlled long-range torpedoes.
20986. Lake, H. H. ..... Electrical welding apparatus (*Lemp*).
20992. Jones, G. H. ..... Electric bells.

24th December, 1890.

21017. Protz & Juckes ..... Arc lamps.
21031. Davies, P. J. ..... Secondary batteries.
21032. Horn, W. W. ..... Insulation for conductors (*Oehrle*).
21043. Essick, S. Van B. ..... Telegraphic apparatus.

27th December, 1890.

21116. Gay & Hammond ..... Arc lamps.

29th December, 1890.

21143. Rhodes, O. Y. ..... Batteries for lighting miners' safety lamps.
21147. Boult, A. J. ..... Insulation of electrical conductors (*Frédureau*).

31st December, 1890.

21254. Morris Brothers, Ld. Instrument for measuring electromotive force and current of electricity.
21301. Murday, T. J. ..... Signalling device for indicating the overheating of journals, bearings, &c.

CHEMISTRY.

22nd December, 1890.

20889. Imray, O. ..... Azo colouring matters (*Farbwerke vormals Meister Lucius & Brüning*).

23rd December, 1890.

20966. Stevens, G. ..... Antifouling or corrosive compositions.
20978. Lake, H. H. ..... Manufacture of nitro-cellulose or pyroxylin (*Mowbray*).

24th December, 1890.

20996. Candy, F. P. ..... Method of treating sewage.

27th December, 1890.

21071. Campbell, Boyd, & Kirkpatrick ..... Treatment of crude bicarbonate of soda to obtain caustic soda, carbonic acid, and other products.
21078. Leith, J. ..... Production of bicarbonate of soda and sulphuretted hydrogen.

30th December, 1890.

21205. Peters, T. ..... Red colouring matters.
21225. Lyte & Steinhart ..... Production of chlorine and of hydrochloric acid.

31st December, 1890.

21284. Geigy, J. R. ..... Manufacture of diethyldibenzyldiamidodiphenylmethan disulpho acid and violet dyestuffs therefrom.

MISCELLANEOUS.

22nd December, 1890.

20879. Jones & Jones ..... Obtaining motive power.
20895. Bott, J. E. ..... Manufacture of armour plates.

23rd December, 1890.

20907. Bristol, F. B. ..... Punches and dies.
20944. Elliott, S. ..... Method of condensing lead and other metallic fumes arising from furnaces.
20954. Imray, O. ..... Process for annealing iron plates (*Bang & Ruffin*).
20974. Sellers, G. H. ..... Drills and augers.
20977. Meier, J. ..... Transmitting power.
20980. Beardmore, I. ..... Regulating valves of regenerative gas furnaces for steel melting.

24th December, 1890.

21007. Dickson, A. C. ..... Weaving shuttles.

29th December, 1890.

21142. Rhodes, O. Y. ..... Miners' safety lamps.

30th December, 1890.

21170. Bauer, C. ..... Flexible tubing.
21222. Siemens, F. ..... Reduction of iron ore.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

18929. Hargreaves.
20656. Lock.
19252. Iles.
20773. Wadsworth.
20792. Lusuardi & Falco.
20974. Van Rysselberghe.
20652. John Wigham Edmundson & Margaret Clarke (Executrix of the late William Clarke).
20975. Van Rysselberghe.

1890.

8. De Negri.
141. Gildersleeve & Matthews.
576. Gill.
669. Ballard.
1124. Helliwell.
1246. Fitz-Gerald & Falconer.
1749. Hunter.
2107. Casebrook & Perry.
2140. Paul.
2559. Maxim & Sedgwick.
2705. Hale.
2725. Mason.
2796. Watson.
2832. Applegarth.
2851. Firth.
2896. Joy.
2911. Kirkbride.
2926. Badams.
2941. Appiani.
2972. Whicker & Parker.
3009. Keene.
3064. Inkpen.
3106. Bradford.
3107. Knight & Ashworth.
3134. McDougall & McDougall.
3252. Hill & Appleton.
3448. Urquhart.
3514. Lloyd & Hemming.
3815. Walker & Parker.
4028. Fitz-Gerald.
4807. Friedrich August Laesecke & Carl Gustav Riedel.
7044. Lake (*Brooks*).
7566. Blake.
7622. Williams.
8225. Bromhead (*Knight & Knight*).
9797. Alexander.
11075. Boswell.
11846. Curry, Mackie, Souter, & Hughes.
11921. Jolly.
12997. Brain, Arnot, & Baker.
14049. Cuthbert.
14506. Breese & Rollason.
15117. Roscher.
15524. Tuthill.
16468. Abel (*Mayrhofer*).
16943. Campbell. (24th April, 1890.)
17268. Orr.
185. Atkinson.
488. Bergman.
529. Kirlew.
579. Reynor.
1118. Hayter & Terry.
1192. Bailey & Lindemann.
1441. Dewrance.
1455. Jenks.
1951. Maxim.
2184. Ellis.
2460. Sedway.
2671. Foster.
2712. Horn & Whinfield.
2780. McLaren.
2804. Dixon & Dack.
2849. Spencer.
2852. Bungeroth.
2905. Horn.
2923. Bridge.
2929. Brever.
2952. Parker.
2974. Aykroyd.
3049. Holmes.
3098. Lake (*A. Leonhardt & Co.*).
3188. Boardman.
3161. Edwards (*Pallweber*).
3221. Hawkings.
3435. Cousins & Clarke.
3504. Fox.
3524. English.
4000. Pinper.
4387. McNaught & McNaught.
5580. Matthewson.
6237. Jones.
7432. Garfield. (17th October, 1889.)
7668. Harris & Lowe.
8612. Moore.
9748. Pearce & Scott.
10122. Dewey. (27th Jan. 1890.)
11143. Smith.
11641. Kaye.
11807. Thompson (*Raps*).
12670. Simpson.
13005. Lake (*West*).
13354. McClaughry. (24th April, 1890.)
14597. Carn.
15397. Roach & Joyce.
16072. Lovell.
16771. Clark (*Spelman*).
17065. Bayly (*Pflueger*).
17248. Stever.
17423. Greenwald.

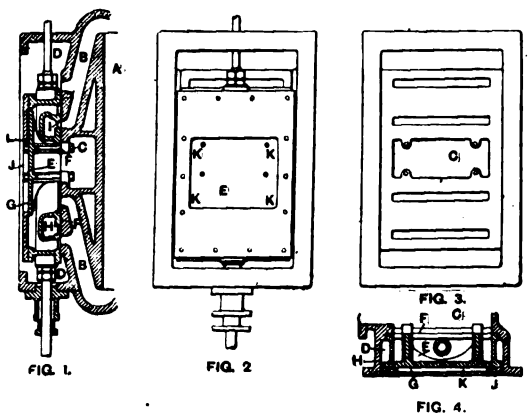
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17437. Bachem.
17678. Peters. (9th June, 1890.)
17768. Douglas.
17962. Foot & Foot.
18089. Chapman (*Massey*).
18237. Jensen (*Anker, Bache, Morterud, & Backer*).
18394. Hausmann.
18468. Jurschina & Von Gunesch.
18893. Ludewig.
18912. Given.
18929. Wojtkiewicz.
19010. Wright.
19038. Cockburn.
19097. Clark (*Bornholdt & Glatz*).
19136. Thompson (*Montgomery*).
19149. Davies.
19162. Dewey.
19170. Wyatt.
19175. Newton (*Smith & Son's Carpet Company*).
19192. Spring.
19255. Alter.
17675. Allen & Doolittle.
17720. Lake (*The Scovill Manufacturing Company*).
17782. Barker (*Silver & Ritchie*).
18201. Cohen & Davis.
18289. Bonne (*Brune*).
18295. Gartmann.
18459. Haeusler.
18478. Faulkner.
18524. Josephson & Friedlaender.
18924. De St. Dalmas.
18973. Lee.
19032. Roberts.
19057. Thompson (*Beach*).
19126. Grant.
19130. Dixon (*Le Plongeon*).
19140. Thompson (*Faulhaber*).
19141. Thompson (*Faulhaber*).
19154. Bardsley.
19163. Lash & Johnson.
19172. Salomon.
19177. Westinghouse.
19179. Bayles.
19193. Lake (*Wotton*).
19303. Williams.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Steam Engine Slide Valves.—*H. Muncaster, St. George's, Wellington, Salop.*—The inventor relieves the pressure acting on the back of the valve, and thereby lessens the friction on the valve face due to such pressure, in the following manner, reference being made to the accompanying illustrations, of which Fig. 1 is a sectional elevation of a double-ported valve arranged according to this invention, and also part of cylinder, Fig. 2 is an elevation of valve and part of cylinder, Fig. 3 is an elevation of cylinder port face with valve removed, Fig. 4 is a transverse section of valve and part of cylinder. In Fig. 1 A is part of the engine cylinder, of which B are steam ports and C exhaust

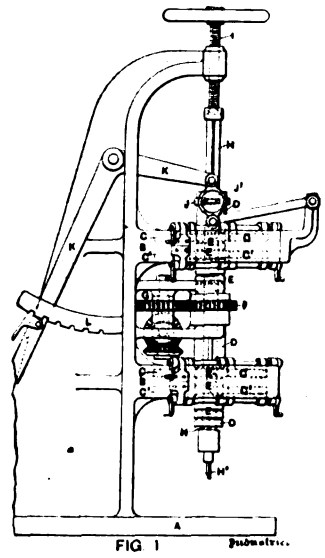


port and D the chest under steam pressure. E is a piece firmly bolted to cylinder port face F so as to form a table with a perfectly flat surface G at some distance from and parallel to the said face, and is of such a shape as not to arrest the flow of the exhaust steam through the exhaust port C. The slide valve H is arranged to work over the table piece E, and has a plane surface at I in contact with the cylinder port face F, and of the proper shape to give the required distribution of the steam. To the back of the valve H is fixed a plate J, having an opening K of an area corresponding with the amount of pressure of which it is found desirable to relieve the valve; the said plate has a narrow strip forming a margin to the opening K. This strip provides a surface L in a plane parallel to the valve face I, and at a distance from it equal to the depth of the table piece E, so that when the valve is in working condition the faces F and I are in contact at the same moment as are the faces G and L. Three claims are made, embracing the arrangement as described.—No. 826. January 16th, 1890. 6*d.*

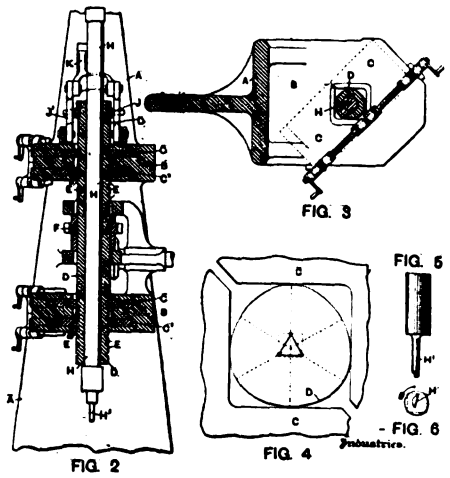
Shuttle Guards for Looms.—*R. Smyth & J. Middleton, both of Tullyelmer, Armagh, Ireland.*—To prevent the shuttles flying out when the loom is in operation, the inventors place a guard bar across the entire reed space, which is carried as follows:—One end of a radius rod at each end of the loom is hinged to the hand rail, and carries at its outer end, at a suitable distance apart, two other radius rods, the opposite ends of one pair of which are hinged to the rocking sword carrying the slay, slay cap, reed shuttles, &c. The opposite ends of the other pair of rods carry the shuttle guard which completely covers the shuttle race, and just touches the yarn when the shade is sprung and the shuttle passing. It then, actuated from the rocking sword, rises and gives the weaver room to regulate the yarn, and is so held while passing over temples and weft forks, and continues to act whilst the loom is in motion. Claims: An automatic shuttle guard with up and down motion at right angles with the shuttle race, and parts for operating same, substantially as described.—No. 20,594. December 23rd, 1889. 6*d.*

Boiler Furnaces.—*A. Jobson, Darlington.*—The invention relates to boilers in which there are internal furnaces, the products of combustion passing out at one end of the boiler into a descending flue and passing along a flue beneath the bottom of the boiler. According to this invention the inventor employs in the bottom flue a supplementary furnace situated at the end where the products of combustion enter, the object being to assist in burning the products of combustion, to increase the quantity of steam raised, and to improve the circulation. In some cases the inventor builds an arch over the supplementary fire or part of it; this arch serves to prevent the products of combustion from immediately entering said fire. Three claims are made, embracing the use of a supplementary fire and arch over same, substantially as described.—No. 1817. February 3rd, 1890. 6*d.*

Square Hole Drilling Machine.—*H. F. Ainley & A. C. Oakes, both of London.*—The chief object of this invention is to construct a machine which will drill both square and round holes. In the accompanying illustrations Fig. 1 is a side elevation, Fig. 2 a part vertical section taken at right angles to Fig. 1, Fig. 3 a sectional plan, and Figs. 4, 5, and 6 details



of a machine constructed according to this invention and for the above purpose. The frame work A is constructed substantially as shown, and has two brackets B, in each of which works two pairs of slides C C¹, the inner ends of which are formed with a notch in them, so that, when brought together, they form a square hole, as shown in Fig. 3. Running between the inner ends of these slides is a sleeve D capable of slight lateral movement, and having formed on its outer periphery six or more pairs of cams E, and rotated by means of gear wheels F and G as shown (Fig. 1). The wheel F is fixed to D by means of a feather working in a slot in the latter, so that the sleeve can move longitudinally in F. Inside D is a rod H carrying the tool H¹ capable of longitudinal movement in D, being raised or lowered by screw I, but rotated by the latter. Around D, in a slot, there is a loose collar J, on which are formed lugs; these project into the piece J¹ attached to the end of a bell-crank lever K, the opposite end of which can be fixed in any desired position by means of a spring catch and notched sector L (Fig. 1). It will thus be seen that either of the six cams on D can be brought between the notched ends of C as desired. The cams E are each of a different cut, the cut depending upon the size of the square hole to be formed, it being necessary to limit the traverse of the cutting tool, formed as shown (Figs. 5 and 6), to suit the size of the hole to be formed, the rule for producing this result being:—Supposing a ½in. square hole is to be cut. The cut of the cam is determined, supposing the square hole formed by the guides C to be 2½in. across, by first drawing an equilateral triangle (Fig. 4), the sides of which correspond to the size of the

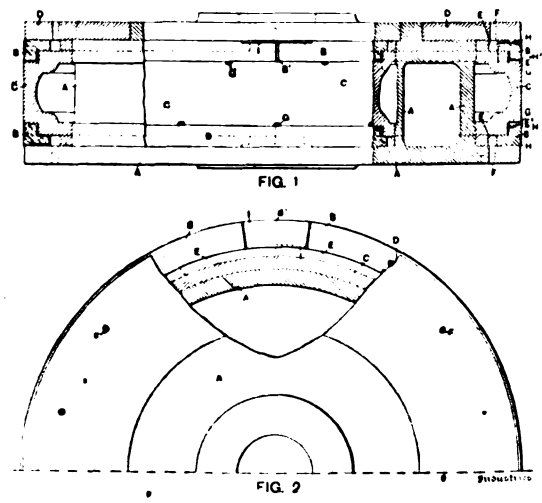


hole to be cut. Three arcs of 1in. radius are then described, the point of junction of the sides of the triangle being taken as centres. These arcs are then joined up by other arcs (1½in. radius) described from the centres opposite to the arcs to be drawn, and the form and size of cam required is thus produced. It will thus be seen that each cam represents a different sized hole, and, as shown in Fig. 2, the cams are duplicated for steadiment, as also are the slides C, the second set of slides C¹ being for the purpose of drilling round holes, for which purpose a circular part of D is brought between the square formed between the ends of C¹. Claims: The apparatus substantially as described.—No. 1019. January 20th, 1890. 8*d.*

Dies for Presses.—*S. Fox, New Wortley, Leeds.*—The object of the present invention is to construct dies for producing, by stamping hot metal plates of suitable form, box-like articles having one or more ends or sides bevelled—that is, at an angle other than a right angle to the bottom. For this purpose the inventor uses, in conjunction with the male die of the desired form and usual construction, a female die constructed as follows:—That end or side of the die corresponding to the end or side of the box to be bevelled is made capable of a sliding movement under the influence of suitable pressure such as that of a spring, whilst the external die is caused to enter the internal die, and thus, during the operation of forming the article, pressure is applied to the sliding parts, so that the metal plate is, during the formation of the box-like article, gripped by the male and female dies in such a manner as to prevent buckling or overlapping in the sides or ends of the article being formed. Claims: The construction of a female die used in conjunction with a male die for pressing metal articles substantially as described.—No. 20,000. December 12th, 1889. 6*d.*

Keys for Railway Chairs and Rails.—*R. T. Wilkinson Gargrave, Leeds.*—The key constructed according to this invention is for the purpose of fixing rails in their chairs, and consists essentially of two metal blocks of a wedge shape, the bevelled sides being placed opposite one another. These blocks are held together and can slide on one another by a bolt passing through a suitable opening made lengthwise centrally through each part. On the outer surface of one of these blocks are two lugs, which embrace the side of the chair, so holding the block in position during the operation of screwing the nut on to the bolt so as to slide one block on the other to increase the key's dimensions laterally. A piece of wood may be placed between the key and the chair if necessary. Claims: (1) The formation of keys for holding rails in position in such a manner that their lateral dimensions may be increased or diminished by operating the nut of a bolt substantially as described; (2) the bevelled blocks, the bolt, and piece of wood between the lugs on one of the blocks in combination, the same being formed and arranged for the purpose set forth.—No. 1856. February 4th, 1890. 6*d.*

Steam Engine Pistons.—*H. E Bedford & G. Rodger, both of London.*—The chief object of this invention is to prevent unnecessary friction between the piston rings and the cylinder where the former is held against the latter by means of the fluid pressure in the cylinder. Referring to the accompanying illustrations, Fig. 1 is an elevation partly in section, and Fig. 2 a half-plan of a piston fitted and provided with packing rings according to this invention. A is the body of the piston, B the packing rings, C a separate ring acting as a carrier for B, and



D the junk ring. As shown, two annular chambers E E¹ are formed behind each ring B. Communication between E and the interior of the cylinder is provided by holes F and between E¹ and the cylinder by exterior grooves G. Consequently the pressure on B, tending to force it outwards, is the mean of those in E E¹, and the pressure tending to force it inwards will vary between the pressure at points H and H¹. It so only remains to proportion the relative areas of the two portions of the ring B so that the outward pressure shall be slightly in excess of the inward pressure, so that the piston will be perfectly tight with the least possible friction. The rings B are cut at B¹ and provided with a tongue-piece I, and are so arranged that when the junk-ring is fixed in position they will be free to move easily in the horizontal position with respect to the axis of the piston. Six claims are made, embracing the arrangement of pistons as described, with modification.—No. 1064. January 21st, 1890. 8*d.*

Self-acting Mules and Twiners.—*J. T. Ainsworth, Bolton.*—The invention relates to an improved easing motion in mules and twiners which ensures the underfallers rising smoothly to prevent breakage of the yarns when "backing off." To effect this a spring is employed which is connected at one end to an arm on the underfaller shaft and at the other end to one arm of a small lever fulcrumed on a bracket secured to the front of the carriage. The other arm of this lever is connected by a rod or spring to a hanging arm pivoted on a bracket secured to the back of the carriage. An adjustable stop is secured to the floor in such a position that as the carriage is on the point of completing its outward run the hanging arm comes against the stop and is thus prevented moving forward with the carriage while it makes, say, the last inch of its run, the effect of which is to tighten the spring connected to the arm on the underfaller shaft. As soon as the salmon head lever comes into action to lift the underfaller, the latter rises against the resistance of the spring, whereby a smooth motion of the faller is ensured until the faller has reached its highest position. When the "backing off" has been completed the carriage begins its inward run, and the hanging arm in receding from the stop allows the different parts to resume their original places. By the use of the above arrangement the weight on the salmon head lever may be increased so that better and harder cops may be built. Claims: Two claims are made embracing the arrangement substantially as described.—No. 1664. January 31st, 1890. 8*d.*

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BORING AND TURNING MACHINES.—*G. Richards, Broadheath, Cheshire.*—In the accompanying illustrations Fig. 1 is a side elevation, Fig. 2 a view of the slide, Fig. 3 a rear view of feed mechanism, and Fig. 4 a plan of the base of a machine constructed according to this invention. A is the table to which the work is attached, B is the main frame of the machine, C is the main bracket in which the slide D moves vertically, E is the turret in which the tools are attached. The main bracket F has a transverse movement on the frame B moved by the screw F. The slide D is rapidly moved vertically by rack G and pinion H, which are connected by gear wheels and shafts to the driving mechanism. The pinion H is also rotated by a suitable hand-wheel. The turret E revolves on the pivot I. The turret is locked in position by the handle J, the tools being inserted in the holes K. When the machine is used for boring, the main bracket C is moved, so that the centre of the turret corresponds with the centre of the table, and is locked to the frame by the handle L. This position is determined by the dowel pin M. The various feed motions of the machine are obtained by means of the friction disc N, which is driven by the main driving shaft, and rotates the friction wheel O. This wheel is fitted to the shaft R by a sliding key, and is moved across the face of the disc N by means of the screw P and the hand-wheel Q, and thus varies the speed of the disc. The shaft R connects with the feed gears S and T attached to the end of the feeding screw F and the shaft U. The latter connects with the vertical shaft T¹, which drives the worm and wheel V and W. This worm-wheel is on the end of the pinion shaft H. It will be seen, therefore, that the rate and the direction of the feed can instantly be changed by rotating the hand-wheel Q and moving

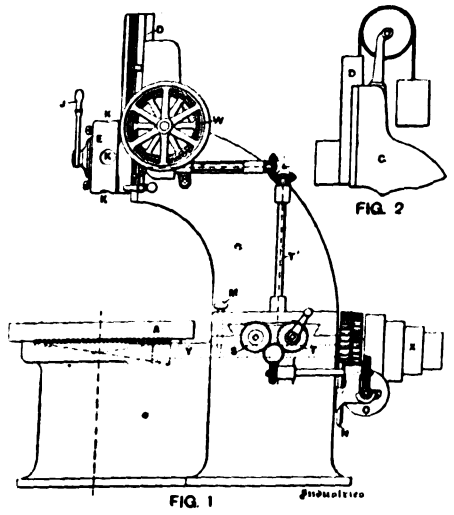
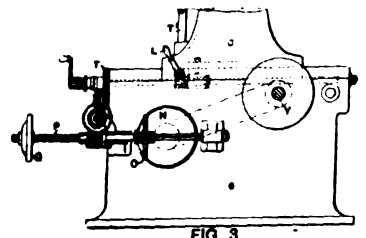
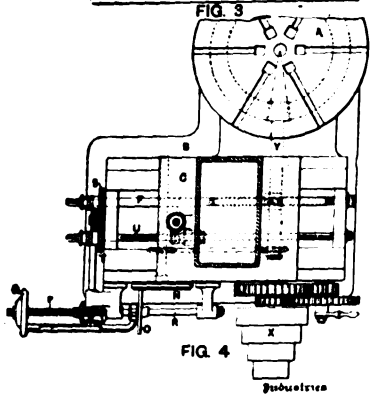

FIG. 1

FIG. 2

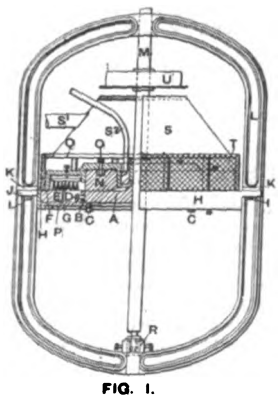

FIG. 3

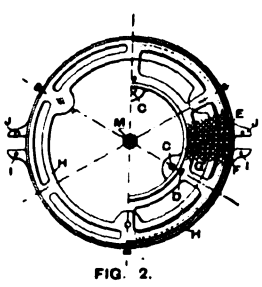

FIG. 4

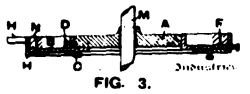
the wheel O on either side of the centre of the friction disc N. The table A running in bearings in the main frame is rotated from X by means of intermediate gearing and shaft and pinion Y as shown. Five claims are made.—No. 19753. December 9th, 1889. 6*d.*

ROVING FRAMES FOR FLAX, &c.—*W. J. Robinson, Belfast, Ireland.*—The inventor prevents "tugging" in the rove caused by irregular or defective action of the differential motion for regulating the speed of the bobbin in relation to the spindles and flyers, as follows:—A flanged socket or sleeve is introduced between the rove bobbin, and the spindle, and between the rove bobbin, and pinion or wharve with which it rotates, and with which the bobbin has only a frictional contact. This sleeve fits loosely on the spindle, and the flange on the former rests upon the top of the bobbin wheel, and is provided with pin-holes which engage with pins in the top of the bobbin wheel. The bobbin fits over and upon the sleeve, and is carried by it and rotates by frictional contact. From the above it will be seen that as the bobbin is carried round by frictional contact it will always tend to run at a uniform speed, without being affected by any slight irregularities in the running of the pinion, which so prevents "tugging." Claims: In a roving frame for flax and similar fibres, the combination with the spindle and bobbin wheel of a flanged sleeve rotating with the bobbin wheel, interposed between the bobbin on the one side and the spindle and bobbin wheel on the other, and with which the bobbin rotates by frictional contact, substantially as described.—No. 1680. January 31st, 1890. 6*d.*

GRAIN CLEANING APPARATUS.—*J. B. Bonnard, Paris, France.*—The inventor here cleans the grain of small stones and such like matter by subjecting it to a slight pressure, which, although not sufficient to crush the grain owing to its elasticity, is sufficient to crush the stones and other foreign matter, and also causes enough friction on the exterior of the grain to clean it. An arrangement of brushes, acting on a riddle, effects the completion of this cleaning by separating and ejecting the heavier foreign matter from the grain, whilst an exhaust fan acting on the whole carries off the lighter particles to the outside. Referring to the illustrations, Fig. 1 is a sectional elevation of an apparatus constructed in accordance with this invention; Fig. 2 is a plan of the machinery of the lower mill, parts being removed on the left-hand half of the figure; Fig. 3 is a transverse section through Fig. 2. The apparatus comprises a lower horizontal mill A of metal, turned and channelled in such a way that the grain drawn down by the upper mill takes a position parallel to the grooving. This mill A is supported by a frame B which has regulating screws C to adjust its position and set screws D for fixing it. The frame carries besides, concentrically to the lower mill A and all round the same, a series of radiating strips or flanges E governed by means of bolts F, and on which the metallic cloth G, constituting the sieve, is stretched. The whole is supported by an annular rim H having regulating screws I, and screws for fixing in position, traversing on the one hand the lugs J cast on the rim, and the plates K on the frame L of the machine. On the fixture above described, a movable device mounted on a rotatable vertical axle M revolves, and comprises an upper mill N with horizontal annular plate fixed and governed by set screw O, and system of brushes P, the position of which can be regulated by means of screws Q. The whole of this


FIG. 1.

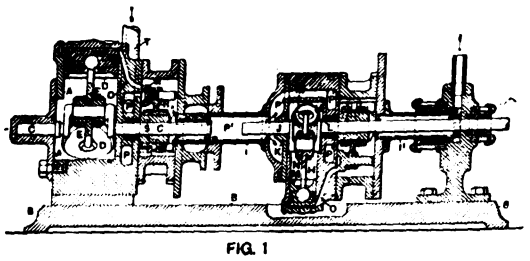

FIG. 2.

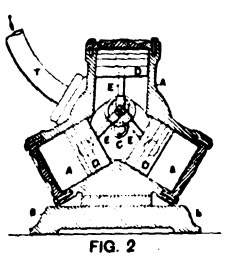

FIG. 3.

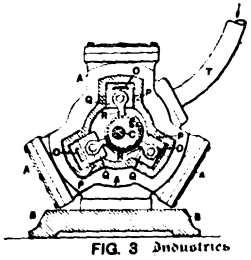
movable apparatus is adjustable by means of the movable foot-piece R. The apparatus is covered with a canopy S in conjunction with which an exhaust fan works by a pipe S¹. A tube S² penetrates into this same canopy which serves for feeding the grain. Around the frame supporting the upper mill and the brushes is placed a fixed sieve T through which the lighter particles of dust detached from the grain escape to the outside. A belt pulley U serves to communicate the motion to all the movable apparatus. The mode of action of the apparatus is as follows:—The grain once introduced by the tube S² falls to the lower mill H, where it is operated upon by the movable mill, which rubs it without crushing it, detaching the impurities which it may have on its surface and pulverising the earth and stones which may be mixed with it. On leaving the mills A and N the grain is brushed by the brushes P, the heavy dust traverses the sieve cloth G in order to fall out of the machine, the grain passes in its turn to any given point, whilst the light dust also passes to the outside through the sieve T under the action of the exhaust fan. Four claims are made.—No. 666. January 14th, 1890. 8*d.*

RAILWAY SLEEPERS AND CHAIRS.—*P. Espinasse, Monclar de Quercy, France.*—The improved sleeper is composed of a double T-shaped steel girder placed flat upon the ground and carrying two chairs of rolled or stamped iron, which are arranged between the upper flanges of the girder at the desired distance apart. These chairs occupy the entire width between the two flanges of the girder; they are made thin at their bases, so that the flanges of the girder can be pressed down upon them and firmly secure them in their places. Snugs formed on the chairs traverse the web of the girder, determine the distance between the chairs, and prevent the sliding of the latter. When a chair has been put in position the flanges of the girder are forced down upon the base of the former by means of a hydraulic press, which at the same time is caused to press the extremities of the said parts upon the web of the girder, so forming shoulders which will hold the chair firmly in position. Claims: (1) A railway sleeper formed of a double T-shaped girder placed sideways upon the ground, and carrying two chairs held between turned-down parts of the flanges of the sleeper as described; (2) in combination with a sleeper as described of chairs whose feet, which are indented at their upper part, occupy the entire width between the flanges of the girder, and which are fixed in their place by forcing down parts of the said flanges as described; (3) the combination of a chair and a sleeper as described; (4) a railway chair fixed as described, and provided at its lower part with a snug, which traverses the said girder and holds the chair in its proper place laterally as set forth.—No. 1498. January 28th, 1890. 8*d.*

HIGH SPEED STEAM ENGINES.—*J. F. Sleat & H. Skelton, both of London.*—The invention relates to an engine in which the motor shaft is driven at a high speed with a comparatively slow piston speed. In the accompanying illustrations Fig. 1 is a longitudinal section, and Figs. 2 and 3 transverse sections through the low-pressure cylinders and valve chest respectively of an engine constructed according to this invention. The low-pressure cylinders A are connected to a base plate B, and through the centre of the casting A the crank shaft C passes. In each cylinder A is a piston D connected, as shown, to C by rods E. The inner end of C is keyed to the casing (supported by sleeves I I¹) of the set of high-pressure cylinders H, as shown, by means of sleeve I. A second crank shaft J passes through the casing of the cylinders H and rotates in the bearings K L. In each cylinder H is a piston M connected to J by rods N. Each cylinder is provided with supply ports O and exhaust port P P¹, and with suitable valves Q to control same, actuated through connecting rods R

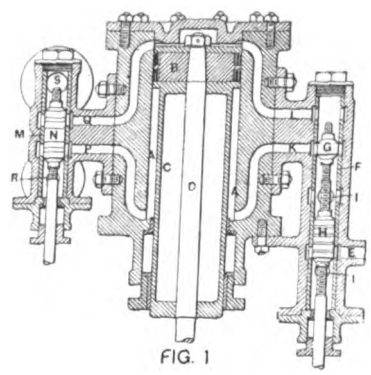

FIG. 1

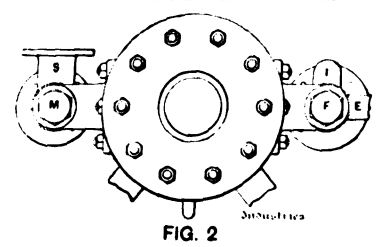

FIG. 2


FIG. 3

connected to eccentrics S mounted on the shafts C and J as shown Steam passes, as shown by the arrows, through the sleeve I¹ to the high-pressure cylinders through passages P¹ and sleeve I to low-pressure cylinders, and escapes by passages P to exhaust pipe T. From the above it will be seen that the shaft J will be driven at a speed equal to that at which the high-pressure cylinders are caused to rotate by the crank shaft C plus the speed at which J is driven by the high-pressure cylinders. In two claims the inventors claim the method of constructing high speed engines in which one cylinder or set of cylinders is fixed whilst the second and third and so on (if more than two sets are used) cylinder or set of cylinders (the pistons of which actuate the main driving shafts) are revolved by the first substantially as described.—No. 1278. January 24th, 1890. 8*d.*

STEAM ENGINES.—*R. Mudgemarchant, London.*—The invention relates to that kind of steam engines in which the high-pressure steam after having done its work in a cylinder on one side of the piston is divided into two parts, one part being used to act on the opposite side of the same piston, and the other part is delivered to another cylinder, so as to actuate the piston therein. Fig. 1 in the accompanying illustrations is a vertical section and Fig. 2 a plan of an engine constructed on the principle of this invention. A is the high-pressure cylinder, B is the piston of this cylinder. The capacity of the cylinder A at the lower end is considerably reduced by fitting a concentric sleeve C around the


FIG. 1


FIG. 2

piston rod D. E is the high-pressure steam supply pipe communicating with valve box F. In this valve box is a valve G and an adjustable check valve H, which is kept in equilibrium by means of a passage I. The valve box has two ports or passages K and L, communicating with A. At the other side of A is another valve box M and valve N, this valve box having two ports or passages P and Q, also communicating with A. The valve box M has also ports or passages R and S communicating respectively with a second cylinder and with a condenser. The high-pressure steam supplied at E and entering the valve box F passes through the port or passage K, which is then in communication with E, to the lower end of the cylinder A, and causes the piston B to make its forward or upward stroke. Then, the steam supply being cut off, one portion of the steam in the lower end of A passes through port K, valve box F, and port L to the other end of the cylinder, so as to cause the piston B to make its return stroke, and the rest of the steam in the lower end of A passes

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through the port P, valve box M, and port R to the second cylinder so as to operate the piston of same. At any determined point in the return stroke of the piston B the valve N is in such a position that the steam above the piston B exhausts through port Q, valve box M, and port S to a condenser. Claims: (1) The construction and arrangement of valves, boxes, and ports, as described; (2) fluid pressure engines as described and illustrated.—No. 843. January 16th, 1890. 8*d.*

ELECTRICITY.

SHIP SIGNALLING APPARATUS.—*J. Campbell, Glasgow.*—The inventor describes an apparatus for the purpose of transmitting messages electrically from the bridge to the engine-room, the chief object being to minimise the expenditure of electricity. In Figs. 1 and 2 is shown the transmitter, and in Figs. 3 and 4 the receiver. The transmitting handle A can be placed in any of the nine positions defined by the notches B, and

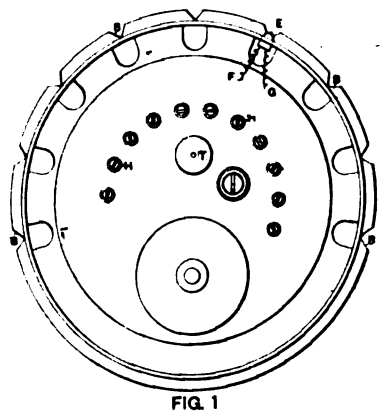


FIG. 1

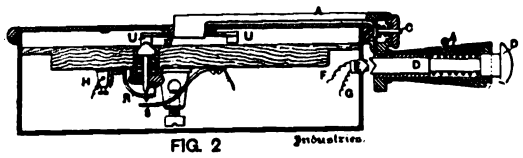


FIG. 2

is held in position there by the spring lock C. By pressing the nob D upon the contact E the circuit in F G is closed. Each wire F is connected with a common source of current, and each wire G is connected to one of the binding screws H, and from thence led to one of a corresponding set of binding screws I in the receiver (Figs. 3 and 4). The wires leading from the screws I pass each round one of nine electromagnets J, and then return to the common source of current. When a current passes round one of the electromagnets J the armature K is attracted, and it pulls with it the pivoted arm L. The lower end of L carries a plate M, which is thus brought over one of the openings N in the indicating dial plate of the receiver. Each plate M bears a particular order or command corresponding with the position of the handle of the transmitter. When the plate M has been brought into position over N it is retained there until the order is countermanded. This is effected by the hooked end

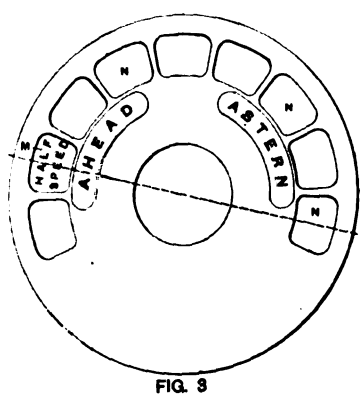


FIG. 3

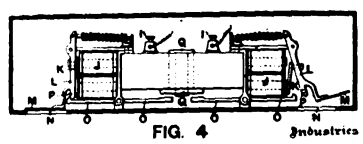


FIG. 4

of the pivoted lever O engaging with the notch P of the arm L. Thus the current of electricity may be switched off and so a saving effected in power. In order to release the notch P and remove the plate M from before the opening N the hinder end of the lever L is made to act as the armature of the electromagnet Q. This magnet is energised by the circuit R S being completed in the transmitter on the piece T being depressed by one of the cams U, which are fixed to a plate V fixed to and turning with the handle A. As there is a cam near every notch B a slight motion of A completes the circuit through Q and so removes M. Four claims are made.—No. 19285. November 30th, 1889. 8*d.*

FIRE ALARM.—*J. Tax & E. Donohoe, both of London.*—The alarm constructed according to this invention consists of a closed metal chamber of any suitable shape, placed horizontally at about the centre of which, so as to divide it in to two compartments, is a concentrically corrugated metallic diaphragm, so fixed that the air in the lower chamber cannot escape. In the upper chamber is placed a horizontal metal bar connected electrically with the diaphragm and carrying two insulating blocks, on one of which is mounted one end of a spring, while the opposite end rests on the other insulating block. Carried by this spring is an adjustable screw, the end of which is in close proximity to the metallic diaphragm. One wire of the circuit, in which the alarm bell and battery are placed, is connected to this spring, and so to the screw on it, and the other wire is connected to the metal bar in the upper chamber and so to the diaphragm. It will thus be seen that as the air in the lower chamber becomes heated by the fire and expands, the diaphragm will be forced upwards, making contact contact with the screw and so completing the circuit. Claims: In an apparatus for indicating rise of temperature electrically an air chamber with a diaphragm, as described.—No. 20506. December 20th, 1889. 8*d.*

SUBTERRANEAN CONDUITS.—*F. Zöpke, Berlin, Germany.*—The conduit forming the subject of this invention consists essentially of a lower part or base and a cover of glazed earthenware, one surface of each of which is corrugated, so that a better joint is formed when the two are placed together. These parts when placed together are in cross section, preferably of an oval form, and have formed between them circular passages. In the lower part of these circular passages segmental grooves are formed into which grooves slide the lower part of an insulator for carrying the conductor. Where secondary circuits are to be connected with the line the upper cover is provided at its upper surface with channels similar to those in the base, but at a suitable angle to the latter, and holes pass from these channels in the cover to those in the base through which the connection is made from the main, a cover of suitable shape being provided to close the upper channels. To facilitate examination of the line manholes are provided at suitable places. They are sunk in the ground to a suitable depth and preferably lined with cast iron. The line is laid with a slight fall towards these manholes, and in the bottom of the latter receivers are placed which communicate with the channels, so that any water condensing in the conduits flows to these receivers, and is from time to time drawn off by pipes in the latter. Claims: (1) The conduits or casings for electric wires substantially as described; (2) in conduits for electric lines the insertion of manholes constructed as described.—No. 19433. December 3rd, 1889. 8*d.*

CHEMISTRY.

MANUFACTURE OF STEEL.—*J. Macintire, Sheffield.*—For the manufacture of steel according to the process constituting this invention a mixture of ingredients as follows is used:—(1) Carbonate of calcium (98½ per cent.) and phosphate of calcium (1½ per cent.), 7oz.; (2) black oxide of manganese, 5oz.; (3) tannic acid, ½oz.; (4) vegetable soot, 2oz., animal charcoal, 2oz.; (5) tar, 2oz., and 2–8oz. hot water. Nos. 1, 2, and 3 are well mixed together, as is No. 4 and also No. 5. Nos. 1, 2, and 3 are then added to No. 5, and when well mixed No. 4 added. The above quantities are suitable for treating 1 cwt. of iron, the iron being treated in the crucible, Bessemer converter, Siemens-Martin open-hearth process or, with any other method. If treated in the Bessemer converter the inventor prefers to introduce the above ingredients in the form of an alloy formed as follows:—40lb. of pig iron is melted to a pasty condition in the ordinary steel crucible, and the above ingredients, mixed as described, but in the following proportions, are added:—Carbonate of calcium and phosphate of calcium, 1¼lb.; black oxide of manganese, 1¼lb.; tannic acid, 1½oz.; soot, ½lb., animal charcoal, ½lb., ¾lb.; tar, 1oz., mixed with sufficient water to make a paste. The proportion of this alloy to be used varies up to 16 per cent. of the iron to be converted. Claims: (1) The improvements in the manufacture of steel or iron, consisting in the manufacture and use of the combination of materials forming a powder or cake substantially as described; (2) the manufacture and use of the above-mentioned combination of materials in the form of an alloy, substantially as described.—No. 213. January 6th, 1890. 6*d.*

EXTRACTION OF GOLD AND SILVER.—*J. Buchanan, Glasgow.*—This invention relates to a process of precipitating gold and silver from the solutions in which they are dissolved in the process of extracting the same by chlorine, bromine, or iodine under pressure or otherwise. This is effected by allowing the liquid so obtained to percolate through iron or steel borings at the ordinary or at an elevated temperature. The gold and silver are thus completely deposited on the iron and may afterwards be removed from the same by riddling and washing or otherwise. In place of iron, copper, brass, zinc, or other metal or alloy capable of precipating gold and silver during the percolation of solutions containing same dissolved by chlorine, bromine, or iodine, may be used, or a combination of one or more of such metals may be used together with charcoal prepared by riddling or otherwise. Six claims are made.—No. 2390. February 14th, 1890. 4*d.*

FIRE EXTINGUISHING COMPOUNDS.—*H. Grimshaw, Clayton, Manchester.*—This invention relates to a new compound to be used for the generation or production of carbon dioxide (carbonic acid), and which is especially adapted for use in gasogenes, fire extinguishers, &c. This compound consists of a mixture of a carbonate or bicarbonate of an alkali or of an alkaline earth, or a mixture of such carbonates or bicarbonates (preferably bicarbonate) of soda with a suitable soluble bisulphate or soluble biphosphate (preferably bisulphate) of soda. The substances constituting the compound are mixed together in the proportions indicated by their molecular weights or thereabouts, allowances being made for impurities and the presence of moisture. Claims: An improved compound for the generation or production of carbon dioxide, consisting of a mixture of a carbonate or bicarbonate of an alkali or of an alkaline earth with a similar bisulphate or biphosphate, substantially as and for the purposes described.—No. 984. January 20th, 1890. 4*d.*

MANUFACTURE OF SODA AND POTASH.—*F. Ellershausen, Hebburn-on-Tyne, Northumberland.*—The inventor effects the above as follows:—A strong solution of black ash is mixed with a sufficient quantity of peroxide of iron to produce a mass having a consistency of a thick paste. This mass is then introduced into a furnace and calcined, whereby it is converted into ferrate of soda. This product is then lixiviated in sufficient warm water to form a strong solution, the soda being converted into hydrate of soda or caustic soda, and the iron precipitated in the form of hydroxide of iron, which can again be used for future operations. This solution of caustic soda is concentrated in the usual manner, the carbonate of soda obtained in this operation being mixed with the black ash during subsequent operations. Caustic potash is manufactured in a similar manner, carbonate of potash being substituted for carbonate of soda. Claims: (1) Improvements in the manufacture of caustic soda or potash from carbonates, consisting in mixing a strong carbonate solution with peroxide of iron, and then calcining and lixiviating the mass as described; (2) in the manufacture of caustic soda or caustic potash the production of ferrate of soda or ferrate of potash as described.—No. 1016. January 20th, 1890. 4*d.*

MISCELLANEOUS.

BOTTLE STOPPERS.—*F. Deimel, Berlin, Germany.*—The object of the invention is to provide a closing device for vessels containing inflammable liquids, which prevents the explosion of such liquids when they are poured from such vessels into fire. For this purpose a cork-stopper saturated with paraffin is fitted into the neck of the bottle. In the centre of this stopper is a tube closed at the top, and which extends some way into the neck of the bottle, and is at the side fitted with a tubular extension forming a spout. The lower end of this tube is closed with wire gauze, and through the gauze passes a second tube extending nearly to the bottom of the vessel and curved at its lower end. The upper end of this inner tube rises higher than the spout, and then curves back to below the end of the outer tube. The outer end of the inner tube has a spherical head fitted with wire gauze. From the above it will be seen that when pouring liquid from the bottle the liquid passes through the gauze at the end of the outer tube and through the latter to the spout, air being admitted only through the gauze and the outer end of the curved inner tube. Claim: A closing device for vessels containing inflammable liquids constructed as described.—No. 19482. December 3rd, 1889. 6*d.*

VALVE FOR METAL LADLES.—*A. H. Holdich, Wigan.*—The inventor constructs the above by fixing to the bottom of the ladle or reservoir a plate of suitable material. Formed in this plate is a hole, in which is fixed a ring of chromic iron ore, lime, magnesia, alumina, or other suitable refractory material, the hole in the centre of which coincides with a hole formed in the ladle. Hinged to the plate, and at a part most distant from the hole carrying the ring of refractory material, is a lever capable of moving in a horizontal plane. Fixed to the upper side of this lever is a block, also of refractory material, which, when the lever is suitably moved, comes opposite the hole in the bottom of the ring on the plate and fits firmly against it and closes it. Claims: The improved valve or stopper for externally controlling the flow of molten metal from the ladle or reservoir employed in steel works, substantially as herein described.—No. 1624. January 30th, 1890. 6*d.*

FIRE BRICKS.—*C. H. Edwards, Liverpool.*—The inventor uses for making fire bricks, and such like semi-fire proof articles, the waste sand from plate glass works, which the inventor has found usually contains about 75 per cent. silica, 20 per cent. glass grinding, 2 per cent. iron, 3 per cent. chlorides of sodium, magnesium, or potassium and emery. This sand is ground with an aluminous material, such as non-ferruginous clay or ground aluminous shale, in the proportion of about $\frac{5}{6}$ths sand to $\frac{1}{6}$th clay. This proportion, however, may be varied down to one part of sand to one part of clay, which depends upon whether the bricks are required to withstand a uniform heat, or continual variations of temperature. After mixing, the whole may be sprinkled with water if necessary, and is then pressed, dryed, &c., in the usual manner. Claims: The manufacture of refractory bricks or fireclay substitute from waste glassmakers' sand, bound with finely comminuted aluminous materials.—No. 2371. February 13th, 1890. 6*d.*

CONSTRUCTING ORDNANCE.—*J. E. Bott, Eyam, Derby.*—This invention consists in providing, in the manufacture of ordnance, a barrel or tube of steel of suitable temper, and after plating the exterior of this barrel with nickel or aluminium, or other slowly oxidisable material, the use of it as a core, around which may be cast a jacket of mild tough steel or aluminium bronze or other suitable metal, so as to gain the longitudinal strength of the tube in conjunction with the resisting power of a suitable cast metal jacket, and by thus casting on the jacket over the whole of the tube the rate of cooling is regular and even, according to the proportional thickness of the cast jacket, so preventing the dangerous strain incidental to the ordinary method of shrinking on the tubes. This method is also applicable to casting manganese steel on to soft metal bushes, which can thus be bored for shafting and the full advantages of manganese steel obtained. Claims: (1) The manufacture of ordnance and other articles by, 1st, preparing a tube, bush, or other part of one kind of metal or alloy; 2nd, coating same by electricity or otherwise with nickel, aluminium, or other slowly oxidisable metal or alloy; 3rd, heating same to a welding heat; and 4th, casting thereon a jacket, exterior or other part, of another kind or quality of metal, substantially as described; (2) the manufacture of ordnance and other articles by, 1st, preparing a tube, bush, or other part of one kind of metal; 2nd, coating same by electricity or otherwise with nickel or other slowly oxidisable metal; 3rd, casting thereon a jacket or other part of another quality of metal substantially as described.—No. 19557. December 5th, 1889. 4*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED PRINTERS' MACHINERY.

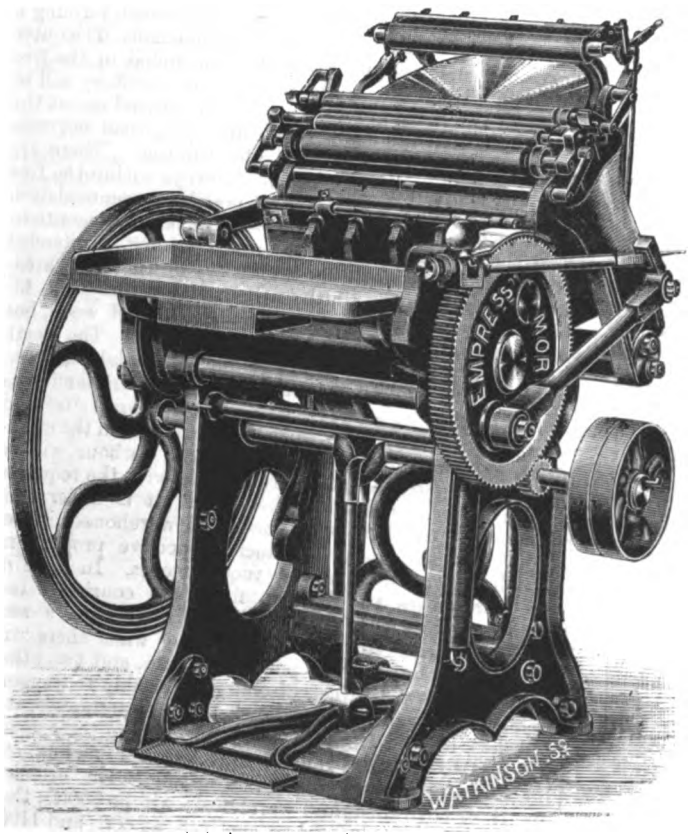


FIG. 1.

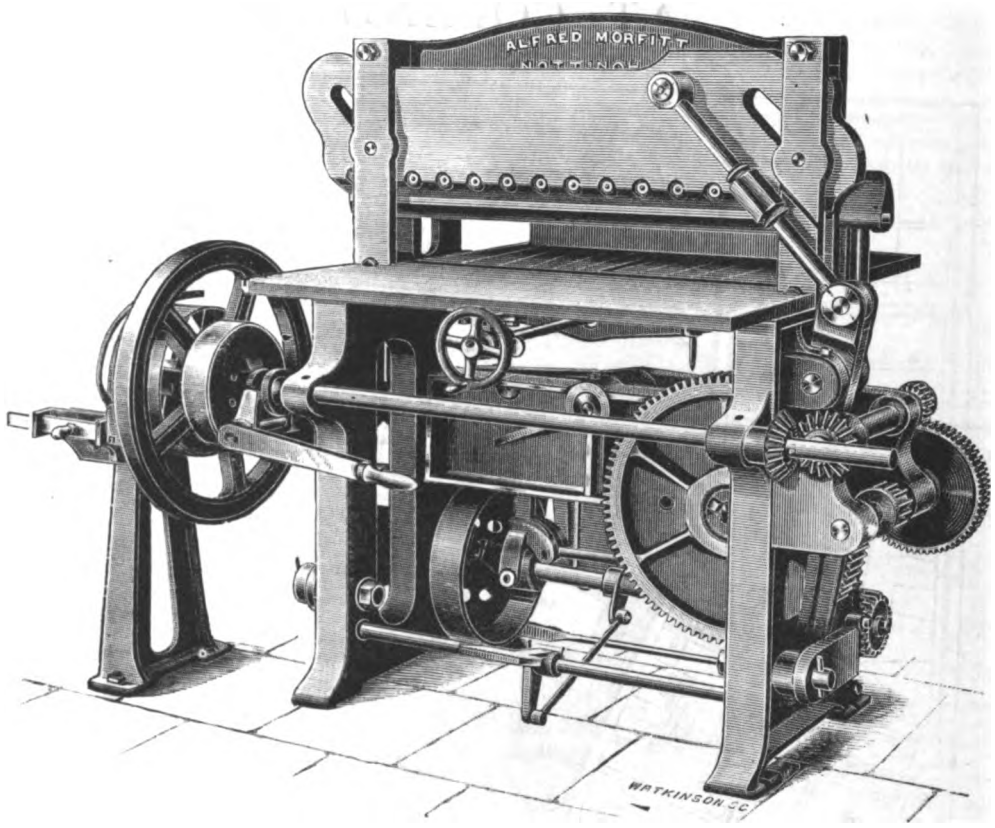


FIG. 2.

IMPROVED PRINTERS' MACHINERY.

WE illustrate above, in Figs. 1 and 2, two new machines –namely, the "Empress" platen printing machine, and the "Empress" self-clamp guillotine cutting machine, both of which are made by Mr. Alfred Morfitt, of Hockley Mill, Nottingham. The first-mentioned machine, shown in Fig. 1, has, in addition to the usual three inking rollers, two "riders," which revolve on and between the former, and at the same time impart a rocking or lateral motion, thereby increasing the printing surface and redistributing the ink, in such a manner that no roller touches two portions of type without receiving fresh ink. A locking apparatus is also provided, consisting of an eccentric shaft which grips the platen frame rigidly against the standards whilst printing. This prevents a "slur," and any wear is taken up automatically by the eccentricity of the shaft. In Fig. 2 is shown a general view of the self-clamp guillotine cutting machine, the novelty of which consists in the manner of holding the material to be cut without the usual weights and springs. This is effected by the employment of a friction clutch, the grip of which is augmented by a powerful lever, so that a variable pressure ranging up to several tons can be brought to bear on the clamping bar with a minimum expenditure of driving power and while the cutting knife is out of action. The machine is of neat appearance, stable, easy and accurate in manipulation, and is fitted for hand or power driving.

THE PROJECTED FREE HARBOUR AT COPENHAGEN.

(*From our Copenhagen Correspondent.*)

IT caused some disappointment that the Danish Parliament, in its recent session, did not arrive at a definite conclusion with regard to this important undertaking, since it was at one time confidently expected that the Government's proposal would have been passed, even if some minor alterations in it were found to be necessary. Although a decision has thus been postponed for a few months, there is every reason to hope that the project will be promptly realised, most people being alive to its great importance. There are at present two plans under consideration, the Government proposal, as it has been modified by the committee of the Landsthing (the Upper House), and another plan, put forward by a private engineer, and supported by several capitalists. We shall first deal with the latter of the two plans.

Mr. J. P. Nielsen is the originator of this plan, which received the first prize at the competition for plans of a free harbour for Copenhagen. Since then he has modified it (see Fig. 1, page 50), so as to meet several minor objections made by the committee appointed to deal with this matter. Mr. Nielsen does not ask for any other favourable conditions than such as generally attach to a concession of this nature. He demands that the State and the Copenhagen harbour authorities shall place at his disposal the areas now in their possession to the north of Copenhagen, where the free harbour is to be placed. He also stipulates for the right of expropriating private owners, if this should be necessary. Mr. Nielsen does not ask for any kind of State guarantee, but, on the contrary, he offers to the State the free use of the projected steam ferry harbour, with all the requisite railway accommodation, &c., such as railway lines, warehouse for railway carriages, and also three steam ferry berths, in addition to which he is willing to lay down a line of railway through the fortification known as "Citadellet," as far the Custom House.

The place selected for the free harbour is almost the same as has been fixed upon in the other projects—viz., that beyond the northern limit of the city. Mr. Nielsen thinks the harbour authorities should carry out the necessary protective arrangements for the vessels in the harbour, such as a breakwater from north-west to south-west on the "Stubbeir," and another from north to south on the "Svanegrunden." It would also be incumbent upon the harbour authorities to carry out all the necessary measurements, &c., outside the harbour. Mr. Nielsen will provide for the works at the "Langelinie" promenade, which should be extended further towards the north. He will also erect the necessary buildings for custom-house offices, &c., as they may be required, and attend to the temporary separation of such parts of the area as in the meantime may be reserved for the local traffic. With regard to the financial aspect of the matter, he proposes that the receipts from the free harbour shall be divided between the State, the harbour authorities (the Copenhagen harbour), and the free harbour, in a proportion which is to be fixed subsequently. The necessary funds for the completion of the undertaking have already been promised by a Copenhagen banking firm. The cost is calculated at about 20,000,000kr., which sum provides for loss of exchange and interest, and for the purchase of some private property wanted for the harbour. Mr. Nielsen states that, as a matter of course, he has also secured the best possible assistance, both with regard to the commercial and the technical sides of the question.

The original plan of Mr. Nielsen's was the most extensive of all those to which prizes were awarded. The area dealt with in the plan was about 175 acres, of which about one-third was water and two-thirds land. It also had the longest expanse of quay—some 13,000 lineal feet —all of concrete, as well as the largest area of quay sheds—about 500,000 square feet. Mr. Nielsen's present plan is still larger, by the addition of a further 12 acres. The area dealt with in the amended plan includes about 35 acres of private property. Of this it will, however, be necessary to purchase only about one-third, as the remaining two-thirds can remain in the possession of the present owners, most of whom will be only too pleased to have their land included in the free harbour territory. The proportions of land and water are about the same as in the original plan, rather more than two-thirds being land, and a trifle less than one-third water. The total length of quay is now increased to 16,000 lineal feet, of which about 3,000ft. are in the ferry harbour. The various basins in the harbour are as follow:—A Mediterranean basin, an American basin, the steam ferry harbour, an English basin, a Baltic basin, and a petroleum basin. The largest of these are to have 25ft. of water, and lengths of 1,500ft., 1,900ft., and 1,750ft. The length of the projected railways is about 18 miles. The steam ferry harbour, with all its requisites, will entail a cost of some 2,000,000kr.; sheds, warehouses, offices, &c., will entail an expenditure of about 7,000,000kr.; and cranes, engines, &c., about 1,500,000kr.

It is calculated that the harbour could be completed within three years from the date of beginning. During that time the harbour excavations, the building of the quays, the filling up and regulating of the site, the construction of roads, railways, steam ferry harbour, fencing, offices, requisite sheds, the lighting appliances, &c., should all be completed. This can, however, only be done by building a dam and pumping out the water so as to lay dry the building sites, which will cost about 400,000kr. A certain number of buildings must be erected in the first instance, and the erection of other buildings is afterwards to be gradually proceeded with.

As the Danish Government did not see its way to accept and endorse any of the various plans received, a fresh plan was directed to be made out by the Copenhagen harbour authorities, which was submitted to Parliament in its recent session. This plan was, on the whole, accepted by the Upper House, but the Second Chamber wished the consideration of the plan to be referred to a joint committee. According to the Government plan, which is shown in Fig. 2, page 51, the free harbour is to be situated to the west of the present Copenhagen inner roads, immediately to the north of the Frederikshavn fortifications. It is to be constructed by and on account of the Copenhagen harbour authorities, and it is to form a part of the Copenhagen harbour,

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THE PROJECTED FREE HARBOUR AT COPENHAGEN.

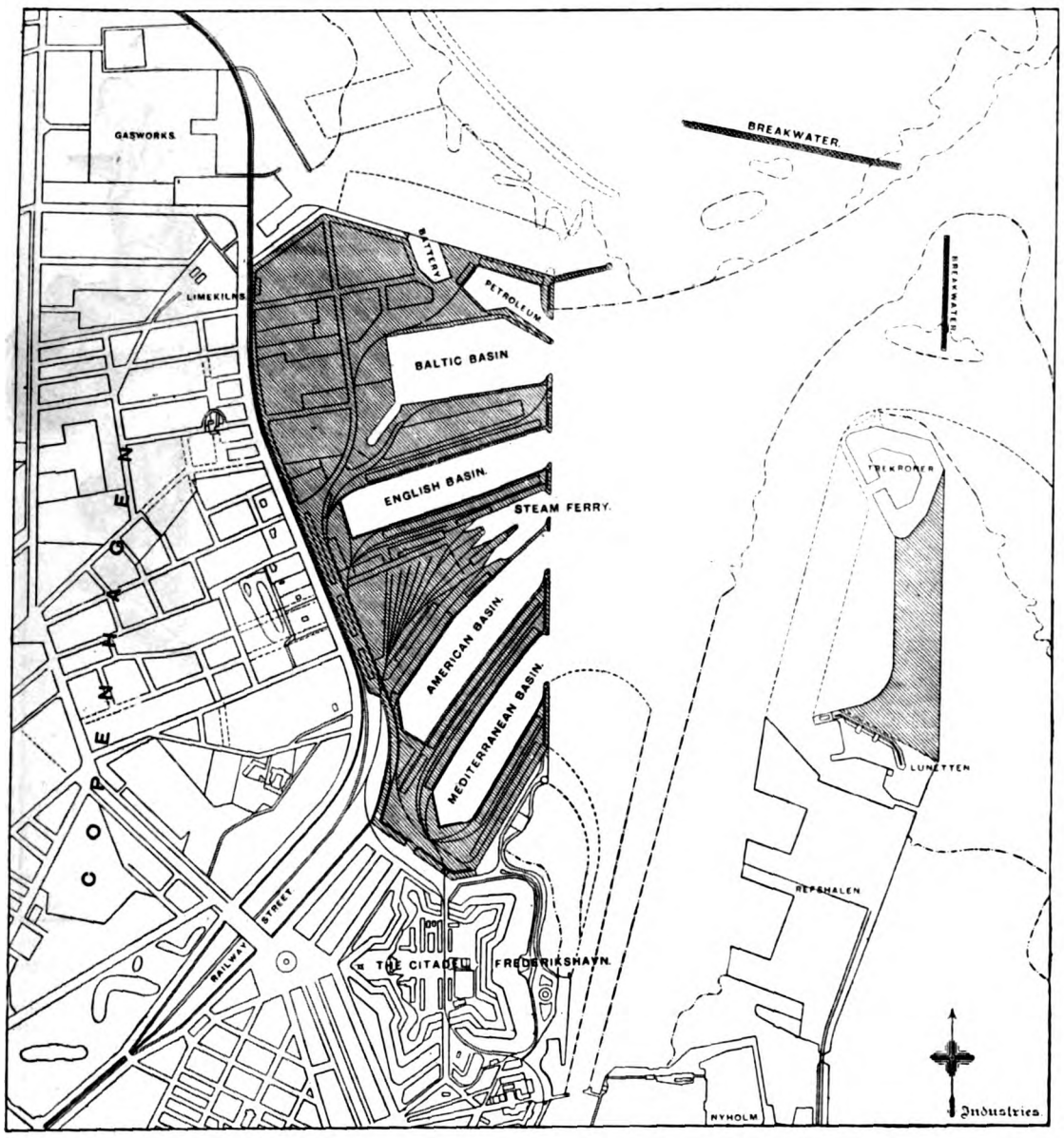


FIG. 1.—SKETCH PLAN OF MR. J. P. NIELSEN'S SCHEME.

comprising, however, the necessary land areas for industrial and commercial undertakings. The Minister of the Interior is to be authorised to build a railway station at the free harbour for goods traffic, and to lay down connections with this railway station to the south to the Custom House, and to the west to a point on the North Zeeland Railway, such stations and junctions to be State railways. The third body, which is to have a share in the working of the free harbour, is a private limited company, which should have been formed before July 1st last year if the Act had been passed during last session. This company will undertake the erection of the necessary commercial warehouses, sheds, cranes, and landing and shunting rails, the minimum capital required being 3,800,000kr. As an equivalent for this outlay the company is to have the working of this part of the free harbour for a period of sixty years. In the agreement between the harbour authorities and the company, it shall be specified what percentage of the annual net profits is to be paid to the company's shareholders in advance, while the rest shall be divided between the company and the harbour authorities in a proportion to be previously agreed upon. The agreement shall also contain the necessary clause concerning the harbour authorities' possible right to take over the company's buildings, &c., at the expiration of the latter's lease. The Government guarantees the interest and amortisation of the bonds which the harbour authorities may issue for the purpose of raising the necessary capital, but the amount is limited to 8,500,000kr. The cost of railway connections, &c., has been calculated at 1,055,000kr., exclusive of the cost of expropriating the land. The requisite area for the steam ferry harbour will have to be reserved, so that the State can take it over either at a valuation or at its actual cost.

The free harbour, as now proposed by the Government, would be protected by breakwaters between the existing fortifications of "Lynetten" and "Trekroner," as also by similar appliances to the north of the latter fortification, on both sides of the "Kronelöb." It is proposed to divide it into two separate harbours (in Nielsen's plan there are five separate harbours), between which the contemplated steam ferry harbour would be located. The south harbour will consist of a reservoir about 2,000ft. long and about 650ft. broad at bottom. Its direction will be very nearly due north and south, and it will occupy the space between the steam ferry harbour and the Frederikshavn fortifications. The entrance will be at the north-east corner, and will be used in common for the south harbour and the contemplated steam ferry harbour. Towards the east the harbour will be protected by a pier of about 250ft. in breadth. The present popular "Langelinie" promenade will be preserved, and a small harbour provided for yachts and pleasure boats. The north harbour will comprise the already existing "Kalkbränderi" harbour (with certain restrictions as to the use of its northern pier) and a 450ft. broad reservoir to the south of this. All the reservoirs mentioned are to have a depth of 24ft., but the various enclosures are to be so constructed that the depth of water in the reservoirs may afterwards be gradually increased to 28ft. The water area of the free harbour will thus comprise about 2,240,000 square feet, with about 8,800 lineal feet of quay. The south harbour is to have 1,400,000 square feet of water area and 5,000 lineal feet of quay, and the north harbour is to have 840,000 square feet of water area with 3,800ft. of quay. The land area, according to the project, amounts to 3,752,000 square feet, of which rather more than 600,000 square feet will be reserved for the steam ferry harbour. The west boundary for the free harbour will be defined by the railway forming the junction between the free harbour and the State railway system, along which runs a road, 60ft. broad, forming a continuation of the "Langelinie" promenade. The outer portion of the east pier will not be included in the free harbour. The access to the free harbour territory will be through two main gates, one at the north and one at the south end, and there will be a connecting road between the two along the inside of the frontier. There are ample provisions for roads and railways within the free harbour territory, with the best possible accommodation for direct loading and discharge. The proposal mentions that the deepening out of the reservoirs, &c., is intended to be effected through the laying dry of the water areas in question. In the south harbour all the quays are, for various reasons, intended to be made, not of wood, but of stone, which will rest on high piling. The north harbour is principally intended for industrial purposes, and for the landing of rougher goods. The land area here will, thus for the most part, remain as open sites, and only the necessary quay lines and roads will, in the meantime, be here carried out. The south harbour will be adapted for regular commercial uses, with the requisite railway lines, warehouses, sheds, &c. It is under contemplation to place both sheds and warehouses immediately at the quays, in such respective proportions as will depend upon actual requirements. In some of the warehouses the bottom floor will consist of one large compartment, which will thus serve as a sort of shed if required. Along the quay walls there will be a railway line for the portable cranes, and two other railway lines for direct discharge from ship to waggon. Behind these rails will be the sheds and warehouses, at a distance of 35ft. from the quay, and behind these again will be two or three railway lines, one for loading, one for forwarding, and one for shunting. The ordinary length of both sheds and warehouses will be 350ft.; their breadths have been fixed respectively at 60ft. and 110ft. The shed on the east pier will, however, have larger dimensions, and be 165ft. in breadth. It has been proposed to have an interval of 100ft. between the different buildings, partly in order to reduce risk of fire, and partly so as to have ample room for traffic. There will, in the first instance, be built four sheds, of which one is to be on the east pier. The ends will be of brick, and both the sides of corrugated iron, which are not to be fixed, but are to be movable like sliding doors. The floor of the sheds is to be on a level with the bottom of the railway trucks. The roof will be constructed of wrought iron and wood, and it will be supported by a row of iron pillars in the centre. The height inside will be 15ft. At the outset two warehouses are to be built on the east pier; they will contain cellars, ground floors, two lofts, and a top loft. Here, too, the ground floor will be on a level with the bottom of the railway trucks, and the harbour cranes will be able to convey the goods straight to the top loft. The warehouses will be divided into several fireproof sections, each with its fireproof staircases and elevators between the various floors. Both warehouses and sheds will be fitted with outside platforms 6ft. broad for the removal of goods from one section to another. Altogether the means of communication, both inside the free harbour territory and between this and the outside, have been very carefully considered and liberally provided for. There will, of course, be the requisite buildings for the harbour and other offices, including the custom house offices, engine and boiler house, fire and police station, offices for merchants, &c. There will be no offices allowed in the warehouses themselves. The majority of these buildings will be placed at the interior quay of the south harbour. The free harbour will be amply fitted with hydraulic cranes and other lifting appliances, and both cranes (stationary as well as travelling), elevators, and winches will be constructed for a capacity of a ton and a half.

In order to carry out the foregoing plan the following areas will be required, in addition to the area which will be obtained through filling up:—

1,656,800	square	feet,	belonging	to	the Copenhagen Harbour Authorities.
97,200	,,	,,	,,	,,	Danish State.
3,600	,,	,,	,,	,,	Corporation of Copenhagen.
467,600	,,	,,	,,	,,	Private owners.
2,225,200	square feet.				

The Landsthing has modified the foregoing plan so far as to particularise the preference dividends to the shareholders in the Warehouse Company at 4 per cent. per annum; of the remainder a quarter goes to the company and three-quarters to the harbour authorities. The limit of State expenditure for railway junctions, &c., has been fixed at 585,000kr., exclusive of expropriation expenses.

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INCREASED BOILER PRESSURE AND PISTON SPEED FOR MARINE ENGINES.*

THE object of this paper is to raise a few questions as to the advisability of increasing (1) the working pressure and (2) the piston speed of marine engines, and to consider what type of engine and boiler would best suit these new conditions. The superiority of the three-crank triple-expansion engine over the old two-crank compound is generally attributed to three causes:—First, to increased working pressure giving a greater total temperature range, and allowing of a greater ratio of expansion; secondly, to decrease of temperature range in each cylinder, thus causing less less from cylinder condensation; and, thirdly, to increased piston speed.

To compare the economy of steam of 165lb. absolute pressure with steam of 115lb. absolute pressure, let it be assumed that we have 1lb. of dry saturated steam at 115lb. absolute pressure. A certain quantity of coal has been expended to produce this lb. of steam, and the first question which arises is—How much coal will be expended to produce 1lb. of steam at 165lb. absolute pressure? The efficiency of the heating surface should be rather less in the case of the higher pressure, as the temperature of the water will be higher. Assuming, however, that the efficiency is not appreciably decreased for the extra rise of temperature (72° Fahr.), then for the same amount of coal expended we have—

$$1 \times \frac{\text{Total heat of 1lb. steam at 115lb. pressure}}{\text{Total heat of 1lb. steam at 165lb. pressure}} = \cdot 99305\text{lb. steam}$$

at 165lb. absolute pressure, to compare with 1lb. of steam at 115lb. absolute pressure.

Next, assume that the steam of 115lb. pressure is expanded adiabatically to 8lb. absolute, and that the steam of 165lb. pressure is expanded to 6lb. absolute, the back pressure in both cases being 4lb. (using a formula given by Rankine for the amount of liquefaction due to expansive working), we have for the proportion of liquefied water at the end of expansion the expression—

$$1 - \frac{T_2}{H_2}\left(\text{J hyp. log. } \frac{T_1}{T} + \frac{H_1}{T_1}\right),$$

where T_1 = absolute initial temperature;
T_2 = absolute temperature at end of expansion;
H_1 = latent heat per lb. of initial steam;
H_2 = latent heat per lb. of steam at end of expansion.

Thus, for steam of 115lb. absolute pressure, and terminal pressure 8lb. absolute—

$T_1 = 799{\cdot}01°$ Fahr.,
$T_2 = 644{\cdot}11°$ Fahr.,
$H_1 = 675{,}864$ ft. lbs.,
$H_2 = 761{,}381$ ft. lbs.,

and the proportion of steam liquefied = 14·34 per cent.; so that, at the beginning of expansion, there is 1lb. of steam at 115lb. absolute pressure, and at the end of expansion ·8563lb. steam at 8lb. absolute pressure and ·1437lb. water. For convenience, let it be assumed that this proportion does not vary during the exhaust period. Then, heat received = total heat of 1lb. steam at 115lb. absolute pressure = 1,216·974 thermal units. Heat rejected = total heat of ·8563lb. steam at 4lb. absolute pressure = 998·843 thermal units + heat of ·1437lb. water at same temperature = 22·043 thermal units. Total heat rejected = 998·843 + 22·043 = 1,015·886 thermal units,

1,216·2,741 − 1,015·886 = 201·088 thermal units utilised.

For steam of 165lb. absolute pressure, and terminal pressure 6lb. absolute--

$T_1 = 826{\cdot}94°$ Fahr.,
$T_2 = 631{\cdot}32°$ Fahr.,
$H_1 = 660110$ ft. lbs.,
$H_2 = 768{,}333$ ft. lbs.,

and the proportion of steam liquefied at the end of expansion = 17·29 per cent., so that, at the beginning of expansion, we have ·99305lb. steam at 165lb. absolute pressure, and at the end of the expansion ·82136lb. steam and ·17169lb. water at 6lb. absolute pressure. Then, heat received = total heat of ·99305lb. steam at 165lb. absolute pressure = 1,216·974 thermal units. Heat rejected = total heat of ·82136lb. steam at 4lb. absolute pressure = 953·29 thermal units + heat of ·17169lb. water at same temperature = 26·339 thermal units. Total heat rejected = 953·29 + 26·339 = 979·629 thermal units.

1216·974 − 979·629 = 237·345 thermal units utilised.
Heat utilised with steam of 115lb. absolute pressure = 201·088 thermal units.
Heat utilised with steam of 165lb. absolute pressure = 237·345 thermal units.

$$\frac{237{\cdot}345 - 201{\cdot}088}{201{\cdot}088} \times 100 = 18 \text{ per cent. economy of 165 steam over 115lb. steam.}$$

Passing on now to the second alleged cause of the economy of the triple-expansion engine, the general effect of cylinder condensation is to cause a lowering of temperature at the beginning of the stroke and a raising of temperature at the end of the stroke, as indicated by the heat diagram, Fig. 1, on page 52. A B C D E represents the heat diagram of an engine in which there is no initial condensation, B C being an adiabatic curve produced down to the zero of temperature. The heat diagram of an engine in which initial condensation takes place is indicated by F G H D E, A B G F representing the amount of heat stored up in the walls of the cylinder at the point of cut-off. By the principle of work the area under the curve A B C is equal to the area under the curve F G H, so that if the process were carried down to the zero of temperature there would be no loss from cylinder condensation; but as in practice the process must be stopped at a point J, say, the difference between the areas A B G F and G J K will represent the amount of loss due to condensation. Or suppose 2lb. of steam are admitted to a cylinder at 100lb. pressure, and that 1lb. is condensed on the cylinder surfaces, then let the steam be expanded down to 50lb. pressure, assuming that all the condensed steam is by that time re-evaporated. Divide the period of expansion into any number of stages. At the beginning of expansion there is 1lb. of steam at 100lb. pressure, and by expanding it down to 50lb., a certain amount of energy can be extracted to do external work. At the end of the first stage a certain amount of the condensed steam will have been evaporated by the heat contained in the cylinder walls, and will be available for doing work. It is, however, at a lower temperature than the initial steam, and therefore has less potential energy. By dividing the period of expansion into a sufficient number of stages, and adding up the available energy of each portion of steam as it gets re-evaporated, and comparing the total thus obtained with the available energy of 2lb. of steam for the total temperature, an idea of the loss due to condensation between the assumed limits may be obtained. Condensation in the cylinder may be prevented by means of a steam jacket, but no economy can be effected thereby. Suppose a certain quantity of steam at 100lb. pressure, containing 200 thermal units, be admitted to an unjacketed cylinder, and assume that the walls of the cylinder absorb 100 thermal units, a certain amount of energy will be extracted from the remaining 100 thermal units, and also a certain portion of the heat stored up in the cylinder walls, will, as expansion proceeds, become available for doing work.

Next, suppose the cylinder to be jacketed with steam of 100lb. pressure. If no steam be condensed on entering the cylinder, it follows that the walls must have absorbed 100 thermal units from the steam in the jacket. In the one case 200 thermal units have been put into the cylinder and 100 thermal units into the jacket, up to the point of cut-off; and in the other case (to secure equal conditions—viz., 200 thermal units at initial temperature at point of cut-off), 300 thermal units are put into the cylinder direct, the result being the same in both cases. Thus no economy can result from the use of a jacket, but it may be very convenient in cases of great ratios of expansion to prevent flooding of the cylinder. It must not be forgotten that the jacket is also transmitting heat to the steam and water in the cylinder during the period of expansion. If the steam in the cylinder has no water mixed with it at the beginning of the expansion the jacket will prevent liquefaction due to expansion, or it may possibly superheat the steam. This transmission of heat from a higher to a lower temperature involves a loss. Suppose, for example, that 100 thermal units were transmitted to the steam in the cylinder during the period of expansion, by jacket steam. The amount of loss in this case is measured by the difference in the efficiency of 100 thermal units at 100lb. pressure and 100 thermal units at some temperature *lower* than this. This argument also applies to all cases where steam of a higher pressure gives up heat to steam of a lower pressure, as happens between the steam and exhaust side of a slide valve, and also where exhaust steam is in contact with the cylinder walls.

The next question which arises is, What is the action of condensation as effected by division of temperature range by passing the steam successively through two or more cylinders? For the means of comparison let us take as examples a simple engine and a compound, the low-pressure cylinder of the compound being of the same capacity as the single cylinder of the simple engine. For convenience let it be assumed that in the case of the compound engine the same amount of steam is condensed in each cylinder. Suppose, for example, that 4lb. of steam are admitted to the high-pressure cylinder, of which 1lb. is condensed up to the point of cut-off. Assume that this pound of water will be re-evaporated by the end of the stroke. The steam is then admitted to the low-pressure cylinder, and 1lb. of it condensed up to the point of cut-off, the water, as before, being re-evaporated by the end of the stroke. This process can be represented by a diagram (see Fig. 2, page 52). Let horizontal ordinates represent weights of steam, and vertical ordinates temperatures. A C will represent the 3lb. of steam present at point of cut-off in the high-pressure cylinder. For the sake of simplicity let it be assumed that the re-evaporation of the condensed steam follows the line C F, so that in the high-pressure cylinder the amount of loss may be represented by the triangle C B F, and similarly in the low-pressure cylinder by the triangle F F J, so that the total loss may be indicated by the rectangle E F J H. Now, what will happen in the case of the simple engine? The surface for condensation will be, roughly, about one-fourth less than before, owing to the earlier cut-off, but it is raised through twice the temperature. Under these conditions it is probable that more than 1lb. of steam will be condensed—say, for example, an amount equal to K B. Then the loss will be represented by the triangle K J B, and the double cylinder will be more economical by the value of the triangle K J C. Of course, there are no grounds for assuming that the re-evaporation takes place as indicated here, but it will serve to show why an economy should result from divided temperature range.

As regards the third cause of the economy of the triple-expansion engine—viz., increased piston speed—the advantage of this is evident. Take the case of two identical engines, one, however, running at twice the number of revolutions of the other. The amount of steam condensed will be the same in both engines, but the proportion of steam condensed to steam passing through the engine (which measures the loss) will be very much less in the fast running engine. Thus an increase of revolutions should always tends towards economy of steam. The increase of piston speed in the case of the triple-expansion engine compared with the compound has not, however, been very great. As pointed out before, the economy of steam of 150lb. pressure over steam of 100lb. pressure is 18 per cent., assuming the boiler efficiency to be the same in both cases.

The generally admitted economy of the triple-expansion engine is 20 per cent., from which it would appear that the economy has been mainly due to the increase of the working pressure and increased expansions, and that the effect of the decreased tem-

* Paper read by Mr. William Russell Cummins before the North East Coast Institution of Engineers and Shipbuilders, on November 21st, 1890.

THE PROJECTED FREE HARBOUR AT COPENHAGEN.

(*For description see page* 49.)

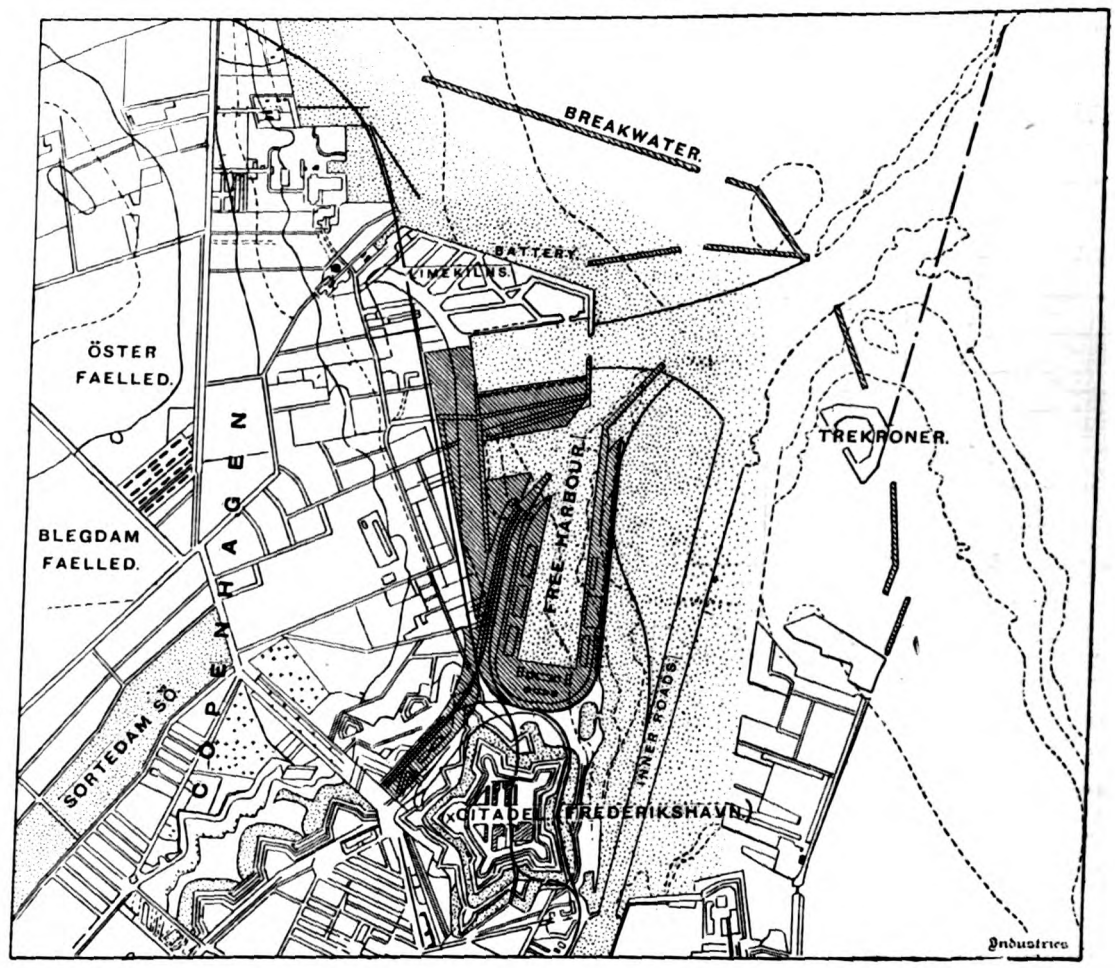


FIG. 2.—SKETCH PLAN OF THE GOVERNMENT SCHEME.

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INCREASED BOILER PRESSURE AND PISTON SPEED FOR MARINE ENGINES.

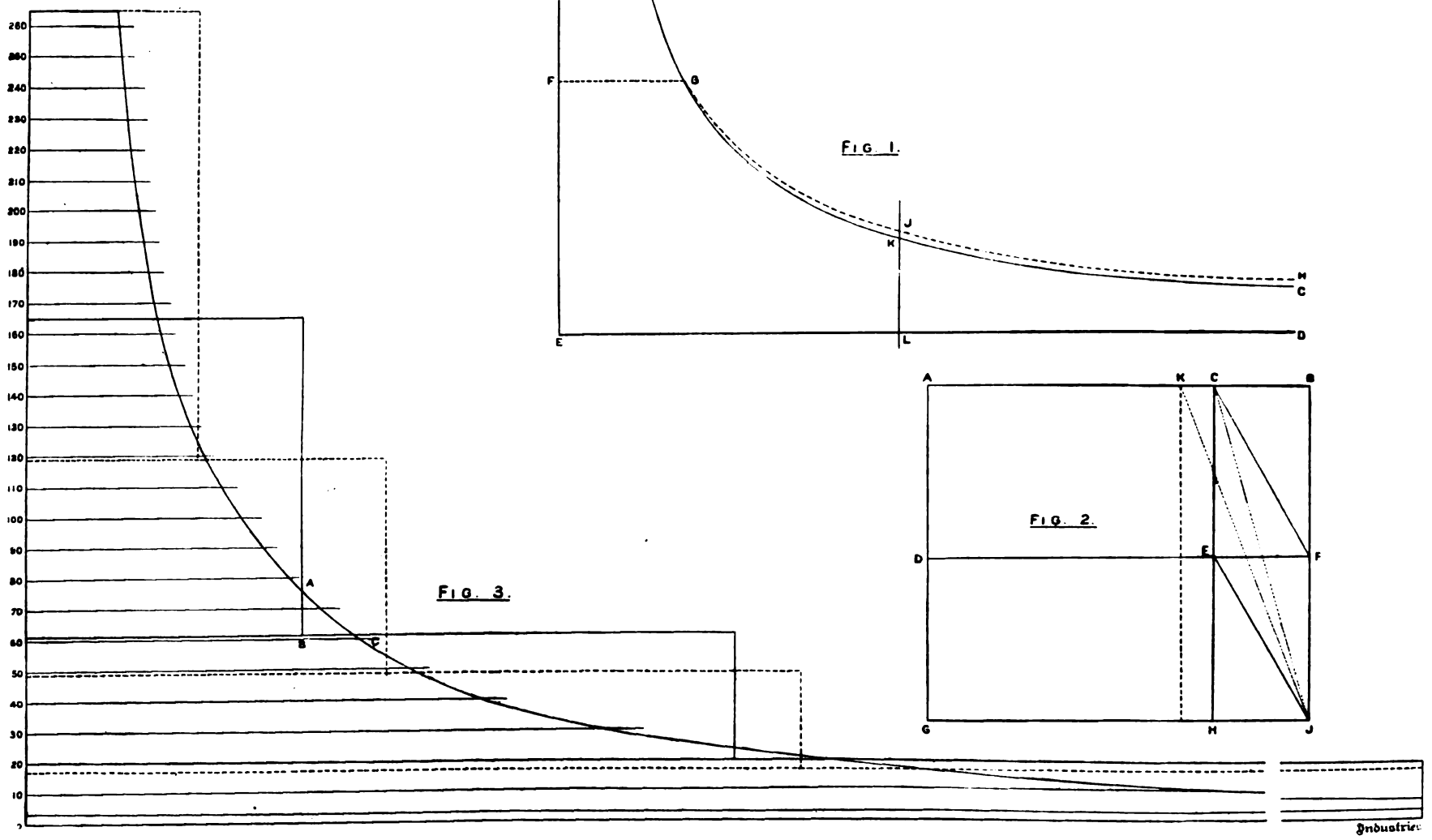


FIG. 3.

FIG. 1.

FIG. 2.

perature range in the cylinders and increased piston speed has in this case been inappreciable. Using the formula as given before for calculating the efficiency of steam of 220lb. absolute pressure expanded to 5lb. absolute, we have—

$T_1 = 851{\cdot}04°$ Fahr.,
$T_2 = 623{\cdot}53°$ Fahr.,
$H_1 = 646{,}423$ft. lbs.,
$H_2 = 772{,}561$ft. lbs.,

and the proportion of steam liquefied at the end of the expansion = 19·32 per cent. The weight of initial steam—

$$= 1 \times \frac{\text{total heat of steam at 115lb. absolute pressure}}{\text{total heat of steam at 220lb. absolute pressure}} = {\cdot}98713\text{lb.};$$

so that, at the beginning of expansion, we have ·98713lb. steam at 220lb. absolute pressure, and at the end of expansion ·79642 steam at 5lb. absolute pressure and ·19071lb. water. Heat received = total heat of ·98713lb. steam at 220lb. absolute pressure = 1,216·974 thermal units. Heat rejected = total heat of ·79642lb. steam at 4lb. absolute = 924·344 thermal units + heat of ·19071lb. water at same temperature = 29·254 thermal units. 924·344 + 29·254 = 953·598 thermal units rejected.

1,216·974 − 953·598 = 263·376 thermal units utilised.

Thermal units utilised by steam of 165lb. absolute pressure = 237·345.

$$\frac{263{\cdot}376 - 237{\cdot}345}{237{\cdot}345} \times 100 = 10 \text{ per cent.}$$

economy of steam of 220lb. absolute over steam of 165lb. absolute pressure.

For steam of 265lb. absolute pressure expanded to 5lb. absolute—

$T_1 = 867{\cdot}04°$ Fahr.,
$T_2 = 823{\cdot}53°$ Fahr.,
$H_1 = 637{,}267$ ft. lbs.,
$H_2 = 772{,}561$ ft. lbs.,

The proportion of steam liquefied at the end of expansion = 20·17 per cent. Weight of initial steam—

$$= 1 \times \frac{\text{total heat of 1lb. steam at 115lb. absolute pressure}}{\text{total heat of 1lb. steam at 265lb. absolute pressure}} = {\cdot}98323\text{lb.}$$

steam at 265lb.; so that, at the beginning of expansion, we have ·98323lb. steam at 265lb. absolute pressure, and at the end ·78492lb. steam at 5lb., and ·19831lb. water. Heat received = total heat of ·98323lb. steam at 265lb. absolute pressure = 1,216·974 thermal units. Heat rejected = total heat of ·78492lb. steam at 4lb. = 910·997 thermal units + heat of ·19831lb. of water at same temperature = 30·419 thermal units, 910·997 + 30·419 = 941·417 thermal units rejected.

1216·974 − 941·417 = 275·557 thermal units utilised.

Thermal units utilised by steam of 165lb. pressure = 237·345.

$$\frac{275{\cdot}557 - 237{\cdot}345}{237{\cdot}345} \times 100 = 16 \text{ per cent.}$$

economy of steam of 265lb. absolute pressure over steam of 165lb. absolute pressure.

If, taking into consideration the gain of 16 per cent. in steam economy and the admitted economy of high piston speed, it is deemed advisable to increase the boiler pressure to 250lb. per square inch, and also to increase the piston speed, the next question to be decided is—What type of engine will best suit these new conditions? There are several types of engine which could be adopted, viz., two-crank four-cylinder tandem, two-crank three-cylinder tandem, three-crank three-cylinder, and four-crank four-cylinder. The two first are not at all suitable for high speeds, so that the choice lies between the two last. In the first place, the four-cylinder type has an advantage over the three-cylinder type in the matter of steam distribution, as the cut-off must be much earlier in the three-cylinder engine. This early cut-off, besides making the engines unhandy, only allows of a small valve opening, thus necessitating a large travel to get the requisite steam opening. The travel of the valves is limited by the length of the cylinders, the limit being often reached with engines of the present type.

As regards the maximum piston speed at which the two types could be run, the three-cylinder engine would have a greater initial pressure to counterbalance the inertia of the moving parts; but, on the other hand, the four-cylinder engine having less initial pressure, would have less weight of moving parts. As, however, the weight of the moving parts is proportional to the initial load, the maximum piston speed will be the same for both types. Another advantage of the four-crank type is, that only two sets of valve gear are required; so that, on the whole, it would appear that the four-crank four-cylinder type of engine will be the most suitable for the new conditions.

We now pass on to the design of the cylinder ratios, &c., for the new pressure, after which the revolutions may be fixed. The usual method of designing cylinder ratios, points of cut-off, &c., is to arrange that the indicated horse-power developed in each cylinder should be the same. The indicated horse-power of each cylinder being the same, the initial loads may or may not be equal (in most cases they are not equal), and since the piston rods and connecting rods are always in duplicate, it follows that they must be designed to transmit the highest of the initial loads. The writer ventures to suggest that cylinder ratios, &c., should be designed so as to obtain equal initial loads in each cylinder. By this method the greatest economy is obtained in the weight of the reciprocating parts, a very important point in high-speed engines. The method used in the present instance has been to combine actual diagrams from a triple-expansion engine of 160lb. boiler pressure (see Fig. 3, above).

Since the diagram is for comparative purposes only, the cards have been set off without taking account of clearance and compression, and the steam curve continued up to 265lb. pressure, has, for the sake of simplicity, been plotted as a constant weight curve. The back pressure has been taken at 3½lb. on the low-pressure piston. The ratios for the triple have been so arranged as to give equal initial loads with a minimum of "drop" between the cylinders. It will be seen from the diagram that there is a considerable "drop" between the first and second cylinders. This is owing to the necessity of keeping the first cylinder small, so that the cut-off need not be too early. The quadruple has been arranged on the same method. It will be noticed that the drop between the cylinders is very small. The loss from drop is represented very nearly by the area of the triangular piece A B C. A certain quantity of heat is, however, regained, as the steam on expanding into the receiver, without doing work, will, if dry, become superheated, or if it contains suspended water, a portion of it will be evaporated, and become available for doing work in the next cylinder, from which it will be seen that, if a drop cannot be avoided, it will be best to arrange it at the higher pressure, so that the greatest amount of heat may be regained, as the farther the expansion is carried the greater the amount of heat regained. It may be argued that with large "drops" smaller cylinders may be used; consequently the engines would weigh and cost less. The most economical amount of drop will be reached when the percentage of loss caused by any further "drop" is greater than the percentage of weight saved by using a smaller cylinder. These same considerations apply to the most economical number of expansions of the steam. By increasing the number of expansions, more work is obtained from the steam; but at the same time the engines will be larger, and the limit to the number of expansions will be reached when the percentage of gain due to any further increase of expansion is less than the percentage of weight added to the engines.

Coming back to the diagram, it will be seen that the cylinder ratios of the triple are 1 : 2·04 : 6·54, and for the quadruple 1 : 2·08 : 4·46 : 10·47. It will be noted that, according to the diagram, the volume of the low-pressure cylinder is the same for both engines. It is probable that actually the low-pressure cylinder of the quadruple will have a greater volume; this, however, will not introduce any appreciable error into the calculations.

For facility of comparison, let us take as an example a triple-expansion engine of $\frac{28'' \times 40'' \times 71''}{48''} \times 150$lb. pressure; revolu-

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tions = 65 = "normal" revolutions of the Institution's Rule, and arrange the corresponding quadruple to develop the same horse-power. The first point is to decide upon the stroke of the quadruple. It will be of advantage to keep the stroke as long as possible, as the longer the stroke the greater the piston speed with "normal" revolutions; besides which long strokes and consequently small diameters of cylinders will save space longitudinally, the height of the engines being in merchant vessels generally of little consequence. Let the stroke of the quadruple, then, be taken at 48in., the same as the triple. To determine the number of revolutions, let it be assumed that the engines can be run safely and smoothly when the initial pressure is equal to the pressure required to absorb the inertia of the reciprocating parts at the end of the stroke, and when there is a margin of pressure, always keeping the slipper on its guide.

Let w = weight of reciprocating parts per square inch of piston.
n = number of revolutions per minute.
r = radius of crank in feet.
c = length of connecting rod in feet.

The weight of the reciprocating parts per square inch of piston will probably be:—

For 1st cylinder = 7·5lb. per square inch.
,, 2nd ,, = 4·0lb. ,, ,,
,, 3rd ,, = 2·5lb. ,, ,,
,, 4th ,, = 1·8lb. ,, ,,

The pressure per square inch of piston required to accelerate the reciprocating parts at the beginning of the stroke:—

$$p = \cdot00034 \times w \times n^2 \times r \times \frac{C \times r}{C} - w \text{ for top centre.}$$

$$p = \cdot00034 \times w \times n^2 \times r \times \frac{C - r}{C} + w \text{ for bottom centre.}$$

In our case:—

p = 146·0lb. per square inch for 1st cylinder.
= 70·0lb. ,, ,, 2nd ,,
= 32·5lb. ,, ,, 3rd ,,
= 14·0lb. ,, ,, 4th ,,

Limit of revolutions—

1st cylinder	top	156	revolutions.
	bottom	188	,,
2nd cylinder	top	148	,,
	bottom	178	,,
3rd cylinder	top	104	,,
	bottom	151	,,
4th cylinder	top	401	,,
	bottom	115	,,

This practically limits the revolutions to 100 per minute.

No account has yet been taken of the inertia of the pumps. If the pumps are worked off the fourth cylinder, the revolutions must be reduced, if the pressures in the pumps themselves are not sufficient to overcome the inertia of the moving parts.

For the second cylinder—

$$p = 70 = \cdot00034 \times w \times 100^2 \times 2 \times \frac{10·5}{8·5} - 4.$$

$$w = \frac{74 \times 8·5}{\cdot00034 \times 100^2 \times 2 \times 10·5} = 8·8\text{lb. per square inch of piston.}$$

Weight of piston, connecting rods, &c. = 4lb. per square inch of piston; so that the steam in the second cylinder would balance 8·8 − 4·0 = 4·8lb. of pump gear per square inch of second cylinder = ·95lb. per square inch of fourth cylinder. The actual unbalanced inertia will probably not be more than this, so that the engines can still be run at 100 revolutions if the pumps are driven from the second cylinder.

We have next to consider the other limit of revolutions—viz., the momentum due to the transverse motion of the connecting rod. This has been estimated in the following manner:—The path described by the centre of gravity of the connecting rod being traced out, an arc of a circle is found which will coincide as nearly as possible with the curve at half stroke. The centre of gravity of the rod is assumed to be rotating on the radius thus found. This is, perhaps, not a strictly accurate solution of the problem, but will be sufficiently near for the present purpose. In the case under consideration the weight of the connecting rod proportioned for a 71in. cylinder = 2,100lb.; length = 8ft. 6in.; centre of gravity, 43in. from bottom end; radius of arc coinciding with path described by centre of gravity at half stroke = 3·6ft.; so that the centrifugal force exerted by the rod will be—

$$\cdot00034 \times 2{,}100 \times 100^2 \times 3·6 = 25{,}700\text{lb.}$$

This is equivalent to 10,400lb. acting at the cross-head.

The pressure on the guides

$$= \frac{\text{Area } 71'' \times 14 \times 2}{8·5} = 13{,}000\text{lb.};$$

so that at 100 revolutions there is still a margin of 2,600lb. to keep the shoe on the guide.

Assuming that, by the increased working pressure and increased piston speed, an economy of, say, 10 per cent. can be effected, the size of the low-pressure cylinder of the quadruple to develop the same indicated horse-power as the triple we have taken as an example, will be—

$$\frac{\text{Area } 71'' \times ·9 \times 65}{100} = 2{,}316 \text{ square inches} = 55\text{in. diameter.}$$

The cylinder ratios, as determined before by the diagram, Fig. 3, are 1 : 2·08 : 4·46 : 10·47, so that the quadruple engines will be—

$$\frac{17'' \times 24\tfrac{1}{2}'' \times 36'' \times 55''}{48''} \times 250\text{lb. boiler pressure.}$$

Revolutions per minute = 100.

The size of the triple engine which it is to replace being—

$$\frac{28'' \times 40'' \times 71''}{48''} \times 150\text{lb. pressure.}$$

Revolutions per minute, 65.

To sum up, the writer has endeavoured to show that the economy of the three-crank triple-expansion over the two-crank compound has been mainly due to the increase of boiler pressure, and, to a small extent, to the increase of piston speed. That by increasing the boiler pressure to 250lb. per square inch a steam economy of, say, 15 per cent. can be obtained over the present three-crank triple. That an increase of piston speed, besides increasing the economy of steam, will also increase the weight

HIGH PRESSURE BOILER FOR MARINE PURPOSES.

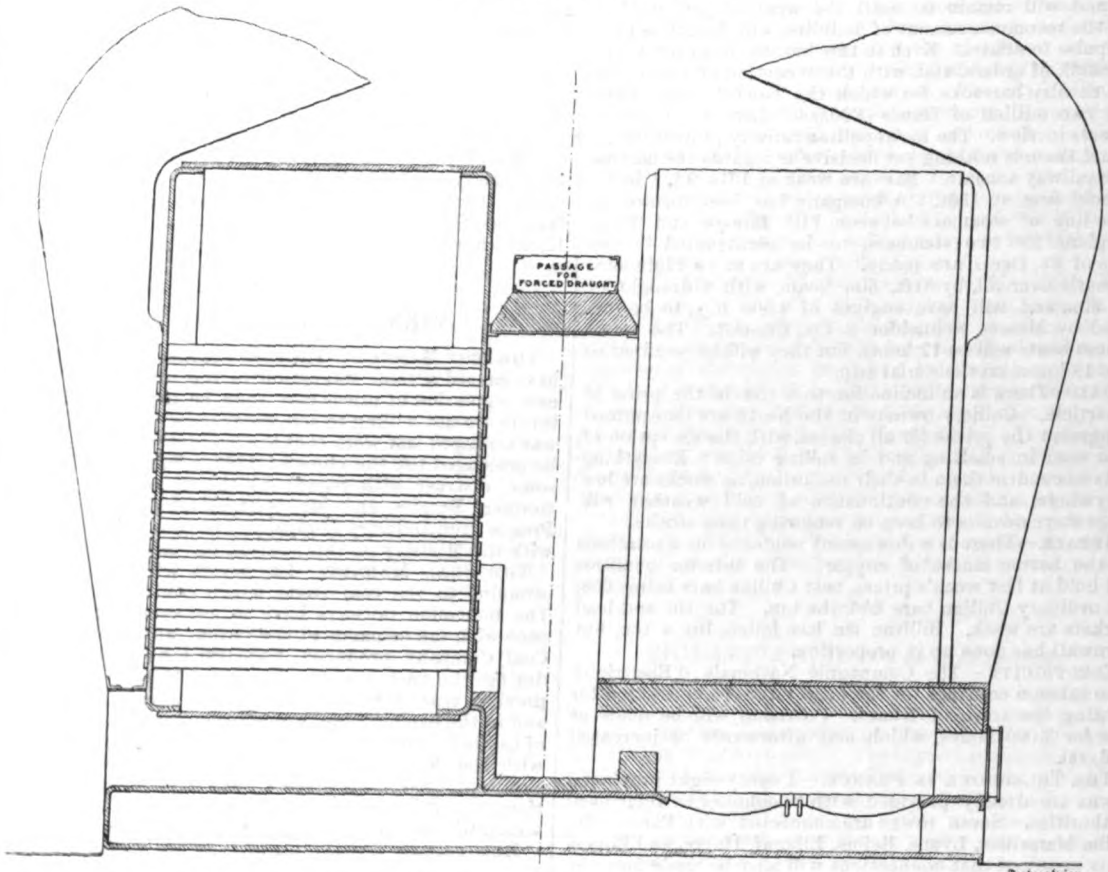


FIG. 4.—SECTION THROUGH BOILER.

FIG. 5.—SECTION THROUGH FURNACE.

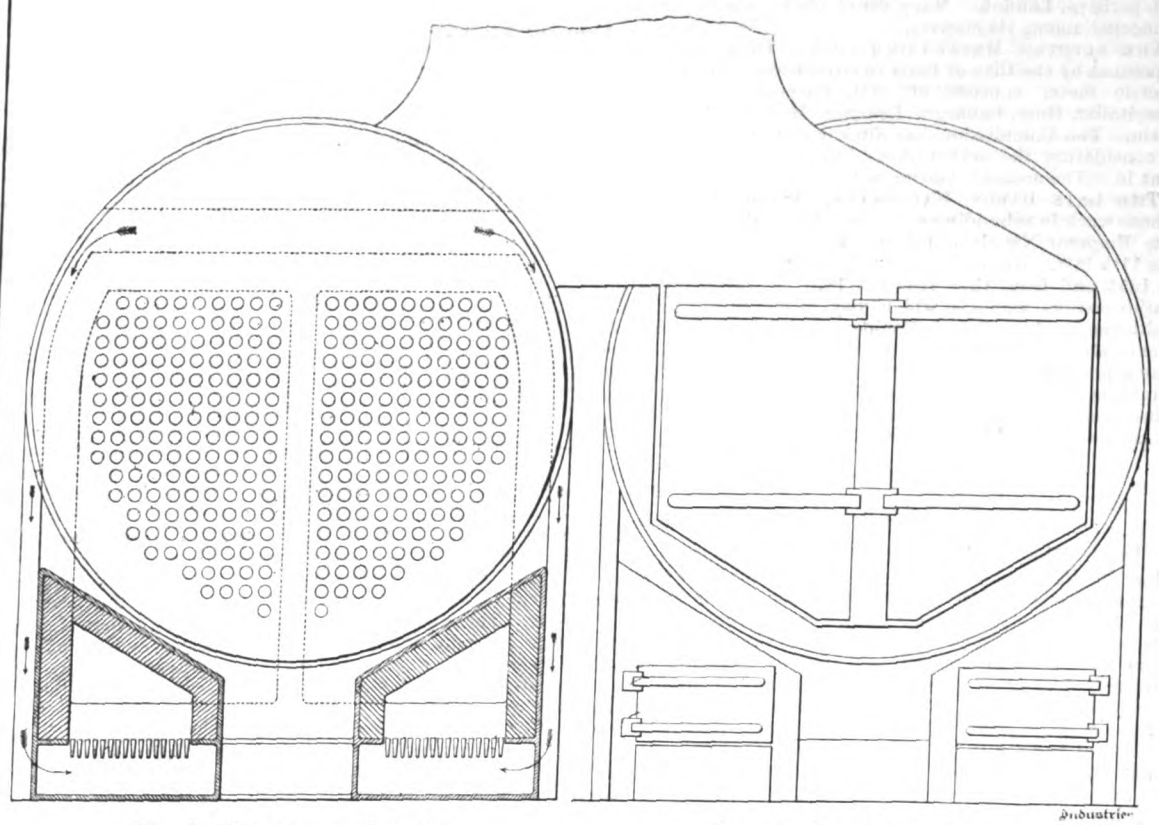


FIG. 6.—TRANSVERSE SECTION.

FIG. 7.—END ELEVATION.

economy, so that the piston speed should be increased up to the limits set down in the paper. That the best type of engine to use this higher pressure, and best adapted to run at a high speed, is the four-crank four-cylinder engine, with unjacketed cylinders and separate steam and exhaust valves.

Passing on to the question of the type of boiler to be adopted, the writer is of opinion that a considerable departure from the present design of boiler is necessary, in order to make a satisfactory structure for 250lb. pressure. With this pressure difficulties will arise with the furnaces, and the flat sides of the combustion chambers. To get over these difficulties the writer proposes to put the furnaces and combustion chambers outside the boiler altogether. The boiler then become a simple cylinder, the tubes running from end to end. As shown in Figs. 4, 5, 6, and 7, the boilers are arranged back to back, with the combustion chambers between them. The furnaces and combustion chamber may be of cast or wrought iron, lined with firebrick. In order to keep down the grate surface, and thus economise space athwartships, it will be of advantage to use forced draught, and all the air on its way to the furnaces is made to pass over the top and sides of the combustion chamber, thus reducing to a minimum any loss from radiation.

The advantages of a boiler of this type are obvious. It is perfectly suitable for a high pressure. There will be no straining from unequal temperatures. The cost of manufacture will be considerably less than that of the present type of boiler. For the same heating surface the space occupied is less; the boiler shown in Figs. 4, 5, 6, and 7, is 10ft. 6in. diameter, and contains the same heating surface as a boiler of the present type 13ft. 6in. diameter, the lengths in both cases being the same.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 13th January, 1891.

Iron.—The iron market is still in a state of stagnation here, and will remain so until the weather gets milder, when the recommencement of building will doubtless give an impulse to affairs. Even in this branch, however, there is a dearth of orders, and, with the exception of some proposed cavalry barracks, for which the Town Council have voted two million of francs (£80,000), there are no large contracts in view. The metropolitan railway project hangs fire, and there is nothing yet decisive as regards the narrow gauge railway scheme. Bars are weak at 131s. 9d.; joists still hold firm at 136s. A company has been formed to run a line of steamers between l'Ile Rousse and Nice. The plans for two steamers, to be constructed in the works of St. Denis, are ready. They are to be 229ft. 6in. in length over all, by 31ft. 6in. beam, with a draught of 11ft. 9in., and will have engines of 2,500 h.p., to be furnished by Messrs. Schneider & Co., Creuzot. The speed of these boats will be 17 knots, but they will be required to make 19 knots on their trial trip.

Coal.—There is an inclination to a rise in the price of this article. Colliery owners in the North are determined to augment the prices for all classes, with the exception of those used in smelting and in rolling mills. Everything tends to confirm them in their resolution, as stocks are low everywhere, and the continuance of cold weather will oblige store owners to keep on renewing their stocks.

Metals.—There is a downward tendency in quotations for the better marks of copper. The inferior qualities still hold at last week's prices, best Chilian bars being £58, and ordinary Chilian bars £56, the ton. The tin and lead markets are weak. Billiton tin has fallen 10s. a ton, but Cornwall has gone up in proportion.

Electricity.—The Compagnie Nationale d'Electricité have taken a contract for the installation to be erected for lighting the town of Nimes. Provision will be made at first for 2,000 lamps, which may afterwards be increased to 6,000.

The Telephone in France.—Twenty-eight provincial towns are already provided with telephones by their local authorities. Seven towns are connected with Paris—viz., Lille, Marseilles, Lyons, Reims, Elbœuf, Havre, and Rouen. It is expected that connections will also be made between Paris and Troyes, Paris and St. Quentin, Paris and Amiens, Arras and Lille, Paris and Orleans, and Paris and Brussels, and, perhaps, London. Many other towns are or will be connected among themselves.

The Electric Meter Commission.—The Commission appointed by the City of Paris to adjudicate as to the best electric meter consists of MM. Carpentier, Chrétien, Hospitalier, Huet, Laffargue, Lemoine, Mascart, Meyer, and Potin. The Commission has already begun its work, and is considering the seventy-one different kinds of meter sent in. The accurate testing will be carried out later.

The Late Baron Haussmann.—Baron Haussmann, whose work in rebuilding and beautifying Paris under the late Emperor Napoleon III. is well known, died here on the 11th inst. He was summoned to Paris by the Emperor in 1853, and from that year till 1870 he was engaged in various works, amongst which may be mentioned the embellishment of the Bois de Boulogne and Bois de Vincennes, the establishment of public gardens, the prolongation of the Rue de Rivoli, the construction of new boulevards, the building of barracks, churches, bridges, markets, fountains, theatres, and the new Opera House. A boulevard, which was named after him, still retains its name.

BERLIN, 12th January, 1891.

Iron.—The year 1891 opens with brightening prospects for the iron trade of this country. In spite of the hindrances caused by the exceptionally cold weather, business is increasing. To what extent the revival will proceed it would be rash to predict. The activity of last year is not likely to be soon repeated, but, from present indications, we may reasonably expect a good average year with fairly remunerative prices. From both the Upper Silesian and the Rhenish-Westphalian districts come more favourable reports of the state and tendencies of the markets. The demand has in some degree revived for both crude and finished iron, and seems likely to become brisker as the spring approaches. Prices are firm. The following list of prices of forge pig and merchant bars current at the end of each month in 1890 shows the general movement of the iron markets in the Rhenish-Westphalian districts in that year:—Rhenish-Westphalian best forge pig, 92s., 92s., 91s., 78s., 78s., 72s., 72s., 68s., 62s., 58s., 58s., 58s. a ton; bars, 195s., 205s., 205s., 205s., 185s., 185s., 170s., 170s., 145s., 140s., 135s., 135s., 135s. a ton. From statistics just published to show the continued and rapid development of the iron industry in Germany, we learn that the number of hands employed in that industry increased from 183,874 in 1873 to 192,625 in 1883 and to 223,091 in 1889. In consequence of the adoption of improved processes and more efficient machinery, the number of hands employed about the blast furnaces have, in the period in question, notwithstanding a large increase in the production of pig, diminished considerably, being 23,985 in 1889, against 28,129 in 1873.

Metals.—The new year has brought no improvement in the metal market. The amount of business done is very small, and consists only of transactions to meet the most pressing needs of the moment. Of purely speculative business, there is absolutely none. Copper is, however, somewhat firmer in price. Mansfeld refined is quoted £69 to £72 a ton, English brands from £55 to £67. Tin is still weak. Lead is unaltered in price, but the tone of the market is languid. Spelter shows a downward tendency. Though no heavy fall in spelter is likely to occur, considerably lower prices will probably be reached before the end of the first quarter of the year. The ordinary Silesian sorts are quoted £25 5s. to £25 15s. a ton. Antimony regulus is fairly firm.

The Dynamite Syndicate.—The German and International Price Convention for Dynamite, which expired with the year 1890, has been revived for a number of years. Two hitherto outstanding firms of dynamite manufacturers, the Geyer Erzgebirgische Dynamitfabrik and the Kosmos Sprengstaff-Gesellschaft, have joined the syndicate.

VIENNA, 12th January, 1891.

The Iron Market.—The cold weather and the holidays have caused a total stagnation in the iron market. As a new regulation of prices may soon be expected, manufacturers are not willing to sell under present conditions. It was arranged last week that the bar iron syndicate should be prolonged till the close of 1893. Manufacturers show some distrust with regard to the agreement with the German Empire, and Mr. Wittgenstein, director of the Prague Iron Industry Company, who was asked to confer with the Ministry on this subject, has refused to do so.

The Coal Market.—The severe winter has given a stimulus to the coal trade, which continues very brisk. The Bohemian railways have to use every effort to keep pace with the demands of the various works. The Brüxer Coal Company produced 1,500,000 tons of brown coals during the past year, as against 1,100,000 tons in the previous year. Generally there is an increase in production and in the export trade, which encourages the investment of capital. The Credit Bank is carrying on negotiations with the Northern Railway for its coal mines. Baron Rothschild has lately given a fresh impulse to the negotiations, and it is expected that a joint-stock coal company which will be the largest in Austria will soon be formed.

Electrical Engineering.—As we have already announced in our report of last week, the International Electricity Company intends to erect a large installation in the centre of the city for the purpose of lighting the new Government printing offices. The installation will provide current for 2,000 incandescent lamps of 16 candles, and will differ from the other central stations erected by this company in its being on the continuous current system. The dynamos consist of three machines of the Ganz type, Δ 4½, and one of the type Δ 3. The engines for this installation are provided by the Brünner Machine Manufacturing Company on the design of Professor Radinger, whilst the laying of the entire system of conduits has been entrusted to Messrs. Brückner, of Vienna.

BRUSSELS, 13th January, 1891.

Iron.—The state of the iron market still leaves much to be desired. There is but little business doing, and to get this little sellers are compelled to make further concessions in prices. Manufacturers are asking 112s. a ton for No. 2 bars, but consumers refuse to pay more than 105s. The outlook, though somewhat less gloomy than it was a month ago, is sufficiently discouraging. More blast furnaces are to be blown out at the end of the present month. This unsatisfactory state of things is due principally to two causes—the great advance in the prices of coal and coke, and the collapse of business in South America. The exports of Belgian iron to that part of the world in the first eleven months of 1890 amounted to only 17,956 tons, against 52,039 tons in the corresponding period of the previous year. There has also been a somewhat serious loss of trade with Holland, where our business in plates has suffered severely from English and German competition. This loss is largely attributable to the augmented cost of production due to dear fuel.

Coal.—There is no abatement of the activity which has so long characterised the coal market of this country. The slackened demand for metallurgical uses, consequent on the depression in the iron trade, has been compensated for by an exceptionally brisk demand for the household sorts, caused by the severe weather of the last five or six weeks. Prices have again an improved tendency. Small coal for coking is scarce, and cannot be bought for less than 9s. 6d. a ton. Coke is nowhere offered at less than 14s. 6d. a ton. German competition continues keen; but the conditions of trade are now such that prices of Belgian coal are but little affected by it. There is no prospect of cheaper coal for at least some months to come.

Glass.—The year 1891 begins badly for the glass industry. Business is very slack, and the circumstances of trade are such that no great improvement is likely for some time to come. The market is depressed in tone. Though the trade is suffering from over-production, new works are coming into operation, and great projects are talked of. The new works of St. Roch Auverlais started successfully on New Year's Day.

DÜSSELDORF, 13th January, 1891.

Coal and Iron.—The general situation of the Westphalia coal market is much influenced by the abnormal state of the weather. The extensive inundations of the Ruhr, which took place in the second half of November, by which many important railway lines were interrupted, were the first cause of a good deal of the irregularity in the shipment of the coal and coke. The severe weather then suddenly set in, which, while it increased the consumption of coal for domestic purposes, decreased at the same time the capacity of the railways, as heavy snowslips accompanied the frost. Many of the coal pits were forced to lie idle two and in some cases even three days during each of the past weeks, and the decrease in the production caused in this way is estimated to be already about 1½ per cent. of the annual output. Of course, there prevails a strong demand for coal, and prices are rising. The quotations are for gas coal, per ton of 1,000 kilogs., 9·50 to 12 marks; cleaned coal for coking, 7·50 to 8 marks; and for coke, 14·50 to 15 marks. The ore market is quiet. Somorostro ore is at 15 marks f.o.b. Rotterdam, and French magnetic ore, containing about 60 per cent. of iron, is being much offered. The pig iron market is steady, and consumers of foundry pig are keeping back, as the Glasgow and Middlesbrough prices are lessening. German foundry No. 1 is quoted at 75 marks; No. 3, at 63 marks; while Luxemburg foundry is at 52fr. at Luxemburg. Hematite is at 75 marks; German Thomas pig at 49 marks. The bar iron market is quiet, as is usually the case at this season. The prices of sheets and boiler plates are declining; Siegen sheets are at about 135 marks. The German manufacturers are deeply struck by the fact that the Bavarian railways and the Prussian State Railway direction of Magdeburg have taken a supply of 8,000 tons of steel rails from their English competitors. They have made up an estimate, according to which the costs involved by the new Social laws are about 5½ marks per ton of rails, and they regard it as the duty of a Government which imposes those heavy charges on the home industries to take their supplies from them, even if they ask somewhat higher prices than those of foreign firms.

Bridge Building.—The Harkort Works in Duisburg have received the order to supply three bridges for Roumania of the total value of about 1,000,000 marks.

AMSTERDAM, 12th January, 1891.

The Weather and Navigation.—The severe weather continues unabated all over Holland, and the frost has been intense. In the country there is no water, and the towns are little better off. In Amsterdam alone it is computed that 8,000 families have their supplies cut off through the water pipes freezing. The Down Water Company has stationed men with huge bells, which they keep ringing incessantly, around the principal hydrants in the streets, where water is supplied free of cost to all comers. Of course navigation nearly everywhere is at a standstill. But Rotterdam offers in this respect a striking contrast to Amsterdam. There has been very little ice trouble in the New Waterway, whilst Antwerp is virtually a closed port, and ocean vessels have been able to reach Rotterdam and to depart from it without let or hindrance, the impediments of ice floes only commencing above the two Maas bridges. On the other hand, Amsterdam is still unapproachable from the sea, along a canal only some miles long. Huge steamers are stuck fast in the middle of it, and either cannot advance or only get on at the pace of some ancient slave galley. This is notoriously the case with the mail steamer "Koningin Emma," of the Nederland Company, which steams up to Amsterdam at the rate of a thousand metres a day. The canal being 23,000 metres long, it will take the ship the best part of a month before it is safely berthed alongside the quay in Amsterdam.

The Ice on the North Sea Canal.—At the town side of the canal 200 workmen are busily engaged in sawing a swinging space and a channel for the outgoing mail steamer, the "Prins van Orange," of the same company. The ice here has a thickness of 50 centimetres. It is sawn into blocks, each weighing about one thousand kilogrammes, and it requires the united efforts of thirty men to handle every block and carry it away over the ice. It goes without saying that these operations are most expensive, and if a railway existed to Ymuiden it would have its carrying power taxed to the utmost. But the Government is blamed for not having undertaken this line, and for neglecting to provide for an efficient ice service upon the North Sea Canal. The officials say, no doubt, that they have nothing whatever to do with the ice service. The North Sea Canal Company held a concession for the purpose, the condition being that the company should keep the canal open and charge "ice dues" to all vessels using the waterway during the winter months. The company, however, ceded its special concession to a subsidiary company, the Ysploeg, an arrangement which the State could not alter when it took over the canal. But the Ysploeg failed after a few iceless winters, and now the ice surface is not maintained by anybody. The Government could surely see to the concession being carried out, and cancel it when it was not carried out. Yet all it will do now is to experiment with powder, dynamite, and other explosives, against the solid ice crust before Amsterdam.

Trade with Antwerp *vid* Flushing.—The closing of Antwerp has benefited Flushing immensely, and all the large ships that cannot proceed up the Scheldt are now

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making for Flushing, where goods are placed in special trains and despatched to Antwerp. Flushing, which at other times is rather sluggish, at this moment offers a curious sight of business at fever-heat. The harbour is full of steamers, and six to eight more are arriving every day. Among the latest arrivals are the "Sheldrake," from Liverpool, and the "Belgenland," from New York, the latter a Red Star Liner.

PETROLEUM AT ROTTERDAM.—The Municipal Council of Rotterdam has approved the Bill to build a connecting line between the nearest railway station and the petroleum depôt at Charlois. The petition of the inhabitants of Charlois to have a movable bridge instead of a fixture was not acted upon, on account of the greater cost.

STOCKHOLM, 10TH JANUARY, 1891.

IRON IN STOCK.—The quantity of iron upon which the Riksbank has advanced loans in Stockholm and in Gothenburg was considerably less at the end of last year than at the beginning, which will appear from the following particulars. At the head office in Stockholm the quantities were :—

	Kilogrammes.
Pig iron	11,449,821
Bar iron	3,601,833
Ingots of Bessemer and Martin steel	5,940,512
Other kinds of iron	3,863,541
	24,855,707
and at Gothenburg—	
Pig iron	5,334,429
Bar iron	2,882,262
Ingots of Bessemer and Martin steel	403,879
Other kinds of iron	2,449,026
	11,069,596

The aggregate sum advanced upon the above was 2,561,639kr., of which 1,747,049kr. were in Stockholm and 814,590kr. at Gothenburg. During the last three months of the year the quantity has been steadily increasing :—

	Kilogrammes.
October 31st	33,203,134
November 30th	34,347,968
December 31st	35,925,303

The quantity at the end of the year was thus about 36,000 tons, against 45,000 tons at the beginning of 1890.

THE ZONE TARIFF IN SWEDEN.—The zone tariff was in the course of last year introduced at the Uddevolla-Herrljunga Railway. The manager reports that it works very well; there is an increase in revenue and a large increase in the number of travellers.

THE HERRING FISHERIES.—The herring fishing on the West Coast has proceeded satisfactorily enough from about the middle of November, and the quantity of herrings salted at Norrviken up to the end of last year amounts to some 72,400 barrels. The fishing at the Bohnslön Skögord has been satisfactory; considerable quantities of salted herrings have been exported to Russia and Germany, and of fresh herrings a large quantity has been sent to Germany.

CHRISTIANIA, 10TH JANUARY, 1891.

THE TIMBER INDUSTRY IN 1890.—The fair promises with which the past year opened have not been fulfilled, and there has been a sudden and almost unprecedented fall in prices. The main reason for this great fall is, no doubt, over-production, and it is to be sincerely hoped that a movement similar to those which have already resulted in a sensible and wholesome reduction of output in other industries may succeed in the timber industry. The over-production of timber during 1890 has not resulted in an excess in the exports above those of the previous year. Though full particulars for November and December are not yet available, it is estimated that the total export for last year from Norway is likely to be about 1,850,000 cubic metres, against 2,021,541 cubic metres for 1889, which shows a decline for the year 1890 compared with the previous year of about 8½ per cent. Up to the end of October last year the aggregate exports of timber amounted to 1,688,357 cubic metres, of which Great Britain and Ireland account for as much as 1,028,503 metres; next comes France, with 147,057 cubic metres; Holland, with 114,726 cubic metres; Belgium, with 102,891 cubic metres; and Australasia, with 100,898 cubic metres. The balance has gone to Germany, Sweden, Denmark, and Spain. The value of last year's timber exports has been put at 32,000,000kr., against 37,000,000kr. for 1889. Last winter floating down conditions were favourable, and the timber came quickly forward. As little has been sold for forward delivery, and as the present owners do not appear to be in want of money, only little will probably be floated down this winter. There must, besides, be good stocks, as the cuttings of last year exceeded those of the previous year, whereas the exports, as already stated, were smaller. The large stocks in Norway, as well as in Sweden and Finland, and especially in these two latter countries, must have a material bearing upon the industry for the present year. It is thought that the more immediate effect of the admittedly large stocks will be unaltered low prices for timber for spring shipment, although it is not unlikely that an improvement may set in later on, on account of the reduction in this winter's production. On the whole the prospects for the Norwegian timber industry are not particularly bright, but the producers have to some extent the matter in their own hands. Whether sufficient co-operation between the Scandinavian timber producers can be brought about to ensure that regulation in the output which is necessary to regulate the prices, the future only can show.

COPENHAGEN, 10TH JANUARY, 1891.

INDUSTRIAL NOTES FROM ICELAND.—Last year was a fairly good one for Iceland, although the cod fishing in some parts has not been satisfactory. There has been no Greenland ice, and the weather has been tolerably good. Of train oil the exports from Iceland to Copenhagen amounted to about 9,000 barrels, which is about 800 barrels less than during 1889. The prices were at first rather low, but improved, especially towards the end of the year. Of dried fish (Klipfisk) some 6,085,000lb.(D.) were exported from Iceland to Copenhagen, and the export direct from Iceland amounted to 6,846,000lb.(D.) The export of dried fish from Iceland direct to Genna amounted to 1,268,000lb.(D.), and for the Spanish market amounts to 4,745,000lb.(D.) The production of wool was comparatively good; the exports direct to England amounted to about 320,000lb.(D.), whereas about 1,000,000lb.(D.) were exported from Iceland to Copenhagen, showing an increase of 157,000lb. as compared with 1889. The export of salted sheepskins amounted to 8,780 bundles, which was about 1,100 bundles less than that of the previous year. The export from Iceland to Copenhagen of cleansed eider down was 5,000lb.(D.)

THE COPENHAGEN BREWERIES.—The amalgamation of about a dozen Copenhagen breweries, to which reference was made in a previous letter, has not yet been definitively completed, one of the breweries in question having recently put some difficulties in the way. The result was a sudden drop of 10 to 12 per cent. in the price of the shares of one of the largest breweries, but it is still hoped that the matter may be arranged.

MADRID, 12TH JANUARY, 1891.

THE BILBAO SHIPBUILDING YARDS.—Some comments have been made on the first announcement that the contract for the building of the three large cruisers, which was undertaken by Messrs. Martinez Rivas & Palmer, is to be transferred, with the consent of the Spanish Government, to a public company. This company will be called the "Astilleros del Nervion," and will have a capital of £1,200,000. The largeness of the capital seems to imply that the whole of the Martinez de las Rivas business, which was originally formed by the Marquis de Mudela, is to be included in the new company. The property consists of iron ore mines, four blast furnaces, coal mines in Asturias, a battery of coke ovens (which is nearly finished), shipbuilding yards, engineering and armour plate shops, and a large steam plant. Some suppose that the change has been effected in order to enable Signor Martinez to become a member of the House of Commons (Cortes), as the transaction of business with the Government in his own name was a disqualification. Others say that the limited company has been formed with the object of relieving Signor Martinez and Sir Charles Palmer of their personal liability.

VINE DISEASE IN THE PROVINCE OF CORDOBA.—The vine disease has appeared in the province of Cordoba. The valuable wine known in the market by the name of Montilla, although much of the wine so named is not made in the vicinity of that place, is grown in this province. The celebrated Xerez wine called Amontillado gets its name from its having some resemblance to the true Montilla.

TELEPHONES.—The bye-laws for the carrying into effect of the decree which deals liberally with private telephone enterprise were published on the 6th inst, It remains to be seen how far these liberal provisions will be carried out in practice. Licences are to be readily granted for private lines at an annual payment of 4s. for each kilometre of line. This should be a great inducement for some company to establish itself for the purpose of erecting these private lines.

NEW YORK, 3RD JANUARY, 1891.

METROPOLITAN TRACTION SYSTEM.—The Metropolitan Traction Company, of New York City, which is now engaged in substituting the cable system for horse-power in Broadway, is about to increase its capital stock from $10,000,000 to $20,000,000, to raise money for the completion of the improvement. Present stockholders may subscribe in proportion to their present holdings, but must pay $2·50 per share as earnest money and 15 per cent. of the par value of the stock on January 15th, and by the 15th inst. must have paid 60 per cent. as called for. This company owns six of the important lines in the city, besides several smaller ones. By introducing cable in Broadway it will do away with the 2,000 horses now employed on the line, and at the same time be able to handle its enormous business with greater satisfaction to the public. The carrying capacity of the cable road will be 600,000 passengers per day, and it is calculated that at least half this number will be carried.

WINDOW GLASS.—An attempt is being made to put the American Window Glass Company, the big trust recently formed by the manufacturers, into active operation. Dealers expect that one result will be an increase in prices, and are placing orders for future delivery at present prices. Objections from factories in Ohio and Indiana have prevented an earlier commencement of business by the new company. Recently there has been a deficiency of gas, which has necessitated the closing of several of the factories, and has had the effect of bringing them into conjunction with the combination. The advance in fuel in Pittsburgh on the first of last month, amounting to about 30 per cent., will not close any of the establishments, as they cannot afford to shut down now long enough to rearrange their furnaces for coal. The rate for natural gas which will prevail during the present year will be higher than the equivalent in coal, but it is probable that the companies will continue to use it, because of the excellence of the gas-fired glass.

NAVAL AFFAIRS.—The contract for building the harbour defence ram, at a cost of $930,000, has been given to the Bath Iron Works, of Bath, Maine, the president of that company having agreed to withdraw his stipulation for the omission of the clause providing for the rejection of the vessel if she should fail to make 17 knots per hour. The cruiser "Newark" has returned, having successfully completed her trial trip under the Navy Board. The required horse-power was 8,500, and, although detailed returns have not yet been made, it is probable that she has earned for her builders a premium of something over $40,000, at the rate of $100 per each horse-power in excess of the power required. The speed from the logs showed an average of 19·7 knots, and at one time, for two hours, the average was 20·4 knots.

PHILADELPHIA, 2ND JANUARY, 1891.

ELECTRIC LIGHTING.—The contracts for lighting the streets of Philadelphia for the present year were recently awarded by the Department of Public Works to eleven different lighting companies. The highest successful tender was 55 cents, and the lowest 30 cents, a light per night. The total number of lights is about 1,472, which, at an average rate of 43½ cents per night, will cost the city $234,000 for the year. The lowest tender was an offer to do all the lighting from the Delaware to the Schuylkill, and from Lehigh to Washington Avenues, at 27½ cents per night after April 1st, but this was rejected. The large amount which must be paid for city lighting brings up again the question of the city owning its own plant. The city now has access to over 600 miles of underground conduits, and it is estimated that plant sufficient to do all the lighting could be erected for $600,000.

CARPENTER STEEL.—A test of some samples of Carpenter steel made at Reading, Pa., for the United States Government, was recently made, and gave rather surprising results. One of the 1in. bars tested broke at 233,000lb. per square inch, the elastic limit was 194,000lb., and the elongation was 7½ per cent. A second bar broke at 170,000lb., with 11 per cent. elongation, and a third at 139,000lb., with 20 per cent. elongation.

WIRE MAKERS.—A conference of wire manufacturers is in session in Pittsburgh, the object being to devise means of curtailing the output of the mills and to advance prices. It is denied that a trust is in contemplation. The manufacturers claim that the business has been run at starvation prices, owing to ruinous competition. The conference will last several days. Every large wire mill in the country is represented.

STEEL RAILS.—There is considerable dissatisfaction felt by steel manufacturers concerning the allotment of rails during the past year. Two meeting were held during December, but with no results. The trouble began last summer, when the Lackawanna Iron and Steel Company, after asking in vain for a meeting with a view to getting a larger allotment of rails, finally made the additional quantity of rails that it claimed to be entitled to. The dull period followed, and after the Allegheny Mills had been bought by Messrs. Carnegie, strong efforts were made to unite the trade. The trade is now in a most unsatisfactory condition. This is a dull season of the year, and the railroads are ordering very few rails. Many concerns are without money, and, in the case of new roads, rails cannot be bought with bonds.

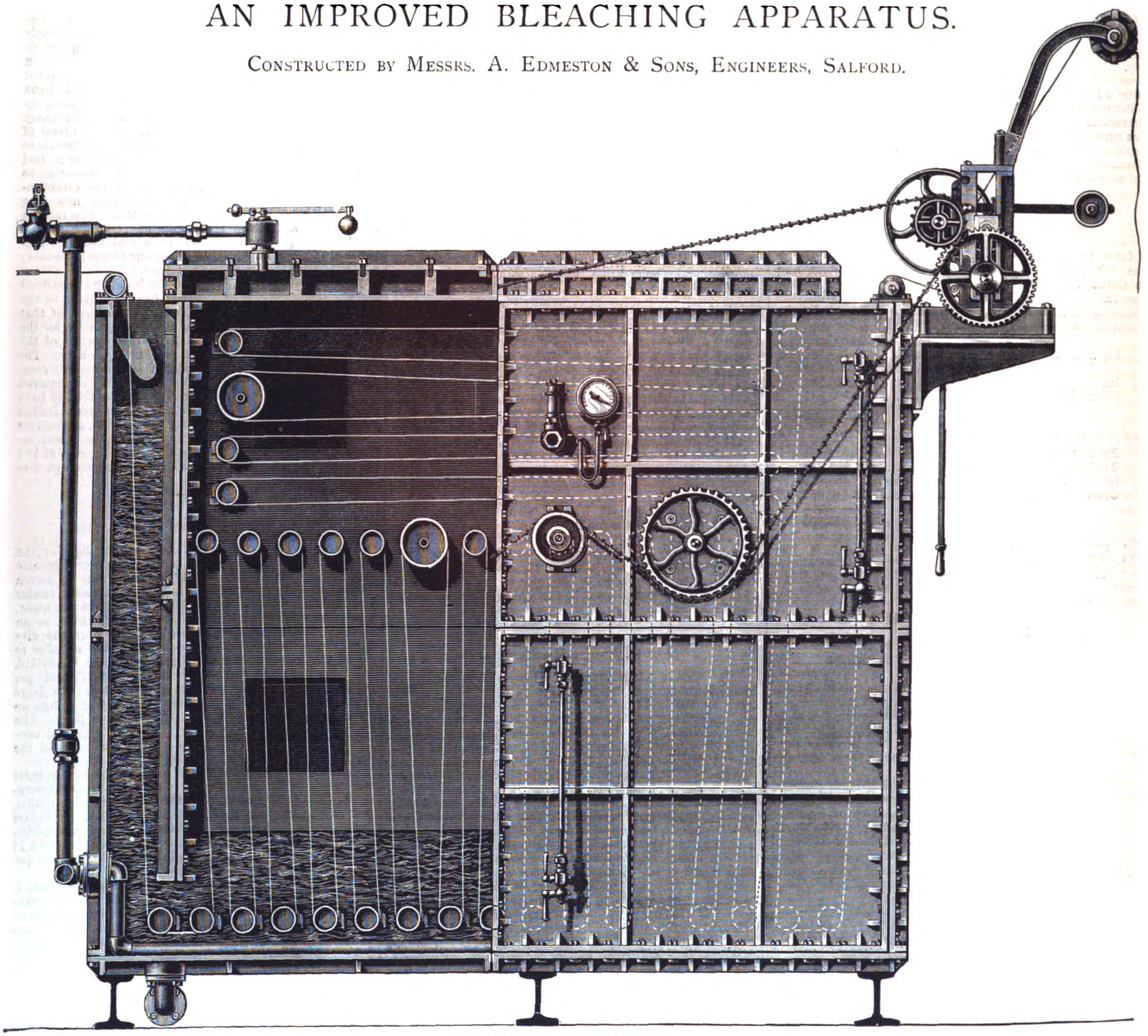
STRIKE AT CARNEGIE'S WORKS.—Between 400 and 500 Hungarians, employed at the blast furnaces of Mr. Carnegie's Edgar-Thomson Steel Works, struck work on the 31st ult., which will cause the works to shut down and throw about 3,000 men out of employment. The existing scale of wages would have expired on the 1st inst. A new scale was presented on October 1st, but the firm declined to sign it. In it the men have asked that the hours of work should be reduced from twelve to eight hours, and that there should be an advance of 10 per cent. in wages. The scale was again presented on the 27th ult. at the city offices of the firm, and as the representative of the firm again declined to sign, the men have struck.

COKE FURNACES SHUT DOWN.—The Frick Coke Company gave notice on the 31st ult. that they would shut down 1,100 more coke ovens indefinitely next week, which will throw about 1,200 men out of employment. No reasons are given for the closing. There are now 4,000 idle ovens in the coke region.

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AN IMPROVED BLEACHING APPARATUS.

CONSTRUCTED BY MESSRS. A. EDMESTON & SONS, ENGINEERS, SALFORD.



PART SECTIONAL VIEW OF KIER.

AN IMPROVED BLEACHING APPARATUS.

(THE BENTZ PROCESS.)

THE process of preparing cotton goods for dyeing or printing is a very important one, and is usually conducted in cylindrical vessels called kiers, in which a large weight of the fabric is placed and alternately treated by an alkaline solution and steam. This alternate treatment has been shown by long practice to be the best method of extracting from the cloth the various fatty matters which are always contained in it as it is woven. Hitherto the boiling or scouring process has necessitated the filling and emptying of the kiers by hand, and this involved a certain amount of labour and loss of time. Not only so, but the volume of cloth within the kier, and the manner in which it is pressed together, causes a great resistance to the penetration alike of the soda liquor and of the steam, so that the process is one occupying several hours. In most bleach works the steam raising capacity is less than the demand for steam, and it has been the practice to fill and empty the kiers in the daytime and boil them at night, when there is less call for steam than during the daytime. There are thus two facts to take a special note of—1st, that the alternate steeping and steaming of cloth is the best mode of dealing with it, and 2nd, that as hitherto conducted this treatment has been carried out with the cloth in bulk.

We give above a partial sectional elevation of an improved kier which is made by Messrs. A. Edmeston & Sons, Cannon Street Works, Salford, which we have recently inspected at work, and which is based upon the principle of a continuous treatment of the cloth. In addition to the actual kier itself there are several arrangements added to it for feeding and delivering the cloth, to which we shall refer a little later. The cloth enters the kier as shown at the left hand side of the illustration, and is taken downwards through a chamber at the end of the kier proper. The latter is a strong rectangular box, to the interior of which steam is admitted. The soda liquor is fed to the kier from a tank suitably placed, and is maintained at a level, as shown in the illustration, which forms a seal, so that the steam in the interior of the kier cannot blow out. A number of easily running rollers are placed so as to guide the cloth in a zigzag direction from one end of the kier to the other, as is clearly shown by the white lines. At different points three larger rollers are placed, which establish a nip on the cloth and so avoid the excessive strain which would take place if it were dragged along by the rollers at the exit end of the kier. It will be noticed that in its vertical course the cloth passes repeatedly into the soda liquor and the steam space alternately, until, when it reaches the end of the kier, it is passed several times in a horizontal direction in the steam space only, after which it is guided, as shown, down, and then up through a similar compartment to that shown on the left hand or entrance end of the machine. The compartment named is formed by means of a partition extending downwards nearly to the bottom of the kier, and is partially filled with liquor kept at the level indicated by the pressure of the steam. After leaving the kier the cloth is passed between the nip of the squeezing rollers, and is thence carried forward by winces to guide eyes, by which it is deposited in storage boxes or bins preparatory to being taken to the souring apparatus. The plaiting of the cloth in the boxes, which is usually performed by boys, is, in this case, done by a self-acting traverse of the guide eye, derived from suitable mechanism devised by Messrs. Edmeston & Sons.

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We have inspected the working of this kier at the works of Mr. Peter Reid, Pendleton, near Manchester, where it has been in operation over a period of eight months. It must be noted that the cloth is passed through either in a perfectly open condition or loosely gathered together in a "rope," as it is technically called. In either case two or three pieces can be passed through the machine at a time, and the chief feature of the process is that it is a continuous and not an intermittent one. Further, the treatment of the cloth in this condition allows of the free action of the scouring liquor and steam to a much greater degree than is possible when it is treated in bulk, and it is found that a much larger quantity of cloth is passed through the machine than is possible by any other method of treatment. Not only so, but the quantity of steam required is largely diminished, and, in Mr. Reid's plant, considerably over 200 tons of coal per month are saved by the use of this kier. Nightwork has been completely abolished, as it is found that there is no difficulty in getting all the steam which is required during the daytime, although previously this was not possible. With reference to the quality of the production, an inspection of the cloth shows beyond a doubt that this has not suffered, and an inspection of a very wide and beautiful range of patterns which Mr. Reid was good enough to show us is convincing of the fact that the cloth is in no way damaged, and is, indeed, somewhat better than it was when treated under the older method. It may also be mentioned that during the eight months' working of this kier stained cloth has been practically unknown, and in no single case has there been the rejection of a complete piece. It will be seen that this kier marks a considerable advance upon anything which has gone before, and inasmuch as it has had the very severe test of eight months' continuous working under ordinary conditions, it is, in no sense, an experiment, but has proved itself to be completely efficient. We have no hesitation in saying, that to all bleachers the provision of a method by which they can get continuous instead of intermittent treatment is of high importance, and the kier we have described is worthy of their full attention.

SPANISH SHIPBUILDING.

We understand that Sir Charles Palmer has retired from the firm of Messrs. Martinez Rivas & Palmer, and that arrangements have been made for converting it into a Spanish company by Mr. Martinez Rivas, under the style of Astilleros del Nervion (the Nervion Shipyards), with a capital of £1,200,000. It is further understood that the Spanish Government has consented to transfer their contracts for the cruisers now building from the old firm to the new one. We are afraid that the Spaniards, like others who have recently taken to shipbuilding, are inclined to stand on their own legs a little too early, and may, in consequence, get a few rather disagreeable tumbles.

SHIPBUILDING NOTES.

On the 27th ult. there was launched at Newcastle the sheathed twin steam cruiser "Sybille," built by Messrs. R. Stephenson & Co., of Hebburn, to the order of the Admiralty. This is the third cruiser launched for the home Government on the Tyne during last year, the other two being the "Sirius," launched by Messrs. Armstrong, Mitchell, & Co., and the "Pique," launched by the Palmers' Shipbuilding and Iron Company, Limited. Three more vessels of the same class are in course of construction, and will be launched in the course of the present year.

On the 3rd inst. Messrs. McIlwaine & McColl, Limited, Belfast, launched the s.s. "Manchester," built to the order of Messrs. S. Lawther & Co., Belfast. This is the first steamer for the new line which is to trade between Belfast and Liverpool, and also to Manchester when the Ship Canal is opened. She has been specially designed to meet the requirements of that trade, and her dimensions are:—Length, 180ft.; breadth, 27ft. 6in.; and depth, 13ft. 11in. She is built of steel, and will class 100 A1 at Lloyd's. The new company has a capital of £150,000 fully paid up. Mr. H. S. Lawther will be acting manager, and the agents in Belfast will be S. Lawther & Co., and in Liverpool J. Mack & Sons. The vessels will carry about 650 tons cargo each, and have accommodation for a few passengers. The "Manchester" will start on her service about the 1st prox.

Recently Messrs. Gourlay Bros. & Co., Dundee, launched for the National Steamship Company, of Liverpool, a steamer having a length of 450ft.; breadth, 46ft.; and depth, 35ft. 9in. The vessel is of steel, with cellular double bottom, and a gross tonnage of 5,100 tons. She is fitted with triple-expansion engines, indicating about 3,000 horse-power, and will make about 12 knots an hour. She is intended specially for emigrants and for the carriage of cattle.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, January 16th, at 7.30 p.m. Students' meeting. Paper to be read: "On a Survey of the Bed of Sutton Pool, Plymouth," by Mr. R. G. Hansford Worth.

Physical Society.—Friday, January 16th. Papers to be read: "Photo-electricity," by Professor Minchin; "A Lecture-room Method of Determining 'g,'" by Professor Bawell; "On the Change in the Absorption Spectrum of Cobalt Glass Produced by Heat," by Sir John Conroy, Bart.

Marine Engineers' Institute, Liverpool.—Friday, January 16th, at 7.45 p.m. Lecture on "The Proposed Museum of Naval Architecture and Marine Engineering," by Mr. B. H. Thwaite, A.M.Inst.C.E.

Junior Engineering Society.—Friday, January 16th. Paper to be read: "Hydraulic Lifts," by Mr. Percy J. Waldram.

Association for the Improvement of Geometrical Teaching.—Saturday, January 17th, at 10.30 a.m. Paper to be read: "On the Use of the Term 'Abstract' in Arithmetic," by Miss Wood. At 2 p.m. Papers to be read: "Another Voyage to Laputa," by Professor Minchin; "The Foundations of Geometry," by Mr. E. T. Dixon; "Some Notes on 'Statics and Geometry,'" by Mr. E. M. Langley.

NEXT WEEK.

Society of Chemical Industry.—Monday, January 19th, at 8 p.m. Papers to be read: "On the Constitution of Butter" (illustrated by specimens), by Mr. J. A. Wanklyn; "Some Experiments on the Cyanide Process for the Extraction of Gold from Low Grade Gold Ores," by Messrs. T. Graham Young and Watson Smith.

Cleveland Institution of Engineers.—Monday, January 19th, at 7.30 p.m. Reply on Discussion of Paper, "On the Desiccation of the Blast in the Manufacture of Pig Iron," by Mr. W. H. Fryer; Discussion of Paper on "The Manufacture of Basic Open Hearth Steel," by Mr. J. Davis; "Notes on American Blast-furnace Practice, and a Comparison with the Work done in the Cleveland District," by Mr. W. Hawdon.

Royal Institute of British Architects.—Monday, January 19th. Presidential Address to Students.

Institution of Civil Engineers.—Tuesday, January 20th, at 8 p.m. Ordinary meeting. Paper to be discussed: "Auxiliary Engines in Connection with the Modern Marine Engine," by Mr. W. H. Allen, A.M.Inst.C.E.

Owens College Union Engineering Society.—Tuesday, January 20th, at 7 p.m. Engineering Society social meeting.

PRICES CURRENT, 14th January, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 0 0	.....	6 10 0	f.o.t. wks.
„ Angles	5 17 6	.....	6 7 6	„
„ Plates	6 0 0	.....	6 10 0	„
Staffordshire Bars	7 0 0	.....	7 10 0	London.
„ Angles	7 5 0	.....	7 15 0	„
Crown Sheets	7 7 6	.....	7 17 6	„
„ Hoops	7 7 6	.....	7 17 6	„
"Siemens-Martin" Steel Boiler Plates			8 0 0	„
„ Ship and Girder			7 2 6	„

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3.	.....	42/6 Cash.
Scotch Warrants, m/n	.....	47/1½ „
Hematite Warrants, m/n	.....	53/- „

METALS.

Spelter: Ordinary	£23	17	6	to	24	2	6
Copper: British Cakes and Ingots	57	10	0	„	58	0	0
„ Chili Bars, G.O.B.'s	52	10	0	„	53	0	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	52	10	0	„	53	0	0
„ Manufactured (strong)	65	0	0	„	66	0	0
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	91	7	6	„	91	15	0
„ Australian	91	15	0	„	92	5	0
„ English Ingots	95	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues quiet, with limited business. An improvement, however, is noticeable in values of Chili bars, which have advanced about 17s. 6d. per ton since the 9th inst., to-day's quotations being £52 10s. to £53 cash, with small trade. Manufactured is quoted £65 to £66, "strong," with slack demand.

Tin: Values declined during the week, but have again recovered, to-day's prices being about the same as on the 7th inst., the date of our last report.

Lead: Rather lower, with small business.

Spelter is advancing, owing to the small stocks in England, the Baltic ports being closed by ice.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	5½	to	0	0	6½
„ „ Liquid	gal.	0	1	0	—	.....		
„ Citric	lb.	0	1	4½	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	12	0	—	.....		
„ Tartaric	lb.	0	1	3	—	.....		
Alum: Lump (powder 10/- ex.)	ton	5	12	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	15	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	10	10	0	—	10	12	6
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	6	12	6	—	.....		
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	29	0	0	—	.....		
Benzole (90 %)	gal.	0	4	8	—	.....		
„ (50/90 %)	„	0	8	7	—	.....		
Copper Sulphate	ton	18	0	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	21	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	3½	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	20	0	0	—	.....		
„ Chlorate	lb.	0	0	5½	—	.....		
„ Prussiate (Yellow)	„	0	0	9½	—	.....		
„ Sulphate (Basis 90 %)	ton	4	0	0	—	.....		
Precipitate: Red	lb.	0	3	9	—	.....		
„ White	„	0	3	9	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Salts: Epsom { Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	5	0	0	—	.....		
Soda: Ash	deg.	0	0	1¾	—	.....		
„ Caustic (White 70%)	ton	11	5	0	—	11	7	6
„ „ { „ 60%)	„	10	5	0	—	10	7	6
„ „ {Cream 60%)	„	9	5	0	—	9	5	6
„ Crystals	„	3	0	0	—	.....		
„ Bicarbonate	„	7	10	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	1	10	—	.....		
Tartar, Cream of	cwt.	4	18	0	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: The new year has not opened very promisingly, there being quite a want of buoyancy about many articles. Carbolic acids continue very dull. Benzoles are less active, but prices are nominally unchanged. Sulphate of ammonia is easier. There is less inquiry for caustic soda; soda ash is steady; bicarbonate of soda drooping. Sulphate of copper is steady on spot, and keeps firm for forward delivery, but there is not much business passing for any position. There is rather more doing in acetates of lime, at slightly easier prices. Acetate of soda is scarce for prompt delivery, shipments from the Continent being interrupted. Prussiate of potash in fair demand. Recovered sulphur scarce

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	33	10	0
„ Ceylon	„	29	0	0
Cottonseed	„	18	10	0
Cod	„	23	0	0
Lard	„	84	0	0
Linseed	„	21	10	0
Olive, Spanish	„	43	0	0
Palm, Lagos	„	25	10	0
Rapeseed: English	„	28	5	0
Seal: Pale	„	25	0	0
„ Brown	„	.....		
Sperm	„	47	0	0
Whale	„	22	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	.....		
Petroleum (Refined)	„	0	0	5½
Spirit	„	0	0	8

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HOME INDUSTRIES.

LONDON, 15th January, 1891.

The Money Market.—After a slight hardening in rates, due to the brief lock-up of large sums in connection with the applications for the new French loan, the money market has moved persistently in the direction of greater ease, and lenders cannot obtain decently remunerative rates for their capital. Continental money rates have also declined, and as the New York Exchange continues to harden, there is nothing to indicate any early change in the position. The stock markets are variable, with an improving tendency, fostered by the cheapness of money and the advance in New York quotations, while the steady rise in silver has told in the same direction. The weak point is the home railway department, the traffic returns being far from reassuring, while the earlier dividend announcements have been decidedly disappointing. The continuance of the labour deadlock in Scotland, and a few stray indications of the beginnings of similar troubles on some of the English lines, help to cloud the horizon in the most important of the home stock markets. The extent to which public attention, both investing and speculative, has been devoted to this department, makes the prospect the more serious. Mining shares have been fairly active, and industrial and miscellaneous securities have been obtaining more than usual favour.

London Institution.—On the 8th inst. a lecture was delivered at the London Institution by Colonel Majendie, C.B., on "Explosives and Some of their Developments and Applications." With reference to the large quantities of explosives used in blasting operations, the lecturer said that recently 3½ tons of blasting gelatine were exploded in the Llanberis quarries, by means of which 214,000 tons of hard gravel were dislodged without any inconvenient projectile effect. In the London and St. Katherine Dock, 2,900lb. of gelatine dynamite were used in the year 1886. In America still larger quantities had been made use of. In 1876, 26 tons were fired in the operations on the Hell Gate Rock, and in 1885, 144 tons of the Sprengler explosive were used at the Flood Rock, which formed an obstruction to New York Harbour. Referring to the progress of the fireworks industry, the lecturer said that nineteen factories were now engaged in the trade, and 689 persons were employed. During last year there had been only four accidents, none of which were fatal. Ten millions of squibs and other fireworks were made each year, each squib requiring fifteen operations and passing through ten pairs of hands.

Annual Report on Copper for the Year 1890.—Messrs. James Lewis & Son in their annual report on copper state that the leading feature of the year 1890 has been the very successful realisation of the large quantity of copper held by the French banks and bankers on account of the official liquidator of the Société des Métaux, the public stocks in England and France being reduced from 93,346 tons to 61,507 tons, and a further quantity, probably amounting to between 10,000 and 15,000 tons, lying in smelters' works and elsewhere, being absorbed by consumers. So well and judiciously were the sales managed that, in despite of them, and in face of the large stock of copper known to exist, the value of good merchantable copper advanced from £50 10s. on the 1st of January to £61 10s. in September, when the last of the Société des Métaux's holding was sold, the final sale being contemporary with the highest price attained during the year, and the markets having since fallen £8 10s. per ton, or to a point within £2 10s. of that at which the year commenced when the public stocks of copper alone were more than 50 per cent. greater than at its close. According to Messrs. Lewis' statistics, there was a decreased import into England and France (allowing for the copper transferred from France to England), and English production in 1890, as compared with 1889, of 1,069 tons, and an increased consumption in, and exports from, England and France of 28,864 tons. English consumption shows an increase of only 411 tons, but the exports from England an increase of 14,120 tons, of which 11,063 tons was of English copper to France, while French consumption has increased to the great extent of 25,396 tons. Whereas the import from the United States into England and France shows a decrease of nearly 10,000 tons, that from Japan shows an increase of 8,000 tons, and from Spain and Portugal of 1,500 tons. From the Cape there is a decrease of 1,500 tons, but from Quebrada an increase of 1,000 tons. With these exceptions there has been but little change in the quantities received from the different producing countries. The consumption of copper during the present year will probably be greater than in 1890, owing to the constantly extending use of electricity, and a probable increased consumption of sulphate of copper.

Tender.—Mr. G. Newnes, M.P., wants a cliff railway or lift constructed at Clifton, Bristol. Those desirous of tendering should send their names as early as possible to Messrs. Marks & Munro, engineers, St. Stephen Chambers, Baldwin Street, Bristol.

Messrs. Woodhouse & Rawson United, Limited.—This firm gave their first annual dinner to the members of their head office staff, at the Guildhall Tavern, E.C., on the 13th inst. Sir Rawson W. Rawson, K.C.M.G., C.B., presided, and there was a large attendance. Mr. F. L. Rawson, managing director, stated that it was the intention of the board at an early date to introduce a system of profit sharing among all their employés. Mr. North, the business manager, stated that a series of lectures had been organised on electrical subjects, for the benefit of the younger members of the staff, and that for attending these no charge will be made.

MANCHESTER, 15th January, 1891.

The Iron Trade.—There is a little more doing in pig iron for prompt delivery, but it is difficult to forecast the immediate future of the trade. There is no doubt that there is a very large amount of work in hand in this district, while the reports from some of the large centres are not so good. It is thought that the price of iron will largely depend upon the future of the coal trade, and in this there does not appear to be any kind of chance of a fall in prices. Any attempt to get a reduction for contracts extending over some months is unsuccessful, and, with the present price of fuel, a reduction in pig iron appears to be impossible. Bar iron is very slow of sale and prices are drooping. It is difficult to assign a reason for this, as all the staple trades of the district in which bar iron is largely used are good, and a large quantity is going in to consumption. The fact remains, however, and no animation prevails in this department.

The Manchester Association of Engineers.—The annual meeting of the above Association was held on the 10th inst., when it was announced that the past year had been a successful one. The President, Mr. John West, C.E., delivered his inaugural address, in which he advocated the establishment in Manchester of a complete scheme for technical education. The scheme should include a large and well-fitted school, which should be the last in a series of continuous stages of education. He urged that the scientific societies of Manchester should have direct representatives on the governing body of the school, and that the teaching should be divided, so as to enable the services of specialists in each department to be secured. He then referred to the taxation of machinery, and expressed regret that the amending Bill referring to the subject had not passed during the last session. Finally the President referred again to the subject of gas *v.* electricity, and said that the right course to pursue was to improve the present antique mode of lighting by an adoption of an improved form of burner. A better light might thus be obtained at considerably less cost than the electric light.

The Late Mr. Alexander Macnab.—The Manchester Ship Canal has suffered a severe loss through the death of Mr. Alexander Macnab, which occurred at Manchester on the 4th inst. Mr. Macnab had taken an important part, under the late Mr. T. A. Walker, in the construction of the Manchester Ship Canal and other important works.

Noxious Vapours.—A memorial has been presented to the President of the Local Government Board praying for an amendment of the Alkali Works Regulation Act, so as to make it more stringent in its operation. After pointing out the deleterious effects on health of the exhalations from these works, the signatories—who are persons engaged in sanitary and social movements—recommend that works, where nuisances arise from the use of chemicals, should be inspected as well as those where they are made, and that the gases to be controlled should be scheduled instead of the works to be inspected. These proposals are far reaching, and require the attention of all concerned.

The Linen and Jute Trades.—The satisfactory manner in which the year's trade opened gave rise to hopes which subsequent events have, unfortunately, tended to lessen considerably. Up to the 12th inst. no consignments of linens had been received for ten days from Scotland, and distributors were beginning to consider the advisability of looking to other sources for the supply of the goods they required. Alarmed at the situation, and fearful of permanently losing a portion of their connection with merchants here, some of the Scotch manufacturers came to Manchester for the purpose of pacifying their *clientèle*. As a result of these visits, urgent telegrams were despatched to Mr. John Walker, the managing director of the North British Railway, at Edinburgh, and a goods train, we are informed, was despatched from Dunfermline, on the 10th inst., with a portion of the goods which had been lying there for some time. This week from 40 to 50 tons of linens were received in Manchester through this action, and we have authority for stating that an effort will be made to effect at least two deliveries per week from the important linen centres in Fifeshire.

The International Okonite Company, Limited.—The directors of the company have announced an interim dividend of 8 per cent. upon the preference shares, and 10 per cent. upon the ordinary shares of the company for the half-year ending on the 31st ult. The dividend is based on the actual earnings of the company since the date of its registration, 24th June, 1890. The new factory at Newton Heath, Manchester, is making rapid progress, and the costly machinery is nearly all ready for delivery.

The Late Mr. Joseph Musgrave.—Mr. Joseph Musgrave, the head of the engineering firm of Messrs. Musgrave & Sons, died on the 12th inst., in the 79th year of his age, at his residence, Western House, Bolton. About the year 1840 his father and himself bought the Globe Foundry, and afterwards the Caledonian Works, from Messrs. Hardman & Openshaw. Their business was gradually extended until they now employ upwards of 1,000 hands, and have constructed some of the largest engineering works in the world, amongst which is the magnificent suspension bridge, over 2,400ft. in length, over the River Dnieper, in South Russia. Mr. Musgrave was one of the earliest promoters of the Bolton Cotton Trade Mutual Fire Insurance Company, Limited, and has from the first been chairman of the directors.

Messrs. John Wild & Company, Limited, Oldham.—At the invitation of the directors, the employés of Messrs. John Wild & Company, Limited, Falcon Iron Works, Oldham, spent an enjoyable evening on the 10th inst. at the Central Conservative Club.

GLASGOW, 15th January, 1891.

The Railway Strike.—The strike still continues to paralyse trade. Representations were made last week by large traders that the suffering should be distributed rather than that the passenger service should be alone considered to the neglect of goods and mineral traffic. This protest resulted in some movement of goods on all the lines, and on the 11th inst. the block at the various depôts was considerably relieved. Still the transport service is in a deplorable state. Many works and shipbuilding yards have not opened yet since the holidays; and in cases where a beginning has been made the employés have been advised that unless coal and material come forward within a few days the works will be closed. Although some of the work is only deferred, yet a large amount of business has already left the district. Orders from abroad are being sent elsewhere, the North of England benefiting largely owing to the paralysis of Scottish industry. Efforts at conciliation continue to be made, but so far without result. Mr. Haldane, Q.C., M.P., made a gallant attempt to settle the difficulty, and influential public men and large traders have done their best to effect a settlement. The railway companies, however, refuse to discuss grievances until after the men return to work. The men are confident, and as they are now, to a large extent, supported by public opinion, refuse to return until some reasonable understanding about hours is arrived at. The trading community is suffering extreme inconvenience. Coals are only obtainable in small lots; cargoes are unprocurable. The shipbuilding yards are working this week, but the steel works are all closed, with the exception of the Clydesdale.

Results of the Strike.—Although the companies have already suffered heavily, both in loss of traffic, in damage to plant through the unskilful work of new employés, and in the depreciation, temporary no doubt, of the capital value of the stock, the greatest sufferers by far are the industrial communities whose operations are practically suspended. The stock of the North British Railway Company has recovered to some extent from the low point reached last week in consequence of the strike and of wild rumours of imminent changes in the management, but it is still about 20 per cent. lower than it was in the first week of October before the threat of a strike was made.

The Edinburgh Railway Schemes.—The three schemes for the increase of railway facilities in Edinburgh were brought before the Edinburgh Town Council on the 12th inst. These schemes are those of the North British Railway, the Caledonian, and the Junction Railway respectively. The areas proposed to be acquired by the companies under the schemes were stated to be 15¼, 14¾, and 15 acres respectively. A number of deputations from various public bodies appeared to state objections to the schemes, and the Town Council resolved to oppose all the railway Bills in Parliament. The summary of the proposals under the schemes was prepared by Mr. Cooper, borough engineer.

Minerals.—The mineral shipments are altogether drawn from Glasgow stock by horse traction, and amount to only a moiety of the amount shipped in the corresponding week of last year. The pig iron market is firm this week, in spite of the falling off in transport facilities, there having been considerable operations on speculative accounts.

Tramways Bill.—The Corporation of Glasgow is promoting a Bill in Parliament to authorise the employment of electrical or other power on the tramways. The lease of the tramways held by the Glasgow Tramway Company expires on 30th June, 1894, and the Corporation bind themselves not to apply the powers asked for until that date unless with the consent of the company. The powers asked for include powers to erect engines and machinery, to construct and maintain subways, tunnels, and cables, and to acquire land and to purchase or lease mechanical power.

(From our own Correspondents.)

LIVERPOOL, 14th January, 1891.

The Liverpool Water Supply.—There is a feeling of great discontent in this city at the restricted supply of water, the hours of supply having been again curtailed. It is stated that the pipe line from the present Rivington supply has become rusty, and although there is ample water in the reservoir it will not supply the demand on the service reservoirs at Prescot. The tunnel under the Mersey is progressing at such an unsatisfactory rate that the direct supply from the Vyrnwy seems as far off as ever, and at a meeting of the Water Committee on the 12th inst. it was unanimously resolved to instruct the engineer to prepare plans for carrying a temporary pipe either across the bed of the Mersey or at a convenient height above it, permission to do so being sought from the Conservators and other interested bodies. The temporary pipe is estimated to cost £5,000.

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THE LIVERPOOL ENGINEERING SOCIETY.—The annual dinner of this society was held at the Adelphi Hotel this evening, when nearly ninety guests were present. The chair was taken by the President of the Society, Mr. Ferdinand Hudleston, Assoc.M.Inst.C.E., and amongst the invited guests present were the Mayor of Liverpool and other visitors. A most enjoyable evening was spent.

LEEDS, 14TH JANUARY, 1891.

THE IRON AND STEEL TRADES.—The year has opened very quietly, and it is impossible as yet to form a definite opinion as to the prospects of trade generally in the next few months. Prices are unchanged for manufactured iron and steel, and also for pig iron, with the exception of Scotch warrants, which advanced on the 12th inst. A period of inactivity in the building trade, on account of the severe winter, has told somewhat against some of the branches of the iron trade, but after the present thaw things should take a turn for the better. Engineers and some iron-founders are in a good position in regard to work, and we hear of tool makers having orders which will not be completed for another three or more months. It is also reported that orders for torpedoes have lately been placed in Leeds, and if that is the case the contracts will have been entrusted to Messrs. Greenwood & Batley.

THE COAL TRADE.—A question of interest just now, both to coal owners and the representatives of the mining classes, is the letting of locomotive coal contracts. Up to now it has not been possible to obtain accurate information as to these contracts, though it is understood that prices are in advance of what they were on the last occasion.

SHEFFIELD, 14TH JANUARY, 1891.

IRON AND STEEL.—The iron and steel works are again in full operation. There is a slight tendency towards reduced values, and, with the exception of armour plates, the heavy trades are rather quiet. Outside competitors are becoming more numerous each year. Leeds manufacturers are preparing to take up the heavy marine and mill shaft trade, Messrs. Taylors and the Monkbridge Steel Company having each put down a forging press. Although these are on similar lines to the Sheffield tools, and are not nearly so powerful, they will turn out heavy forgings with rapidity. Messrs. Taylors have also put down a splendid heavy lathe (by Greenwood) capable of turning off one ton per hour with four tools, and both these firms make open-hearth steel, in addition to their well-known brands of Yorkshire iron. In steel castings business is decidedly quiet, most of the orders left over from last year having been completed.

COAL AND COKE.—The coal trade continues buoyant, and all collieries are working full time. Some local firms are feeling the effect of increased cost in fuel. One firm, where 500 hands are employed on ordinary general engineers' work, have paid in 1890 over £1,400 more for the same quantity of coal than in 1889. Coke is not in great demand at present, except best qualities for foundry and steel melting purposes. Messrs. Hawksley, Wild, & Co. are extending their boiler and engineering works at Brightside, to enable them better to meet the demand for their specialties.

NORTH STAFFORDSHIRE, 14TH JANUARY, 1891.

THE IRON TRADE.—At the quarterly meeting of the trade, held in Birmingham last week, list prices of finished iron were reduced 10s. per ton. There was no appreciable fall, however, in actual prices, business having been done for some months at figures under list prices. Merchants made use of the official reduction to endeavour to force sellers, but were not generally successful. Pig iron is in better demand, and selling at rather higher prices. There appears to be an expectation on the part of some local iron-masters that there will shortly be an appreciable advance in Scotch warrants.

THE COAL TRADE.—Owing to the want of flints and clay, through the canals being frozen up, several manufactories have been brought to a standstill, and there has consequently been a falling off in the demand for this class of fuel. Colliery proprietors are still unable to keep their customers fully supplied with house coal. Prices have not varied.

BIRMINGHAM, JANUARY 14TH, 1891.

GENERAL TRADE.—The very severe frost in this neighbourhood has effectually stopped all outdoor work for nearly five weeks. Plumbers and gasfitters are in great demand, and makers of gas and lamp stoves have an unusually heavy call for goods. The bedstead trade is rather quiet at the moment, but a good demand is expected. The iron works were making nearly full time right up to Christmas, but since then they have received very few new orders. There is a considerable lull in the iron trade of the district, but it is not expected that prices for finished iron will be materially lower. At the quarterly meeting last week marked bars were reduced 10s. per ton, but the price of fuel continues very high. Engineers generally are very busy, as also are boiler makers. The Royal Small Arms Factory and the Birmingham Small Arms Works are still busily engaged in the manufacture of the much-abused magazine rifle. Chain and cable makers in the Cradley district are not fully employed.

ADMIRALTY CONTRACTS.—The Admiralty has recently asked for tenders for bar iron for the dockyards for the next three years. The contract has been held by the New British Iron Company, Limited, Corngreaves, near Cradley, for the last seven years, and it is hoped that it will remain in the district.

LEICESTER, 14TH JANUARY, 1891.

WOOL SPINNING AND YARN TRADES.—There is no great increase in the amount of business in the local wool market. Users are buying very cautiously, and decline to go beyond their most immediate requirements. As there is an increase in consumption, spinners are more frequently buying, and the tone of business is healthy. Deep-stapled fleeces are making 23s. to 24s. per tod for half hog and ewe lots; superior lots, 24s. 6d. to 25s. 6d. per tod; choice lots, including Shropshires, 26s. to 27s. per tod. The market generally is firmer for fleeces, but skin wools are irregular. Spinners are busier, and a considerable amount of business is on offer, but there is an endeavour being made to obtain better prices. Cashmere and fancy yarns are more in demand. Cotton yarns are flat.

BOOT AND SHOE TRADE.—There is a continual and marked improvement in this industry. Some good orders are now on hand both for home and export. Some heavy contracts have been placed for early spring delivery. The manufacturers' association here have accepted the demand of the workmen's union that all work shall be done in workshops provided by the employers, and have formed a committee to carry the matter into effect. This is an important step, and will considerably affect the industry, as a very large amount of work in some branches has been hitherto done at the homes of the men. Leather merchants are busier, and prices remain very firm.

SWANSEA, 14TH JANUARY, 1891.

THE FLUX QUESTION.—The report of Dr. Heel, of Birmingham, on the samples of flux sent to him for analysis by the Dyffyn men, was received by Mr. Phillips, the General Secretary of the Tinplate Workers' Union. It appears that the liquid flux consists of a strong solution of chloride of zinc, which is present to the extent of 61·1 per cent. The black solid mass also mainly consists of chloride of zinc, but "there is present a considerable quantity of metallic tin and also a little iron." The analyst states that, if the tin is heated much above the melting point, fumes are given off, and if these fumes are inhaled they are irritating and annoying, but that all these difficulties could be obviated by conducting the tinning process under a hood, with a strong draught of air. It is to be hoped that a friendly arrangement will now end the strike.

BARROW-IN-FURNESS, 14TH JANUARY, 1891.

HEMATITE.—An easier tone is noted in the hematite pig iron trade this week, and prospects are not so good as they have been. Bessemer iron is not in such full request as of late, owing to the fact that some of the steel works in West Cumberland have been irregularly employed. Prices are firm at 54s. for hematite warrants net cash and 54s. to 54s. 6d. for Bessemer in mixed numbers net f.o.b. Stocks have again begun to increase—this week's increase being 555 tons. The stocks now held represent 210,923 tons, and makers are considering the advisability of reducing the output. Fifty furnaces are still in blast.

STEEL.—There is steadiness, but not briskness, in the steel trade, and although some mills are stopped because the orders held are largely for forward delivery, there is rather a better prospect, especially in the heavier classes of steel. Rails are being inquired for, with a view to the placing of some heavy contracts, but makers are not very fully sold forward. Prices are steady at £4 17s. per ton for heavy sections, £5 17s. 6d. for light sections, and £7 for colliery rails. In steel shipbuilding material there is no improvement to note, but on local account a fuller demand is expected. Prices are steady at £6 7s. 6d. for plates, £5 12s. 6d. for angles, and £7 2s. 6d. for boiler plates. Other branches of the steel trade are unchanged.

IRON ORE.—Much steadiness is noted in the iron ore trade, and business is being done at 11s. 6d. to 12s. per ton net at mines. The latter are better employed than they have been for some time past.

MIDDLESBROUGH, 14TH JANUARY, 1891.

PIG IRON.—Since last report the tone of the market has been somewhat more favourable, and prices have slightly improved. On the 12th inst. No. 3 G.M.B. was quoted at 43s. 3d., but yesterday it fell to 43s. There is an impression, however, that prices have reached their lowest point. It is expected that with milder weather there will be an improved trade, as consumers must now be short of supplies. It is thought, too, that Scotland will take more when the Scotch ironmasters have depleted their stocks. Connal's stores have 33,000 tons more than when the strike began. On the 12th inst. the stock amounted to 119,881 tons.

WAGES.—The mine-owners have had a protracted meeting with the miners' representatives, and claimed from them a reduction of 12½ per cent. The high price of coke and the low price of iron are seriously affecting the trade, and unless relief is obtained disaster will ensue to all concerned.

MANUFACTURED IRON AND STEEL.—The outlook for the new year is by no means bright, and the demand for steel is very quiet. Iron ship plates are £5 15s.; ship angles, £5 10s.; and common bars, £5 15s.; steel ship plates, £6 2s. 6d.; ship angles, £6; engineering angles, £6 5s.; and rails (heavy section), £4 17s. 6d. per ton, all f.o.t. at works less the usual discount.

SHIPMENTS OF PIG IRON.—The shipments up to the end of last week amounted to only 12,525 tons. Up to the 12th inst. the shipments for the current month amounted to 12,525 tons, against 32,031 tons to similar date in December and 16,860 tons to the 12th of January, 1890.

THE TEES COMMISSION FINANCES.—The revenue of the financial year (which ended on the 31st October) has recently been announced as £69,069, as against £70,062 in the previous year, a falling off accounted for by the decrease in the shipments of pig iron during the spring, when the prices of pig iron were high. The total indebtedness of the Commission now stands at £838,125 14s. The Commission has about 1,000 acres of reclaimed land, under which it is believed that salt deposits lie. Tenders for working those salt deposits have just been advertised for.

BOILER EXPLOSIONS AT WEST HARTLEPOOL.—About 10 o'clock p.m. on the 6th inst. two boilers exploded at the Seaton Carew Iron Works, West Hartlepool, causing considerable damage to the works and destroying the offices of the company. One man was scalded, and another was seriously injured in the head. Travelling on the North-Eastern Railway was interrupted for a short time owing to portions of the boilers disturbing the permanent way. The boilers were 60ft. in length, 4ft. in diameter, made of ⅜in. plates, heated by furnace gases. They both appear to have ripped round at the circular seam about the middle of their length. The steam pressure per gauge is reported to have been about 37lb. at the time of the explosion, although the safety valves are said to have been weighted to 60lb. per square inch. Both boilers are, we understand, insured in the Scottish Boiler Insurance and Engine Inspection Company.

NEWCASTLE, 14TH JANUARY, 1891.

THE IRON TRADE.—Within the past few days a more hopeful feeling has been manifested in the finished iron trade, and, though prices have not altered, offers from consumers to negotiate for future supplies have become more numerous. Works are generally busier than they were for some time before the close of last year, but this improvement is largely to be accounted for by the necessity of making up for time lost by the observance of the Christmas holidays. In the forges business has fallen off, owing, no doubt, to the dearth of new orders in shipbuilding, but iron foundries are for the most part well employed. Rivet works are also less active, and though in the chain and anchor trade unfinished orders are still keeping the works fully engaged, it seems likely that when these orders are completed an interval of slackness will occur.

THE COAL TRADE.—Since last week no change of importance has occurred in connection with the local coal trade, but it is stated that the employers contemplate reducing the miners' wages, and it is thought probable that opposition will be experienced if their intention is carried out. The shipments of coal and coke at Tyne Dock during the week ending 10th January amounted to 96,493 tons, being a decrease as compared with the shipments in the corresponding week last year of 5,424 tons.

GLASS WORKS AND POTTERIES.—In these establishments business is less brisk than during the closing weeks of last year, the falling off being, no doubt, attributable to the fact that customers are not now so urgently in need of supplies of goods. In the bottle works, however, the production is fully maintained, the demand being quite equal to the supply.

ELECTRIC LIGHTING.—Messrs. J. H. Holmes & Co. continue to have plenty of work in all their departments, the number of steamship installations arranged for, to be fitted by the firm during the next few months being no less than thirty. Some of these are of special importance, one being for a foreign steamer of the very largest class, which is now being built on the Tyne. The firm completed fifty steamship installations in 1890.

DUNDEE, 14TH JANUARY, 1891.

JUTE AND FLAX TRADES.—In consequence of the railway strike some factories are in danger of running short of coal, and the difficulty in distributing goods is causing much inconvenience. Where possible, consignments are being sent and received by sea, but business generally tends to become disorganised. Jute is selling moderately well. The fluctuation in the Exchange makes prices somewhat unstable. This week the rupee price of first marks is R.20 8an. per bale of 400lb. In jute yarns there is not much activity, but prices are well maintained. Cable advices from Calcutta report Australian cornsacks dearer. Hessians, 40in. 10½oz., are quoted at 4⅞c. per yard in New York; light weights, at from 4¼c. to $4\frac{9}{16}$c. per yard. The prices at present obtainable in the American market are up to the average of the last three months. In the earlier half of last year the ruling price was about 5⅜c.

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IMPROVED WATER-TUBE BOILER FOR TORPEDO BOATS.

CONSTRUCTED BY MESSRS. YARROW & CO., ENGINEERS, POPLAR.

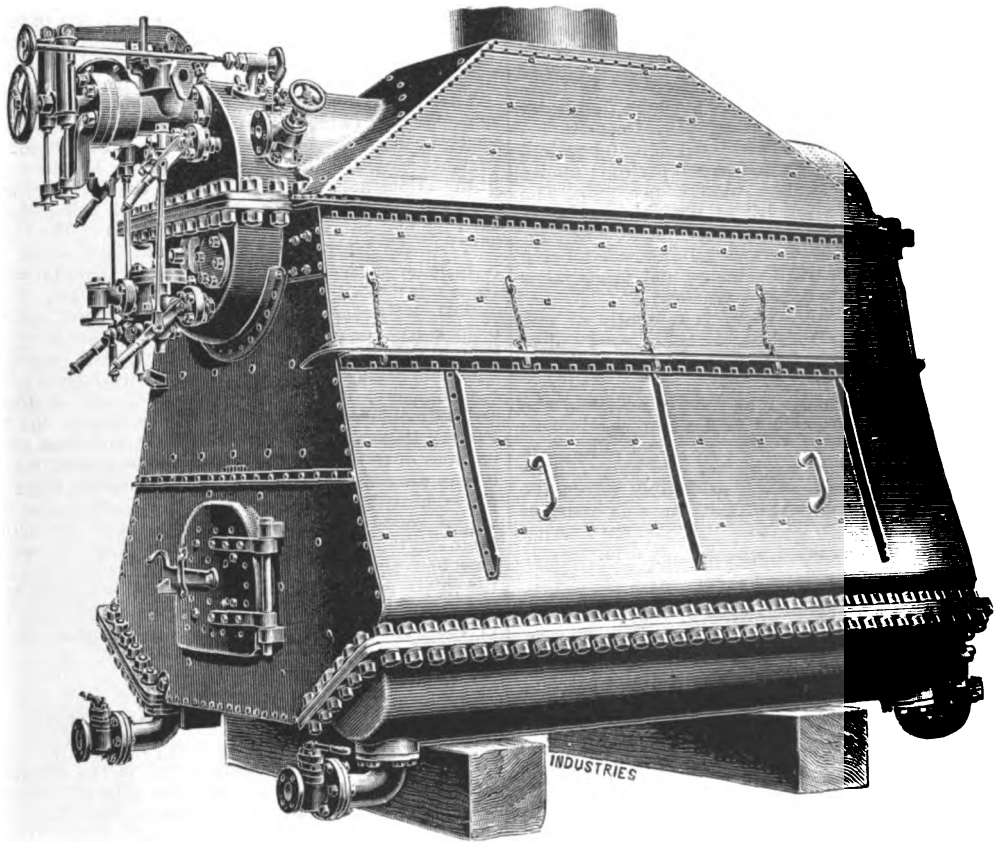


FIG. 1.—GENERAL VIEW.

IMPROVED WATER-TUBE BOILER FOR TORPEDO BOATS.

GENERALLY speaking the locomotive type of boiler is employed for torpedo boats in connection with forced draught, but although, under ordinary conditions, and when well designed and constructed, such boilers give little trouble, yet, when worked at their maximum power for considerable periods, numerous failures have occurred,

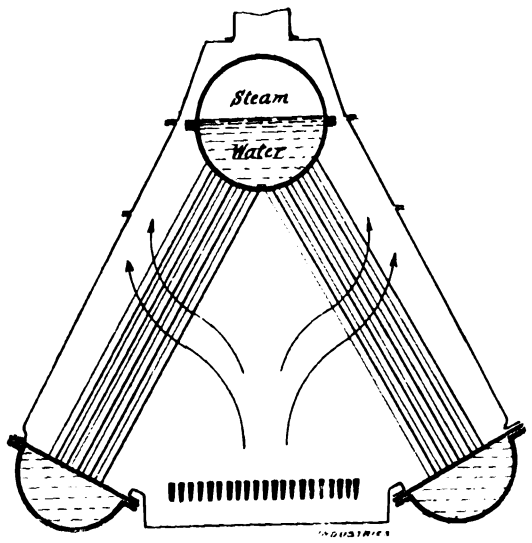


FIG. 2.—TRANSVERSE SECTION.

due mainly to leaking tubes. In order to avoid such mishaps, and in view of the probable further increase in boiler pressures, Messrs. Yarrow & Co., of Poplar, have constructed a new form of tubulous or water-tube boiler. One of these boilers, fitted to a second-class torpedo boat built for the Argentine Republic, we recently had an opportunity of inspecting, through the courtesy of Messrs. Yarrow & Co. The boat has a length of 60ft. and 9ft. 3in. beam, the displacement being, when fully loaded, about 15 tons. The engines are of the triple-expansion type, with surface condensers, and are capable of developing 250 horse-power.

The general construction of the new boiler will be clear from Figs. 1 and 2. Two parallel longitudinal chambers, the cross-section of each having the form of a sector of a circle, are united with a third—of cylindrical shape—by a great number of steel tubes. The section thus resembles an inverted V with the cylindrical chamber at the apex, the tubes sloping downwards at an angle of about 30 degrees. The two lower chambers form water-pockets, and the water extends up to about the middle of the top chamber, the remaining space of the latter being filled with steam. The flat surfaces of the water-pockets form the tube plates at one end of each series of tubes, the other ends being secured in the lower half of the cylindrical upper chamber. Each of the three chambers is about 6ft. long, and the upper cylinder has a diameter of about 20in.; each is made in two parts, with longitudinal flange joints. By removing the lower (circular) portions of the water-pockets and the upper part of the top cylinder all the tubes are rendered accessible for cleaning or renewal. There is no direct connection between the lower chambers, and the whole system has complete freedom for expansion. The grate occupies the space between the water-pockets, and the fire gases ascend between the tubes on either side, as indicated in the sketch, and over the top cylinder to the funnel. With the exception of the lower portion of the water-pockets, the whole is enclosed in a double wrought-iron casing filled with asbestos. All the tubes and chambers are of steel, and galvanised within and without. The feed-water is introduced from the front into the top cylinder near the middle of its length.

The circulation takes place upwards through the hotter inner tubes—next the furnace—and downwards through the outer tubes. Contrary to what might have been expected from the design, it is stated that no priming takes place.

The boiler in question is not an experimental one, as Messrs. Yarrow have built several of the same type, which have been at work for some years. No trouble has been experienced from leaking tube joints, and it may here be noticed that there is an essential difference between the conditions obtaining in an ordinary locomotive boiler, where the tubes are filled with the fire gases and are subject to external pressure, and those existing in Messrs. Yarrow's boiler, in which the water fills the tubes. As compared with a locomotive boiler suited for the same work, it is stated that the new generator is about 10 per cent. lighter, including coal and water. The cost is about the same in both cases.

The average speed of torpedo boats of the dimensions previously stated, and of the same type as that shown us, when fitted with locomotive boilers, is 17 knots; the boat with the new boiler runs at 18 knots under exactly similar conditions of trial. This increase of speed is ascribed partly to the smaller weight of the boiler and partly to its greater steaming capacity. Appended are the results of the official trial, which took place at Long Reach, on the Admiralty measured mile, on December 23rd, 1890:—

LOAD ON BOARD, TWO TONS.

Steam. Lbs. per sq. in.	Vac'm. Inches.	Air Pressure.	Revns. per Min.	Time. h. m.	Speed. Knots.	1st Means.	2nd Means.
170	23	2·7	570	3 3	19·672	17·765	
170	23	3·2	577	3 47	15·859		
170	22·7	3·5	568	3 1	19·890	17·909	18·021*
171	22·5	3·3	680	3 46	15·929	18·113	18·098*
172	22·7	3·2	597	2 57	20·338	18·063	18·121*
172	23	3·6	578	3 48	15·789	18·180	18·215*
174	22·5	3·1	582	2 55	20·571	18·250	
173	23	3·4	583	2 56	15·929		
172	22·7	3·35	578				

* Admiralty means, 18·113.

From our description it will be seen that the design of this boiler is of an eminently practical character. The fact that all the tubes are straight and of nearly the same length is a strong point in its favour, especially at foreign stations, as it is not necessary to carry a reserve of curved tubes bent to various templates, and the whole apparatus is almost as easily accessible for cleaning and repairs as a locomotive boiler.

THE BOARD OF TRADE RETURNS.

THE last Board of Trade returns issued cover the month of December, and also the whole trade of the past year. The value of the exports in December was £21,384,270, as compared with £21,001,670 in December, 1889, an increase of £382,600, or 1·8 per cent. In coming to the items, metals show a falling off. The value of unwrought and wrought copper was £389,223, as compared with £413,382, a decrease of 8 per cent., and the value of unwrought and wrought iron was £2,268,958, as compared with £2,508,030, a decrease of 9½ per cent. The value of hardware and cutlery fell to £224,344 from £242,671, a decrease of over 7½ per cent., but, on the other hand, machinery and millwork rose slightly, the figures for last month being £1,349,037, as compared with £1,325,675 in December, 1889. Coal, coke, and fuel have advanced considerably, the value being £1,535,230, as compared with £1,245,104, an increase of over 23 per cent. In the textile trades, cotton yarn is £1,030,133, as compared with £901,001, an increase of over 14 per cent.; cotton piece goods, £4,920,402, as compared with £4,123,080, an increase of over 19 per cent.; jute yarn, £32,398, as compared with £36,982, a decrease of nearly 12½ per cent.; jute piece goods, £229,584, as compared with £231,085, a slight decrease; linen yarn, £68,577, as compared with £77,124, a decrease of over 11 per cent.; linen piece goods to £334,906, as compared with £398,751, a decrease of 16 per cent.; silk manufactures to £151,894, as compared with £191,137, a decrease of 20½ per cent.; woollen and worsted yarn to £293,286, as compared with £371,766, a decrease of over 21 per cent.; woollen tissues to £484,008, as compared with £558,498, a decrease of over 13 per cent.; and worsted tissues to £689,986, as compared with £921,586, a decrease of over 25 per cent. In chemicals, alkali was £170,850, as compared with £123,476, an increase of nearly 38½ per cent.; bleaching materials, £39,085, as compared with £47,922, a decrease of nearly 18½ per cent.; and manures, £181,155, as compared with £191,414, a decrease of over 5 per cent.

The value of the goods imported during the month amounted to £39,434,448, as compared with £38,297,208 in December, 1889, being an increase of £1,137,240, or about 3 per cent. Raw materials for textile industries were £9,900,104, as compared with £10,232,829, a decrease of 3⅓ per cent. Metals were £2,220,215, as compared with £1,977,357, an increase of over 12 per cent.; chemicals, dyestuffs, &c., £771,395, as compared with £628,155, an increase of nearly 23 per cent.; and oils, £655,451, as compared with £655,099, a slight increase.

The exports for the year ended 31st December amounted to £263,542,500, as compared with £248,935,195 in 1889, being an increase of £14,607,305. The imports for the year amounted to £420,885,695, as compared with £427,595,442 in 1889, being a decrease of £6,709,747.

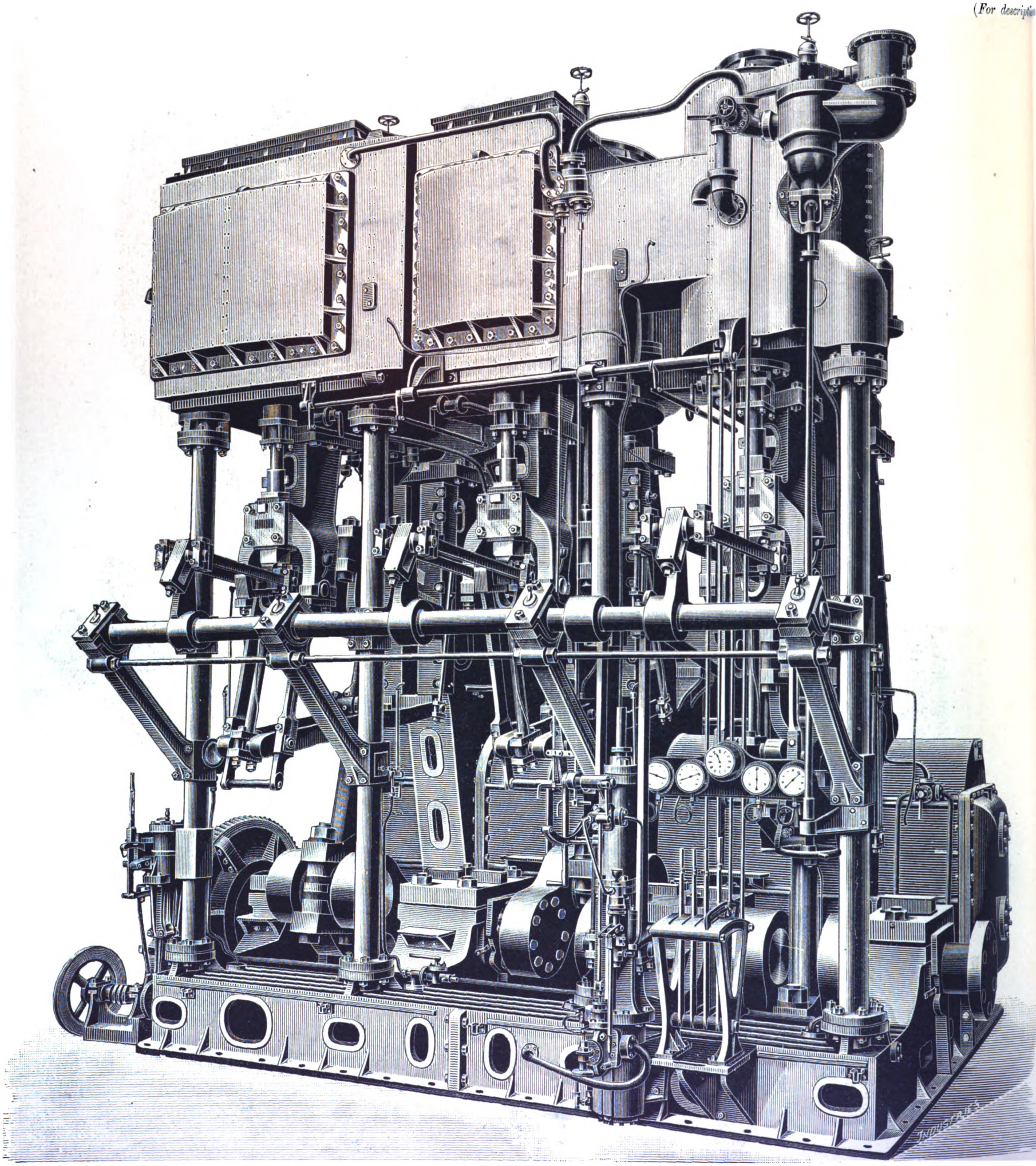
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TRIPLE EXPANSION ENGINES OF

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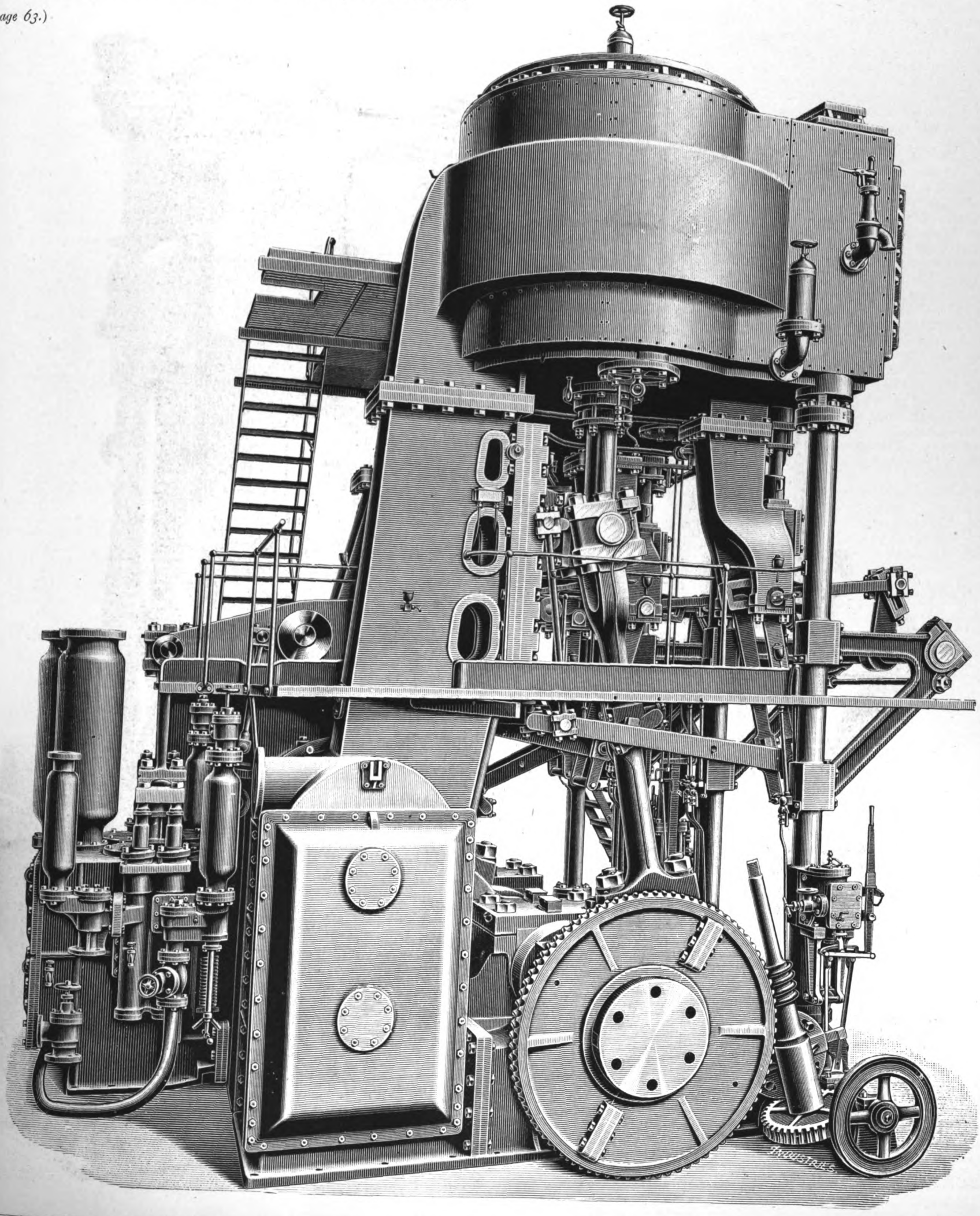


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...OF THE S.S. "CITY OF PERTH."

...AND JA...OMSON, FINNIESTON ENGINE WORKS, GLASGOW.

(...n see page 63.)



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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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FRIDAY, 16TH JANUARY, 1891.

PATENT FEES AND THEIR EFFECT UPON INVENTION.

WHEN the Patent Act of 1883 came into force the public generally, and inventors in particular, expected, in a vague sort of way, that great benefits would follow. There is no doubt that the alterations then made in the law have, on the whole, been beneficial, but the numerous complaints that come to the front every now and then show that there is still considerable discontent with regard to the working of many of the details of the existing patent laws. The most important question is, perhaps, that of fees—that is, as to what amounts they should be fixed at, and to what purpose they should be applied.

There is considerable misunderstanding regarding the nature of the property embodied in patents and copyrights. Many people seem to think it is perfectly obvious that an invention being the product of a man's brain, he, therefore, has an absolute right of property in it. This is, of course, an entire misunderstanding of the case. Property is really of the nature of a bargain. If a person in this country owns a house, or plate, or an estate, it is held under an unexpressed contract with the State, or that organised system of society of which he is a member. The State finds it is best for all that each member should retain what he acquires and should not be robbed of it; so that the general understanding is that each person retains his own property and abstains from taking that belonging to others. The reality of this general understanding or bargain is easily shown in the case of patent and copyright properties, for both came into existence as bargains, whereas the origin and growth of private general property is more difficult to trace. As regards patents the arrangement with an inventor is briefly this. The State says, in effect: "The public see the advantage of improvements in all sorts of manufactures, but, as it is not the business of any particular person to make them, they would not be made at all unless some special inducements were offered. It is better for the public good to have the deferred use of improvements than not to have them at all. An inventor is, therefore, offered a monopoly for fourteen years of his invention if he introduces a new manufacture, and shows the public how to work it." Exactly the same idea underlies copyright law. It is considered a good thing to have books, but, if nothing were done to encourage authors and publishers, books might not be forthcoming. With regard to international patents, we maintain that if a monopoly of fourteen years in one country is a fair remuneration for a given invention, it may be contrary to the public interest to give this invention a monopoly in several other countries for a similar period. From this point of view the whole system of international patent law is, in our opinion, on an unsatisfactory basis. A patentee would probably submit that he has a right to foreign as well as English patent rights, inasmuch as he has paid large fees for his privilege. But this would be a complete misunderstanding of the nature of fees. An inventor is not given the privilege embodied in a patent because he has paid certain fees, but in return for his trouble and risk of monetary loss in bringing out his invention. The fees are merely incidental. If the fees were really the purchase money of the monopoly there would be no need for a would-be monopolist to invent anything, as he might at once buy a monopoly of anything he might name, without inventing.

In most kinds of copyright, it is easy to know exactly in what the monopoly consists, though in cases of photographs of celebrated persons curious points have arisen. With regard to an invention, however, a document or documents must be lodged in some specified place which state clearly and exactly the extent of the monopoly granted. This necessarily entails some little expense. If copies are printed, as indeed they must be, the printing is partly, if not wholly, paid for by purchasers, but in the case of many specifications, which have a small sale, there will be some loss. This small loss, and the expense of registering patents and performing the other necessary work of the Patent Office, should be quite trifling; and an inventor should be able to secure protection for his invention for a very modest fee. The reason for the high fees now charged is not difficult to explain.

A system of government is an admitted necessity, and in order that the expenses of government may be met the public must submit to taxation. Every form of taxation is more or less distasteful to the public, and yet taxation is necessary in order to supply the government with revenue. An important problem which the statesman has to solve is how to get the necessary revenue with the least apparent pressure on the public. Generally speaking the best method is to levy certain taxes that appear to fall heavily upon the wealthy, and not to affect the poorer classes. So little is generally understood about the actual incidence of taxation that this policy is generally the most effective. There are, however, several still more effective methods of raising revenue, such as the working of a department like the Post Office at a profit. The head of such a department is free to say to the public: "Look how well I manage your letter-carrying generally; not only do I carry your letters for you for the ridiculously small sum of one penny, but I make a considerable profit out of the business, and thus lessen your taxes." Some persons really think that a benefit has thus been conferred, and are much pleased. The Patent Office, however, gives the statesman a still better chance of ingratiating himself with the public. In the case of the Post Office the public has to pay its penny, and has, moreover, to put up with many small inconveniences, which are sometimes a little exasperating. The Patent Office costs the general public nothing. The statesman is, therefore, able to point out the advantages to industry and invention of our patent laws, and dwell on the great benefits that accrue from cheap protection to inventors. He, however, arranges a scale of fees that shall not be so high as to prevent applications for patent rights, nor so low as to leave little or no surplus after paying the necessary expenses of the office. He, in fact, fixes the scale of charges so as to obtain the greatest possible revenue. This policy really throws an abnormally heavy tax upon inventors—a tax which has no counterpart in the case of copyright, or in that of any other monopoly. The average patentee is so sanguine about the merits of his own invention, and of its chances of success, that he unwittingly bears an undue load of taxation—in other words, he

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is fined by the State because he is an inventor, and in some cases a great public benefactor.

We thus see how both inventors and the progress of industry are hampered and taxed. That a public department like the Patent Office should be made a source of revenue is deplorable. We hope to consider the question of the details of patent fees at some future time. We only wish to point out now the shameless way in which inventors are taxed on the one hand, and the progress of industry hindered and hampered on the other, for the mere object of raising a small amount of public revenue.

THE RECENT MOVEMENT OF TRADE AT OUR PRINCIPAL PORTS.

One of the principal matters of local interest at the chief ports of the United Kingdom is the question of how far the trade and commerce of the individual port, as represented by the entrances and clearances of shipping, or by the value of the imports and exports, is increasing or diminishing by comparison with the business done at other ports at which the same character of business is carried on. As is very well known, there is a great deal of rivalry between the various ports in reference to their facilities and resources, and most of them have expended large sums of money with a view to providing the means of attracting shipping business, and earning a larger amount of revenue therefrom at the expense of other ports. The amount of capital sunk in this endeavour in the various shipping centres of Great Britain is not very readily ascertainable, but it must be enormous. Liverpool alone has expended nearly thirty millions sterling in making the Mersey the most convenient harbour in that region, and yet, as is generally admitted, has not been altogether successful in that endeavour. In London, again, the amount of money spent upon docks, wet and dry, upon warehouse accommodation, upon loading and unloading facilities, upon the channel of the Thames, upon lights and beacons, and upon other means to the same end, must have been very large, and the capital of the dock companies alone runs into a good many millions; and so with many other ports throughout the Kingdom as a whole. There is hardly a harbour, however obscure, that has not had its quay walls extended, its area deepened, its facilities improved, and its general character, so to speak, rehabilitated, with a view to the acquisition of some share of the enormous trade that is carried on between the United Kingdom and the rest of the world.

The most important ports of import in the United Kingdom are, of course, London and Liverpool. These ports have long been engaged in a very close race for the championship of the world, as regards the extent of their shipping trade and the value of their imports and exports. The enormous population of London naturally makes the Thames a point towards which imports largely gravitate for the purposes of distribution. This is especially true of breadstuffs, and of articles subject to Customs' duties, such as tea, coffee, and wines. Liverpool, on the other hand, is the shipping centre for almost as large, if not a larger population, than even that of greater London, the promoters of the Manchester Ship Canal having calculated that there was a population of over seven millions tributary to Liverpool. The latter port, again, has this in its favour, as against London, that it is the shipping centre of an enormous manufacturing population, which draws upon the outside world for supplies of raw materials, such as raw cotton, raw wool, pyrites for the alkali manufacture, unhewn timber, caoutchouc, leather, and other imported materials that are worked up in subsequent processes of manufacture. To this extent, then, the import business done at these two several ports is distinct and characteristic. The value of the imports at each of the principal English ports in 1880 and 1889 is appended:—

Value of Imports at the Principal Ports of England and Wales in 1880 *and* 1889.

	1880. £1=1,000.		1889. £1=1,000.		Increase (+) or Decrease (−) in 1889. £1=1,000.
London	141,443	...	144,711	...	+ 3,268
Liverpool	107,460	...	111,152	...	+ 3,692
Southampton	9,205	...	8,964	...	− 241
Newcastle	6,602	...	7,618	...	+ 1,016
Hull	20,163	...	26,288	...	+ 6,125
Bristol	8,481	...	8,115	...	− 366
Cardiff	2,338	...	2,518	...	+ 170
Barrow	791	...	635	...	− 156
Grimsby	3,906	...	5,774	...	+ 1,868
Goole	3,836	...	4,803	...	+ 967
Total	304,225	...	321,578	...	+ 17,343

It will be observed that the increase that has taken place in the interval has not been much different as between London and Liverpool, and that Hull, Grimsby, and Goole are the only other ports that show a notable advance, these making up a total increase exceeding that shown by London and Liverpool, from which the inference is obvious that the Yorkshire ports are becoming more largely the distributing centres for the imported breadstuffs and other commodities required in the manufacturing towns of that county. The exports from the same ports for the same two years have been as under:—

Value of the Exports of the Produce of the United Kingdom at the Principal Ports, 1880 *and* 1889.

	1880. £1=1,000.		1889. £1=1,000.		Increase (+) or Decrease (−) in 1889. £1=1,000.
London	52,600	...	48,251	...	− 4,349
Liverpool	84,029	...	102,513	...	+ 18,484
Southampton	9,306	...	8,341	...	− 965
Newcastle	4,528	...	4,560	...	+ 32
Hull	18,572	...	16,768	...	− 1,804
Bristol	1,763	...	1,148	...	− 615
Cardiff	4,161	...	6,533	...	+ 2,372
Barrow	1,201	...	401	...	− 800
Grimsby	7,236	...	7,429	...	+ 256
Goole	3,093	...	5,556	...	+ 2,663
Total	186,489		201,763		+ 15,274

Here it will be observed that Liverpool has very largely outstripped any other port on the list, and has left London far behind, the difference in imports and exports together amounting to about 21 millions in favour of the great Lancashire port, whereas in 1880 the difference was some two millions in favour of London. Liverpool is now far ahead of every port in the world as regards the value of its import and export trade. It has outrun London, not so much because of its superior facilities, or lower dues, or better access, or nearness to other countries, as because of its geographical situation in relation to the great manufacturing centres of Lancashire and Cheshire. It is probable, also, that in the year 1889 some exporters, who would otherwise have shipped from the Thames, transferred their shipments to Liverpool, or to some other port, in order to be rid of the uncertainty and difficulty created by the dock strikes.

There is another important point in reference to which the superiority of Liverpool stands out with marked prominence. It will be observed that the import and export trade of that port almost balance each other, there being a difference of less than nine millions between them. In the case of London, however, there is a difference of some 96 millions as between exports and imports, and the difference, which amounted to 89 millions in 1880, clearly tends to increase. This means that the vessels that enter the Thames have nothing like the same good chances of outward cargoes as the Liverpool-bound ships, and that their homeward freights must consequently be higher. As regards many ships engaged in the transportation of such comparatively costly commodities as tea, coffee, and spices, there is usually a sufficient margin in the homeward freight to allow of a large provision in the way of outward ballast.

The next tabular statement shows how the shipping business of each part of the United Kingdom compares over the last five years as regards the value of the imports received into the ports generally.

Value of the Total Imports received at Ports in England and Wales, Scotland, and Ireland, 1885 *and* 1889.

	England and Wales. £1=1,000.		Scotland. £1=1,000.		Ireland. £1=1,000.		Total. £1=1,000.
1885	330,755	...	32,170	...	8,982	...	370,968
1886	315,117	...	27,919	...	6,802	...	349,863
1887	324,457	...	29,771	...	7,973	...	362,227
1888	349,147	...	31,221	...	7,232	...	387,635
1889	382,508	...	36,771	...	8,319	...	427,637

The same movement has been apparent in exports from the three divisions of the United Kingdom, England and Wales having largely improved their position during the last five years, while Scotland and Ireland, although both showing decidedly better results, have each advanced to a much less extent. More than one-half of the exports of Scotland are shipped from Glasgow, which is a large manufacturing centre, and is annually increasing the value of the machinery, &c., that it sends abroad. Of course, were the tonnage of the ships built on the Clyde to be treated as an export, the relative importance of Scotland would stand much more prominently forward:—

Value of the Total Exports of the United Kingdom Shipped from England, Ireland, and Scotland, respectively, at Different Dates.

	England and Wales. £1=1,000.		Scotland. £1=1,000.		Ireland. £1=1,000.		Total. £1=1,000.
1885	193,412	...	18,881	...	750	...	213,944
1886	193,368	...	18,248	...	816	...	212,132
1887	201,760	...	18,849	...	805	...	221,414
1888	212,150	...	20,821	...	871	...	233,842
1889	224,924	...	22,310	...	813	...	248,048

It will be understood that in this analysis we have only dealt with the principal ports and with general results. There are many smaller ports in the United Kingdom that have their own special trades, such as Stockton, Middlesbrough, and the Hartlepools, that do a large business in the exportation of iron; Blyth, Seaham, and other North country ports, that do a large business in the exportation of coal, and so on. But these ports do not, as a rule, take a large, nor a greatly varying part in the general import and export business of the country, being excluded therefrom, except to a very limited extent, by their geographical position, and by the usually insufficient character of their facilities. Newport and Swansea, in Wales, are entitled to be treated as exceptions to this rule.

INDUSTRIAL WILLS OF 1890.

The following are the more important of the industrial wills proved in 1890:—

Coal and Iron.—C. R. M. Talbot, of Margam Abbey, M.P., £1,388,617; Wm. Hargreaves, Soho Ironworks, Bolton, £586,455; Andrew Knowles, of A. Knowles & Sons, coal owners, £316,653; David Davies, Welsh coal owner, £404,000; James Nasmyth, inventor of steam hammer, £243,845; Joseph Mills, Kingswinford, Staffordshire, £140,842; Handel Cossham, M.P., coal owner, £59,127: and Daniel Adamson, Didsbury, engineering works, £41,489.

Cotton, Linen, &c.—Samuel Fielden, Todmorden, cotton spinner, £1,170,113; James Ormrod, Bolton, cotton spinner, £432,000; Henry Maden, Bacup, cotton spinner, £327,588; John Grubb Richardson, Bessbrook Spinning Company, Ireland, £226,477; Fred. Wm. Grafton, calico printer, Accrington, £215,951; James Hargreaves, Heywood, cotton spinner, £282,706; Sir Peter Coats. thread spinner, Paisley, £123,457; John Fish, Southport, cotton spinner, £99,447; and Sir John Preston, linen manufacturer, Belfast, £94,000.

Railways and Shipping.—T. A. Walker, contractor, £551,694; Arthur O. Wilkinson, Lloyd's, £100,545; Sir George Burns, Bart., Cunard Company, £91,357; and Ed. Fletcher, chief engineer, North-Eastern Railway, £75,178.

Miscellaneous Manufacturers.—Christian Allhusen, Newcastle-on-Tyne, chemicals, £1,128,852; John Noble, varnish manufacturer, £929,044; Stephen Christy, hat manufacturer, Stockport and London, £283,254; James D. Doulton, art pottery, Lambeth, £115,544; Hugh M. R. Ewing, Turkey red dyer, £108,000; George B. Kent, household implements, £61,500.

Merchants.—Bernard Hall, Liverpool, £533,552; Sir T. Edwardes Moss, Bart., West Indian merchant, £494,844; Robert Needham Phillips (of Welcombe, Warwickshire), J. A. Phillips & Co., Manchester, £428,087; Joshua M. Heap, merchant and sugar refiner, Liverpool, £330,472; George B. Blair, Balfour Bros., Liverpool, £219,129; Daniel H. Rücker, colonial broker, London, £169,895; Philip Falk, colonial merchant, London, £159,279; W. E. Baxter, of Kincaldrum, Dundee, merchant, £128,903; John Hartley Hind, J. H. Hind & Co., hemp merchant, Liverpool; Lord Addington, Russian merchant, £112,000; Edward W. Bell, merchant, Bradford, £102,000; and Henry Cox, merchant, Liverpool, £100,000.

Bankers.—Junius S. Morgan, J. S. Morgan & Co., London and New York, £2,022,054; Robert C. L. Bevan, Barclay, Bevan, & Co., £951,886; Henry Oxley, Leeds, £420,286; Edward Bolitho, £383,601; Robert Williams, Williams, Deacon, & Co., £214,147; Philip Playdell Bouverie, Ransom, Bouverie, & Co., £164,438; Edwin Henty, Worthing, £143,962; Sir Charles W. Sikes, Huddersfield Banking Company, £141,414; Thomas Lloyd, Warwick, Lloyd's Bank, £129,000; William G. Coles, Stuckley's Bank, £119,888; and Right Hon. E. P. Bouverie, Ransom, Bouverie, & Co., £91,627. We should add the name of Miss Anne Raphael, Stockwell Hall, Essex, who left £236,000, largely bequeathed to her by her brother, Edward Raphael, foreign banker in London, who died in 1888.

Stock Exchange.—Sir James Mackenzie, Bart., of Glenmuick, £659,022; Wm. Morris, of Morris & Pickle, London stock dealers, £356,000; Isaac Brathwaite, of Foster & Brathwaite, London stock brokers, £289,059; Fred. Banbury, London stock broker, £221,000; and Wm. Hy. Barry, London stock broker, £119,000. Mr. Jacob J. Astor, the American millionaire, left £290,809 in this country, and Mrs. McCalmont, Eaton Square, who left £132,873, owed her wealth to the great house of McCalmont & Co., whose head, Mr. Hugh McCalmont, died in 1887, leaving more than three millions sterling.

Printers and Publishers.—Edward Lloyd, owner of *Daily Chronicle* and *Lloyd's News*, £563,022; Sir Edward Baines, owner of *Leeds Mercury*, £165,818; George Routledge, publisher, £94,000; Ch. Ed. Mudie, London

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library, £59,347; and Robert Farran, of Griffith, Farran, Okeden, & Welsh, £30,000.

Brewers, &c.—Charles Goding, Lion Brewery, £409,625; Charles Florance Young, Wandsworth Brewery, £349,915; Pickering Phipps, Northampton brewer, £263,311; Hugh Tennant, Wellpark Brewery, Glasgow, £230,226; Sir Edward P. Cowan, Irish distiller, £213,000; Mrs. Charrington, Anchor Brewery, Whitechapel, £192,204; Charles Dobson, wine shipper, London and Bordeaux, £169,940; Christopher Hall, wine merchant, Whitechapel, £127,000; James Jameson, Dublin Distillery Company, £85,588; Arthur L. Charrington, Charrington & Co., Burton-on-Trent, £75,320; and Wm. Allen Block, London wine merchant, £82,000.

QUICK STEAMING BETWEEN QUEENSTOWN AND LIVERPOOL.

On Saturday last the Cunard steamer "Umbria" made a remarkable passage between Queenstown and Liverpool. After a smart passage of 6 days 6 hours and 59 minutes across the Atlantic against easterly winds, she left Queenstown on Saturday at 2.5 a.m., in order "to catch the tide" at Liverpool. In order to avoid waiting outside the bar, advantage was taken of the clear weather to steam the "Umbria" at her best, and not only was the bar successfully crossed, but with time to spare, the run from Queenstown occupying only 10 hours and 40 minutes. It was performed at an average speed of nearly 22 knots per hour. It is supposed that this speed has not been exceeded in any passenger vessel afloat.

COAL, IRON AND COGNATE INDUSTRIES.

The Board of Trade returns for December and for the twelve months then ended have now been published. The declared value of the exports for the month is £21,384,270, and for the twelve months £263,542,500, being an increase of £382,600 and £14,607,305 respectively, as compared with the corresponding periods of the previous year. The declared value of the imports for the month is £39,434,448, and for the twelve months £420,885,695, being an increase of £1,137,240, and a decrease of £6,709,747 respectively, as compared with the corresponding periods of 1889. The total quantity of iron and steel exported last month was 263,559 tons, valued at £2,268,958, being a decrease of 51,445 tons in quantity, and £239,072 in value, as compared with the corresponding period of last year; for the twelve months the exports amounted to 4,001,579 tons, valued at £31,582,172, being a decrease of 184,603 in quantity and an increase of £2,440,043 in value. Exports of coal show no signs of relapse, and an increase in their value to the amount of £4,237,999 for twelve months is, indeed, a remarkable proof of the vitality of this branch of the coal trade during 1890.

We append our usual tabular statement:—

	Month of December.		Twelve Months.	
	1890.	1889.	1890.	1889.
Pig and puddled	£168,696	£258,777	£3,502,050	£2,988,324
Bar, angle, &c.....	172,841	127,857	1,655,081	1,624,576
Railroad.....	332,036	511,856	5,983,547	5,330,858
Cast and wrought ...	448,743	491,527	5,974,467	5,431,422
Hoops, sheets, &c. ...	329,079	336,126	3,844,134	4,133,667
Unwrought steel.....	145,582	161,588	1,904,075	1,699,010
Unwrought copper ...	263,600	219,663	2,634,803	1,536,917
Coals, &c.	1,535,230	1,245,104	19,019,989	14,781,990

A retrospect of the twelve months shows that the foreign and home trades have been subject to similar influences. In the iron trade the year opened with considerable excitement, prices in all branches having reached a point in excess of any experienced since 1875; and opinions were freely expressed by many shrewd members of the trade that a still higher level was to be anticipated. The January quarterly meetings afforded a reflex of this opinion, and much legitimate and speculative business was transacted. Taking Scotch pig iron warrants as affording a fair barometrical reading of the general industry, these were sold at 65s. per ton in the early days of last year. Directly afterwards, however, a downward tendency became apparent, and owing partly to speculative necessity, and partly, no doubt, to a diminution in immediate consumption, and to a perceptible relapse in iron-consuming industries, more particularly in that of shipbuilding, the fall assumed a continuous rapidity unprecedented in the annals of the trade. Before the close of the first half of the year warrants had fallen fully £1 per ton, and, although during the last six months some important fluctuations occurred, the year closed with warrants selling at 46s. In respect of the coal trade, for collieries near the sea board producing a good steam coal there has been a large demand throughout the year. The railway companies have had to pay much higher prices for their fuel supplies. In the house coal trade demand continued, even through the summer months, quite equal to the supply, and prices were well maintained; and during the keen frosts of the last few weeks merchants and colliery proprietors have found it quite impossible to keep their customers fully supplied. It is only in the land-locked centres, where collieries are worked in conjunction with iron works, a large proportion of their output of fuel being consumed in the melting and manufacture of iron, that, owing to the heavy fall in the value of that commodity, great difficulty is experienced in meeting the increased cost of production. Miners' wages have been generally advanced during the year 20 per cent.

Letters to the Editor.

OUR BIG GUNS, AND HOW THEY ARE MADE

To the Editor of "Industries."

Sir,—The letter in a recent issue by Lieutenant Gubbins directs attention to a matter which ought to have been fully considered by our military authorities long ago, especially after the opinion of such a high authority as Sir William Siemens on the point. Any one who thinks about the matter must see that the present method of shrinking on the rings of guns, which are subsequently to be expanded by heat when used, is wrong, and after a certain number of charges the guns are sure to crack, the number depending, to a very large extent, on the state of stress of the different parts of the body of the gun. The method suggested by Sir William Siemens, and which, I believe, was carried out by the Government of the United States in the manufacture of cast-iron guns with highly satisfactory results, may be a little more complicated in practice than the present one, but that would be more than balanced by a distribution of stress which would be highly advantageous to the guns.

Perhaps some of your readers who have had practical experience in the manufacture of guns will say whether there are any great difficulties in carrying out Sir William Siemens' suggestions, and then you may be in a stronger position to call upon the authorities to explain why they have so long ignored them.

Yours, &c.,
London, 7th January, 1891. C.E.

IMPROVEMENTS IN THE MANUFACTURE OF NITRIC ACID.

To the Editor of "Industries."

Sir,—I am much obliged to Mr. Guttmann for his reply to my inquiries, and fully appreciate the advantages which his process possesses. My interest in the matter has led me to refer to sundry German technical journals, and look up the criticism of Mr. Andersch, which I find appeared in the *Zeitschrift für Angewandte Chemie*. Pursuing my investigation, I came across a reply by Mr. Guttmann to that criticism in a later number of the same paper; but in that reply the main point at issue between the disputants—namely, the saving to be effected by the process—is not satisfactorily settled. Its success must depend on its cost, and when one finds Mr. Andersch asserting that the plant on which Mr. Guttmann proposes to save 80,000 marks costs only 30,000 marks altogether, and, getting no more conclusive answer to this statement than is given by a doubt being cast on the adequacy of the plant, and therefore on the accuracy of the estimate, one is naturally desirous of more definite information.

Yours, &c.,
Bertram Blount.
Laboratory, Broadway, Westminster, S. W.,
8th January, 1891.

THE TRIPLE EXPANSION ENGINES OF THE S.S. "CITY OF PERTH."

In our two-page supplement this week we give illustrations of the triple-expansion engines of the s.s. "City of Perth," constructed by Messrs. John & James Thomson, Glasgow. These engines indicate 2,250 h.p., and have cylinders 26½in., 44in., and 72in. diameter, and 48in. stroke. The working pressure is 160lb. per square inch, and the steam is supplied by two single-ended boilers fitted with Howden's system of forced draught. The boilers are 14ft. 6in. diameter by 11ft. 6in. long, with three furnaces each of 42in. diameter. The total fire-grate area is 99 square feet, and the total heating surface 4,260 square feet. The air for the forced draught is supplied by one of Messrs. Drysdale's 60in. fans driven by a belt from a vertical engine made by the same firm. There is also a spare engine. The main engines are fitted with Morton's valve gear, and the valve casings are on the cross-centre lines of each engine, thus making the engine as compact as possible. The high-pressure engine is fitted with a piston valve; the intermediate engine, a double-ported slide valve; and the low-pressure engine is fitted with one of Thom's double-ported Trick valves. The condenser has a surface of 2,701 square feet. The circulating water is drawn through the tubes by a double-acting pump, which, along with the air-pump, two bilge and two feed pumps, is worked from the intermediate engine by levers. The feed pumps are arranged to pump either direct to the boilers, or to one of Weir's patent feed-water heaters, from which the feed water is discharged into the boilers by a pair of direct-acting pumps. There is also a Weir's 14-ton evaporator to supply any loss of feed water. The crank shaft is 13¾in. diameter, and is made of wrought iron with steel crank pins. It is in three pieces, and is supported by four bearings, the outer two of which are 1ft. 8in. long, and the inner ones 2ft. 6in. long. The cylinder castings are of cast iron, but the pistons are of steel, and are fitted with Lockwood & Carlisle's rings. The high pressure and intermediate cylinders are fitted with hard close-grained liners, and the intermediate cylinder has a loose valve-face. The cylinders are supported on the front of the engine by four wrought-iron columns, to which the upper shaft brackets are fastened. These brackets are of steel. The starting engine is made by Messrs. W. H. Allen & Co., of London, and has a cylinder of 10in. diameter by 16in. stroke, and is found very efficient. The thrust-block has six rings of the horseshoe type, and is provided with very ample surface.

The "City of Perth" was built by Messrs. Workman, Clark, & Co., Ld., of Belfast, for Messrs. Geo. Smith & Sons, Glasgow. Her dimensions are:—Length, 361ft. 7in.; breadth, 42ft. 7in.; depth, 26ft. 4in., with a gross tonnage of 3,427 tons. She is classed 100 A1 in Lloyd's Registry, and is built considerably above their requirements. The vessel is of the three-decked type, having two steel decks, the upper being sheathed with teak, and having a poop bridge and topgallant forecastle. The officers are housed under the forecastle, the engineers in wing-houses under the bridge, and the crew in the poop. The ship has five cargo holds, and is divided into eight water-tight compartments. The vessel is fitted with Harrison's steam steering gear and Harfield's windlasses, Sir Wm. Thomson's standard compass and patent sounding machine. Electric light is fitted throughout by Messrs. Paterson & Cooper, of London. The holds are provided with seven steam winches and derricks for the working of the cargo. Captain Anderson's "hold-handy ladder" is fitted for examining the hold and for assisting in stowing the cargo. On a recent trial trip against the tide the speed was at the rate of 12 knots per hour, and with the tide 12½ knots.

Books Received.

The Patentee's Guide: Information for All Sorts and Conditions of Inventors in All Parts of the World. By H. F. Broughton, M.I.M.E. London: Simpkin, Marshall, & Co.

May's Popular Instructor for the Management of Electric Lighting Plant. By Dr. Oscar May. London: *The Electrician* Printing and Publishing Co., Ld.

The "Shipping World" Year Book, 1891. Edited by Evan Rowland Jones. London: The *Shipping World* Office.

Modern Cotton Spinning Machinery: Its Principles and Construction. By Joseph Nasmith, Assoc. Inst. M.E. London: E. & F. N. Spon.

Coal Dues and the Price of Coal: Report to the Court of Common Council from the Coal and Corn and Finance Committee.

The Journal of the Royal Agricultural Society of England. Third Series. Volume the First. London: John Murray.

Cleveland Institution of Engineers, Proceedings, December 15th, 1890.

The Journal of the United States Association of Charcoal and Iron Workers. Vol. 9, No. 1.

THE PHENOMENA OF THE DEPTFORD MAINS.

By J. Swinburne.

II.

(*Concluded from page 40.*)

Among those who have discussed this subject, Mr. Kapp alone holds that the resonator effect occurs at all periods, so that I have dealt with that point separately. The other cases, alleged to be possible, have been gone over more than once, both by Mr. Glazebrook and Dr. Fleming, so that it will be better to discuss the explanations in order.

In the first place, the *Electrical Review* suggests that the Deptford transformer is wound wrongly. This is an eminently commonsense explanation, which commends itself to any one who has made transformers, and knows how frequently errors arise in practice. Even experienced gas-meter inspectors continually make mistakes in taking the indications of revolution counters, and such a reading as 399 is frequently put down as 499 or 409. I do not think, however, in this case that there can be such an error.

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Turning, therefore, to effects due to capacity and resistance, we may best begin by finding exactly, or approximately, what quantities we have to deal with. Dr. Fleming* gives the specific inductive capacity of the dielectric, brown paper and ozokerite, as 3·5. This seems very high, as paraffin wax is generally given as from 1·9 to 2·5; it would be interesting to learn how this was obtained, as absorption may have interfered with the accuracy of the readings. We may assume, however, that Dr. Fleming's values are correct, as his carefulness is well known. The resistance given is high, being twice that due to the copper, which goes to show that the joints must be bad. I do not know whether the resistance due to bad joints would not fall when there is a current, but we may again take Dr. Fleming's figures as accurate. Arranging them for reference, we have for a seven mile trunk main—

Self-induction.....	0·002	henry.
Resistance	2·275	ohm.
Capacity	2·057	microfarad.
Frequency	67	periods per second.

Professors Ayrton and Perry have often lamented that electrical engineers have so little idea as the values of self-inductions met with in practice; I think there is the same want of familiarity with capacity.

Take first the case with the pressure of 10,000 volts at the London end. First suppose the circuit at London open, so that there is no load. The current into the cable is 10·8 amperes. The self-induction of ·002 and the capacity are both distributed, but even if put in series, the self-induction would only account for 9 volts out of 10,000. I think, therefore, the self-induction of the main may be neglected. To give 2,000 volts, which is, I understand, about the rise observed, demands a self-induction of 0·44 henry.

This self-induction is enormously great for such a circuit. It would have to be in the transformer or in the dynamo. Professor Ayrton stated that the rise was confined to the London side of the Deptford step-up transformer, so this enormous self-induction would necessarily be somewhere in the leads, as a transformer cannot alter its ratio of transformation at ordinary frequencies without an alteration of the primary current. It is easier to believe Professor Ayrton was misinformed than to find any explanation for the alleged phenomenon.

It might be said that self-induction of half a henry or so is lurking in the transformer. Supposing the transformer to be wound one to one, and neglecting the exciting or magnetising current component, the primary and secondary current would be equal and opposite. It would then make no difference if the circuits were joined in series in opposite directions, so that the transformer was like a choking coil with half its turns arranged backwards. It would then act as a choking coil to the very small extent due to the waste induction. This waste induction always exists in a transformer, and causes a "drop." The "drop" in a well-designed transformer for fifty lights or so should be a fraction of 1 per cent., in a very large transformer it should be much less. It can be easily calculated, but I have not the dimensions of the transformers under discussion. Assuming the drop to be 0·25 per cent., at a full load of 300 amperes, which is what the mains carry, according to Mr. Ferranti the transformer would behave as if it had a self-induction of 0·006 henry in the 10,000 volt circuit. The transformer cannot, therefore, produce the effect.

As to the dynamo, there is either armature reaction or self-induction. If there is armature reaction, which accounts for the variation of pressure, the theory as given in my Physical Society paper, is correct. Even if the armature reaction is disguised under the name of self-induction, this theory remains correct. If it is desired to call it self-induction, we can, of course, find a value, which, at this particular load, would give the same external results as armature reaction. To produce a rise of pressure of 500 volts when the machine is excited to give 2,000 volts in open circuit needs, with a capacity current of 43 amperes, a self-induction of 0·0275 henry. That the effect is due to the dynamo thus seems quite possible and reasonable. It also accounts for the effect disappearing when the dynamo is excited up to 10,000 volts, and coupled direct to the mains. The percentage rise is then only one-sixteenth of what it was before. This is Dr. Fleming's case (I.), and Mr. Glazebrook's case, giving R_2 an infinite value. Mr. Kapp also discusses it with reference to his Fig. 10, except that his values for L C and R do not apply. He says, however, that the dynamo self-induction cannot be large enough to have this effect. It may, however, be "somewhat" increased by the use of a step-up transformer. He appears to regard a step-up transformer as adding to the self-induction of the circuit as if it were a choking coil. It cannot do this perceptibly, and it cannot increase the "self-induction" of the dynamo, but by multiplying the armature current with a given capacity by four, and necessitating weak fields, there results an arrangement which admits of great armature reactions.

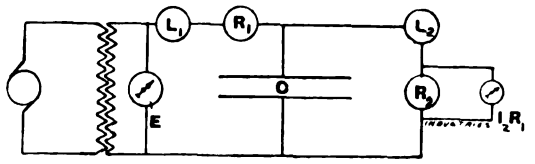


Fig. 1.

Take now the case with, say, 2,000 30-watt lamps on in London. This is equivalent to a resistance of 1,666 ohms put across the London end of the main. This corresponds to Dr. Fleming's case (II.), and Mr. Glazebrook's case with $R_2 = 1{,}666$. The self-induction in the London transformers is not as small as at Deptford, because there are two sets of step-down transformers. We may, therefore, go so far as to write L_2 as equivalent to 0·02 henry put in the high-tension circuit. If there are 10,000 volts on R_2, i_2, the current which is transformed down and used on lamps is 6 amperes. The pressure needed to overcome the self-induction L_2 is then 50 volts, and the pressure on the mains, or on the condenser, is only increased one-tenth of a volt in 10,000. L_2 might as well have been taken as zero. The condenser current is still 10·8 amperes, and, taking L_2 as zero, the total current i_1 at Deptford is 12·3 amperes. The step-up transformer being taken as before, we still have only the dynamo to come upon. If it has a self-induction $L_1 = 0{\cdot}0275$, which acts as 0·44 in the high-pressure part of the circuit, the rise of pressure is only 76 volts less than before. Taking 25 amperes used at London, which is about the full load of the machine when used with a four to one step-up transformer, we have 4,820 volts spent on the "self-induction" of the armature. The modulus of 8,000 and 4,620 is 9,236, so there is still a rise of 764 volts.

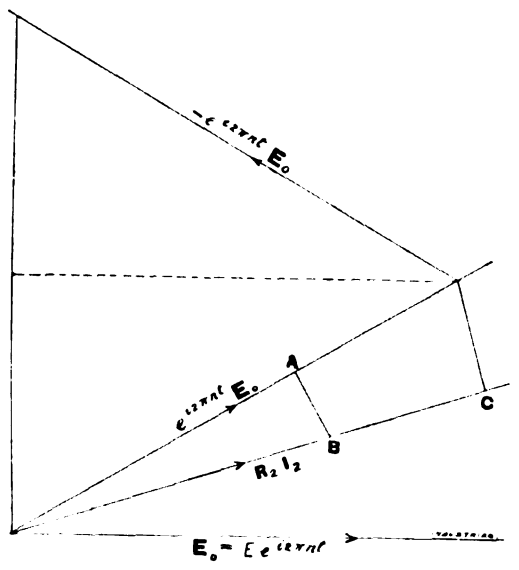


Fig 2.

Mr. Glazebrook merely gives a general statement of the theory of two parallel circuits, each with self-induction and resistance, with a condenser in shunt to them, and an alternating electromotive force in one of them. His working may be simplified by translating into vector or quaternion methods. Let E Sin $2\pi nt$ or E Cos $2\pi nt$ be the instantaneous electromotive force in one of the circuits, say, the pressure at Deptford. If the effective pressure is 10,000 volts, the maximum value is 14,140 = E (Fig. 2). Represent this by the vector $E_t = Ee^{i2\pi nt}$. When $t = o$ suppose this vector is E_o, differing in direction but not in length. Then if the instantaneous electromotive force follows a sine law, $E \text{ Sin } 2\pi nt = E\frac{1}{2}(e^{i2\pi nt} - e^{-i2\pi nt})$. To get this add $Ee^{-i2\pi nt}$, which reaches to Y, then $1/2\ \overline{OY} = E \text{ Sin } 2\pi nt$. E Cos $2\pi nt$ is similarly found. The numerical relation between the pressure on the lamps, or R_2, to that at Deptford, is given by Mr. Glazebrook thus:—

$$E = \Big[(R_1+R_2)^2 + (2\pi n)^2(L_1+L_2)^2 - 2C(2\pi n)^2 \Big\{ R_1^2L_2 + R_2^2L_1 + (2\pi n)^2(L_1+L_2)L_1L_2 \Big\} + C^2(2\pi n)^2(R_1^2+(2\pi n)^2L_1^2)(R_2^2+(2\pi n)^2L_2^2)\Big]^{\frac{1}{2}} I_2,$$

which may be altered into

$$E = (R_1+R_2+2\pi in(L_1+L_2)+2\pi inCR_1R_2+(2\pi in)^2 CR_1L_2+(2\pi in)^2CL_1R_2+(2\pi in)^3CL_1L_2)I_2.$$

Separating the coefficients of I_2 with odd and even powers of i we have

$$E = \Big\{ R_1+R_2-(2\pi n)^2CR_1L_2-(2\pi n)^2CR_2L_1+i\big(2\pi nL_2+2\pi nCR_1R_2-(2\pi n)^2CL_1L_2+2\pi nL_1\big)\Big\} I_2.$$

Taking R_2, the lamps, as, say, 1,000 ohms, and L_1 as ·001, most of the components of E become inappreciable, and we have a simple case of condenser and resistance in parallel on a dynamo. If the dynamo has armature reactions, which are equivalent to ·44 henry under the particular circumstances, we must treat the case as if $L_1 = ·44$. We then have

$$E = (802 + i \cdot 190)\, I.$$

Along E_t mark off O A = 802 in any convenient scale; from A draw A B = 190 in the direction $-i\,\overline{OA}$; from the end of E_t let fall a perpendicular on O B produced, meeting it at C, then $\overline{OC} = R_2I_2$. If we want to see the effect of varying any of the values, such as the capacity of the condenser, we can first find R_2I_2, when C = O, and then operate again on this vector by means of the terms involving C.

Mr. Glazebrook's case of infinite value of I_2 cannot occur at Deptford. It is when R_1 R_2 are each equal to zero, and when

$$C = \frac{L_1 + L_2}{n^2\, L_1\, L_2}$$

This is merely the case of the resonator again, with two self-inductions in parallel with the condenser instead of one. Two self-inductions coupled in parallel act as one self-induction, whose value is found like that of two conductivities coupled in series. I think Mr. Heaviside has called the reciprocal of the inductance "permittance"; to get the joint permittance of two permittances placed in parallel we add them like conductivities. I do not remember, however, whether permittance is the reciprocal of inductance or of impedance; whichever meaning is given, permittances can be combined like conductivities.

Mr. Glazebrook goes on to say that Mr. Mordey's difficulties with his armature may be accounted for by his having values which cause resonance. I think Mr. Glazebrook can hardly have any idea of the quantities dealt with. The resistance in circuit with a Mordey machine is, say, 100 ohms, and the capacity of the coils of the armature, if such an expression can be used, is infinitesimal. The strip, if unwound, has a total area of only a few square feet, and neighbouring turns are separated by only a volt or two. It would seem more likely that the armature breaks down more easily than the average coil, just as a chain breaks more easily than the average link. Similarly the capacity of the transformers may be left out of account as quite inappreciable in comparison with two or three microfarads.

Beyond giving a complete statement of the case of two parallel circuits with a condenser in shunt to them, I cannot see that Mr. Glazebrook's paper explains the Deptford phenomena at all. No appreciable value of L_1 can be found, unless the armature reaction is called self-induction, and it is then merely a general statement of the theory given in my Physical Society paper.

Dr. Fleming goes over the same ground in a different way, but does not show the existence of any appreciable L_1, unless it is taken as in the dynamo. He also discusses the case of capacity, resistance, and inductance distributed along a main, and gives an equation taken from a paper of Mr. Heaviside's. I have not this paper at hand, and object to working with any formula until I have worked it out for myself. As given by Dr. Fleming, the formula conveys no meaning, as G, H, and θ make their appearance without any introduction.

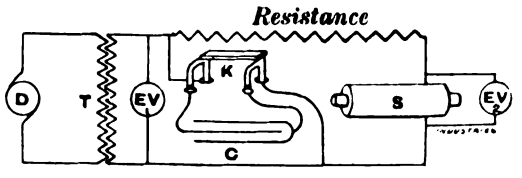


Fig. 3.

Professor Ayrton gives the diagram, shown in Fig. 3, and says that when the condenser is put in circuit the reading on the voltmeter EV1 is not increased so much as that on EV2; and says he is glad to find Mr. Glazebrook agrees with him. Mr. Glazebrook's paper does not in the least bear out the results of such an experiment as that given by Professor Ayrton. The London voltmeter is connected across a self-induction S instead of a resistance. The result is impossible also. The reading of the Deptford voltmeter, placed as shown in the diagram, is to that of the London voltmeter as the modulus of R and $2\pi nL$ is to L, and this ratio remains constant whether the condenser is on or not. I can only suggest that Professor Ayrton has confused an equal percentage increase of reading with an equal increase, or that the speed altered, or that his readings or instruments are inaccurate.

* *Electrician*, January 2nd, 1891.

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THE KIOTO CANAL, JAPAN.

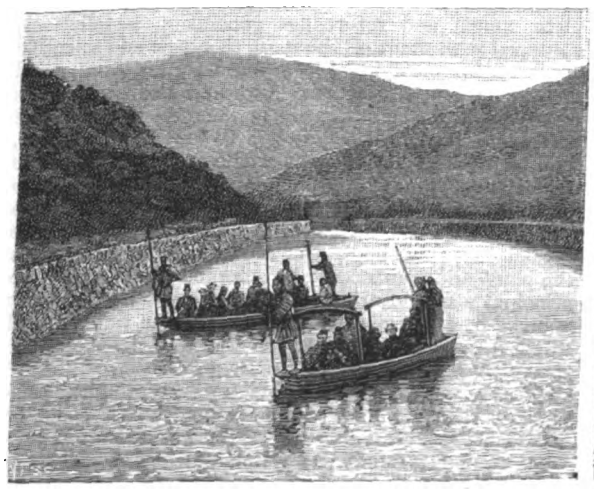


Fig. 1.—Entrance to the Canal from Lake Biwa.

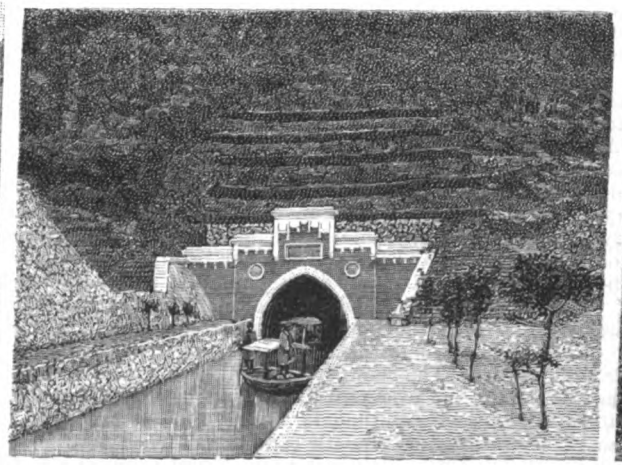


Fig. 2.—Entrance to No. 1 Tunnel.

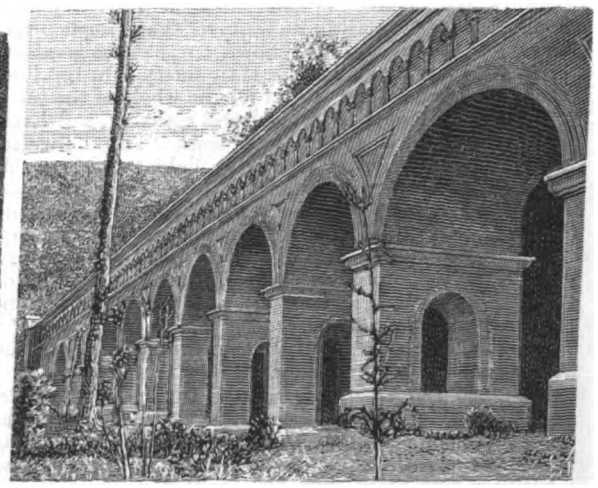


Fig. 3.—Aqueduct Carrying Canal across a Valley

THE KIOTO CANAL, JAPAN.

Early last year (see *Industries*, Vol. VIII., page 80) we published a map showing the district between Lake Biwa and Kioto, and the line of the Kioto Canal, together with a general description of the undertaking. Since that time the construction of the canal, which has occupied almost five years, has been completed, and we are now enabled to give three views of the completed canal, for which we are indebted to our contemporary, *La Nature*. Fig. 1 shows the entrance to the canal at the extremity of Lake Biwa. This entrance to the canal was formed by reclaiming about 1,000ft. of the lake, and forming a breakwater to protect it and ensure still water.

The canal, which has a length of 6⅜ miles, has to pass through several ranges of mountains, and this is effected by means of three tunnels, the length of which are 2,680, 137, and 934 yards respectively. These tunnels are of the section shown in Fig. 2, and have a breadth of 16ft. and a height of 14ft. They are lined throughout with masonry. Fig. 2 shows the entrance to No. 1 tunnel, and is the second longest in Japan. At a distance of about 5¼ miles from Lake Biwa the canal is divided into two portions, one joining the River Kamagawa, and the other leading northwards to Kogawa, the northern extremity of the city of Kioto. The second portion of the canal, after passing through a tunnel 150 yards long, crosses the valley of the Imperial Tombs by a handsome aqueduct, which we show in Fig. 3. This aqueduct is 300ft. long and consists of fourteen arches. For a more detailed description of this canal we would refer our readers to the former description given in *Industries*.

THE PROGRESS OF ELECTRICAL ENGINEERING IN 1890.

II.

(*Concluded from page* 41.)

The various dynamo makers have been very busy supplying plant for stations at home and abroad.

The Brush Electrical Engineering Company have been turning out large numbers of Mordey alternate current machines. Their works at Belvedere Road have been fully occupied, and the Falcon Ironworks, of Loughborough, are also in full swing making engines, tramway carriages, and everything connected with electrical engineering, as well as with the original province of the business before it was taken over by the Brush Company.

Messrs. Siemens have been supplying numerous large drum armature machines for station work. Some of these, such as those recently supplied to the St. James's and Pall Mall Station at Mason's Yard, are particularly fine machines. These have air ventilation through the bodies of the commutators.

Messrs. Crompton & Co. have been confining their attention to direct current dynamos. They have supplied several large machines to many of the London electric light companies and a large four-pole machine for smelting work. This firm have, as is well known, a private electric power station for lighting the town of Chelmsford. There are two systems in use, one with alternate current parallel supply and transformers, and a high tension direct current for series arc lamps. Messrs. Crompton & Co. also fitted up a tramway along Southend Pier within a month from the date of order, which is decidedly quick work. The Crompton-Howell battery has been making great strides, and has succeeded beyond the expectations of the most sanguine.

Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, have been kept extremely busy, their output in dynamos being about double that of any previous year. They have sold during the past year 152 dynamos, having an average output at usual speeds of 18,000 watts each, or a complete output of nearly three million watts. The demand for these machines has increased so rapidly that, although the works have been doubled in size during the year, the firm have been obliged to decline some urgent orders. Messrs. J. H. Holmes & Co. have, in addition to supplying other electrical engineers with dynamos, completed sixty-six installations of electric light in mills, factories, residences, and steamships.

Messrs. Johnson & Phillips have turned out a large number of dynamos both for continuous and for alternating currents. Among the former have been machines for the Duke of Northumberland, the General Post Office, Birmingham, the National Museum and Libraries, Dublin, Madame Tussaud's Exhibition; whilst among the latter may be mentioned complete sets for the Hong Kong Central Station, a machine for the extension of Keswick Central Station, and several others which have been exported to the Continent. Eleven sets of the Kapp central station continuous current dynamos are in various stages of erection for St. Pancras, and will be delivered early this year. The accumulator and vulcanised rubber cable departments have been kept full of work, and extensions have been found necessary to both. The business in the Brockie-Pell arc lamp department has been highly satisfactory, and shows a very large increase over the previous year.

Messrs. Laurence, Scott, & Co., of Norwich, have been well supplied with orders for dynamos and motors, and among others nearing completion is a large dynamo to generate 2,500 amperes, to be used in the reduction of aluminium, also a 40 unit continuous current transformer just completed for the Chelsea Electricity Supply Company, and a large 600 lighter dynamo for Messrs. J. & J. Colman, of their city. They have within the last few months introduced a specially-wound accumulator dynamo that will charge cells and supply constant e.m.f. to lamp mains independently or at the same time. These are said to work well. They have also worked out a meter which is soon to be on the market. Their installation department has also been kept fully employed.

Messrs. Paterson & Cooper have been supplying large numbers of dynamos for installation work, their output being greater than in any previous year. They have also worked out an alternate current arc lamp of which reports are favourable. Though most of their dynamos are supplied to contractors, they have themselves carried out several important installations.

Messrs. Royce & Co. have slightly more than doubled their plant during the past year, and have been running night and day. They have supplied many machines for ship lighting and colliery work, and for private installations.

Messrs. C. A. Parsons & Co. have during last year turned out plant of no less than 1,400 electrical horse-power, consisting of direct and alternating current dynamos, and their well-known turbine electric generators.

Messrs. Browett, Lindley, & Co. have been extremely busy with engines for electric lighting, and among these were five pairs of 100 h.p. compound condensing engines for lighting a large city abroad, as well as about forty other installations of electric light, many of them for ship-lighting. The business has been turned into a limited liability company, to enable the proprietors to extend their facilities for production, as they have for a long time had more orders offered than they could accept, chiefly for electric lighting.

Messrs. Ransomes, Sims, & Jefferies have supplied a number of engines for various private installations, and have also made a 30 h.p. compound engine for Fareham, as already mentioned. One of this firm's long-stroke 10-horse engines was employed for driving the exhibit of Messrs. Norman & Son at the recent Edinburgh Exhibition. They have also done a considerable export trade in engines for India and elsewhere.

Messrs. Robey & Son have had an increased business in electric light engines for ship, private, and central station work. They now make their well-known triple-expansion Corliss engines up to 1,000 h.p.; 200 or 300 h.p. is, however, the favourite size, and these smaller engines are to be seen in the Newcastle Central Station and elsewhere.

Messrs. Tangye have supplied numerous engines for station and ship lighting. They make a fast-running vertical engine, which meets with considerable favour for direct driving.

Installation Work.

There has been great pressure in the wiring of houses during the last year, as so many companies are growing rapidly, and the increase of customers has been very great.

Messrs. Drake & Gorham have been busily employed in installing isolated plants. For instance, they have put electric light plant in the new police buildings, capable of supplying 1,500 lamps of 16 c.p. They have also lighted Madame Tussaud's. A gas engine and Kapp dynamo were used. The foundations present some novelty in the way they are arranged to prevent any noise from the gas engines. They have also carried out some twenty private installations.

Messrs. Paterson & Cooper have carried out a large number of ship-lighting installations. Amongst the vessels have been the "Peruvian," "Brazilian," and "Parisian," belonging to the Allan Line; the "City of Vienna," the "City of Venice," the "City of Perth," and "City of Dundee," for the City Line; and the "Arranmore" and "Tuska," for the Clyde Shipping Company. They have now in hand the lighting of the "St. Nicholas" and "St. Dunmow," the "America," and the new boats for the Manchester, Sheffield, and Lincolnshire Railway Company.

The Liverpool Electric Supply Company have fitted up a very large number of lights for private installations, and have equipped several ships, one of the most important being the White Star steamer "Majestic," which has about twelve hundred 16 candle-lamps, with four combined sets of engines and dynamos, each capable of supplying 400 lamps at one time.

Messrs. Woodhouse & Rawson have been very busy. In the Yorkshire district alone forty-two installations have been carried out by their Bradford branch. In the Lancashire district they have also been very busy. In London they have done work for the Savoy Mansions, Crosse & Blackwell, Clowes & Sons, Smith & Sons, and many other well-known firms.

General Work.

Messrs. Spagnoletti & Crookes have done a large business, consisting of the manufacture of railway, telegraph,

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and block instruments, and general railway appliances, together with many sets of C. E. Spagnoletti's patent electric locking block apparatus. This system has been employed on the Metropolitan, Great Western, and other railways, and has recently been fitted upon the City and South London Electrical Railway, so that people may travel on this line with the knowledge that the greatest precaution has been taken for their safety. On this line they also secured the contract for the whole of the telegraph arrangements, both block and speaking, and have had the greatest success with the work. They have also made a great quantity of electric light requisites. A considerable amount of work has been done for the trade in railway instruments, fire alarms, &c. Many thousands of battery cells have been made in their factory during the past year, and this trade seems to be a very increasing one. They have manufactured a fair share of ship-lighting plant, and supplied measuring and test instruments for cable work.

Messrs. Sharp & Kent, Woodhouse & Rawson, the Electrical Fittings Company, the General Electrical Company, and the various firms who supply instruments, switch boards, lamp fittings, lamps, carbons, and all the thousand and one accessories, have been busy trying to keep pace with the demand. On the whole, last year has been very prosperous, and there is a general feeling that this year will be even more so.

Messrs. Berend & Co. have been doing a large business in the various measuring instruments made by Messrs. Hartmann & Braun. The demand for these is very rapidly increasing. These instruments are all carefully designed to meet the actual requirements of electric light engineers. They also find increase of business in enamelled reflectors and the numerous electric requisites which they import from Germany.

Messrs. Woodhouse & Rawson have been developing rapidly. They have purchased a large engineering works at Kidsgrove, near Stoke-on-Trent, for boilers, large dynamos, cranes, &c. They have also taken over the launch-building business of Mr. W. S. Sargent, of Chiswick. There they have built several of the best electric launches. Their supply department has also been kept exceedingly busy, providing every conceivable article needed by engineers.

Messrs. Goolden & Co. have supplied Messrs. Sharp & Kent with 160 h.p. dynamos, engines, boilers, &c., and eight underground mains to the Houses of Parliament. They only had three weeks to complete this order, and did so with success. They have also supplied dynamos to the Westminster Company, as already mentioned, and boilers for the St. John's Wharf Station. They have also large orders in hand for Brighton and elsewhere. Messrs. Sharp & Kent are contractors for these.

The General Electric Power and Traction Company have for their main object electric traction and general power work, but they in no wise confine themselves to these branches. Mining work has been exceptionally brisk, and installations have been erected in England, Wales, Scotland, the Continent, Asia, Africa, and Australia. Without going into details, it may be mentioned that almost the whole range of mining work has been successfully accomplished by the "Immisch" plants, winding, hauling, pumping, fan driving, rock drilling, &c., having been carried out in different pits, and in nearly all cases the plants have been arranged on the compound parallel system so as to be adapted for both lighting and power. The aggregate horse-power supplied during 1890 in dynamos and motors for this purpose is very nearly 1,000. During the past summer the company had launches both on the Thames and on the Union Canal at Edinburgh during the late Exhibition. The total number of passengers carried at Edinburgh was 100,000, and the result commercially was thoroughly satisfactory. On the Thames some twelve launches were kept for hire, and, although the season was a bad one, they were patronised by the public to a large extent. The general work of the company during 1890 was far in excess of that of the previous year, and shows a large increaes in the demand for motors suitable for central stations, and motors for special machine tools have been in fair demand.

THE LONDON SMOKE AND FOG PLAGUE:

ITS ORIGIN AND DANGERS, AND A PROPOSED SOLUTION FOR ITS REMEDY.

By B. H. Thwaite, C.E., F.C.S., A.M.Inst.C.E.

II.

(*Concluded from page 42.*)

Year by year the fertilising value of our coal resources is lost to the nation. This loss is enormous and deplorable, and if the familiar adage that "wilful waste makes woeful want" is applicable to nations, our future will be woeful indeed. The nitrogen in its compound form as ammonia sulphate is extremely valuable to agriculturists, but, in flagrant violation of the great natural order of the conservation of energy, tens of thousands of tons of this fertilising agent are annually thrown into the atmosphere of London whilst we ransack Chili and Peru for the mineral substitute. The annual value of the mineral sodio-nitrate imported for the fertilisation of our soil may be taken to equal 650,000 tons, of the value of 6½ millions sterling. Doubless much of this is re-exported to the Continent and elsewhere. But if, instead of this agent being imported, we abstracted the nitrogenous treasures of our coal deposits, a great part of this 6½ millions sterling would be saved. Even were the nitrates recovered from the twelve million tons of coal used annually in London, this would be almost equal to half the amount of the foreign nitrates imported. It may be taken as a fair ratio that there is recovered from 16 tons of coal one ton of ammonia sulphate, so that the London coal consumption carries with it at present the burden of a national loss of 750,000 tons of fertilising agents, less that recovered by the gas companies. The manurial value of this artificial fertiliser recovered from coal was proved by the remarkable Rothamstead experiments. They showed that under fairly satisfactory climatic conditions the artificial fertilisers (ammonia salts) are capable of giving a much larger crop, both of grain and straw, than the farmyard manure.

Besides the nitrogenous loss there are the recoverable tar compounds, which possess—thanks to the discovery of our chemist Perkins—valuable constituents. The weight of tar lost by the annual London coal consumption, deducting coal used by the gas companies, may be estimated to equal 400,000 tons, of an approximate value of £400,000.

The weight of fuel lost in transmission by rail and by sea would not be over-estimated at ½ per cent. of the weight, or 60,000 tons, equivalent to a money loss of £45,000. It is impossible to estimate the wear and tear of the rolling stock in carrying coals, but it is very considerable, as the trucks have to travel both loaded and empty. The cost of carrying the twelve million tons of coal to London by rail and by sea is, however, not great. It may here be stated that the rate for railway carriage of coals fixed by Parliament is so low that, taking into account the double journeys to be performed, the profit on this class of goods cannot be very great; indeed, in the instance of the Great Western Railway, the carriage of coal is said to involve a positive loss of 0·4d. per ton per mile. The charge for carriage may be reckoned at 0·838d. Taking the average distance over which the coal has to be transmitted to be 100 miles, then the amount paid for railway carriage of coal to London equals £2,780,000.

By sea the annual cost of shipment of the 4,000,000 tons assumed to be carried at the rate of 7s. per ton, and with a cost of 5d. per ton unloading, will equal £1,566,000. The cost of shipment is great because, as in the case of transport by rail, great wear and tear are involved, and the cost has, in both instances, to cover the expense of the return journey.

If we attempt to calculate the profits of the various merchants, middlemen, and carters, adding 3s. per ton for the former and 2s. 6d. per ton for the latter, the cost of the 8,000,000 tons used, in addition to the 4,000,000 tons used by the gas companies, would be equal to £2,200,000.

We can now approximately estimate the expense of merely transmitting the twelve million tons of coals to the inhabitions of the London metropolis. It reaches the colossal figure of £6,591,000 annually. If to this we add the value of the nitrogenous and tar or hydrocarbon constituents of the coal now wasted, the total expands to £9,535,400.

The Solution.

The solution of the problem is to supply London with gas generated in the coalfields of South Wales, South Yorkshire, and Staffordshire.

A great part of the enormous annual expenditure in bringing coals to London would be saved by carrying out in its entirety the project first suggested in the author's lectures at Sheffield, Manchester, and Halifax, on the subject of "Gaseous Fuel." This project is an adequate imitation of the natural gas system of distribution in use in Pennsylvania and Ohio. The gas issuing from the natural gas wells at pressures equal to 500lb. to the square inch, is led by pipes to distances of 70 miles from the place of production—indeed, the mains for supplying this gas for industrial and domestic purposes exceed 2,000 miles in length. The advantage of gas for all purposes where heat is required is fully appreciated in the area of the natural gas distribution, and its displacement of solid fuel or coal in Pittsburgh has transformed the atmosphere of this industrial centre. That there should be no difficulty in distributing the gas will be evident from the fact that in London alone there are 4,000 miles of gas mains.

Instead of the natural gas, which the author has reason to believe may yet be discovered in England, it is proposed to erect on the coalfields, in a central position, in South Yorkshire, Staffordshire, and South Wales (as shown on the map given on page 67), complete cupola and retort gas generating installations, equipped with plant of the most economic and scientific character for purifying the gas and for recovering and treating the hydrocarbons (tar) and the nitrogenous constituents. The gas would be compressed by special machinery into storage cylinders to very high pressures, and from these cylinders it would be supplied to the steel trunk mains of suitable capacity and strength to lead the gas without loss to the Metropolis. In the first instance, the mains would be only of adequate capacity to fully supply the Metropolis, but afterwards the plant and mains could be enlarged so as to feed the principal manufacturing centres traversed by the trunk mains. The velocity with which the gas would travel would depend upon the sectional area of the mains, but the velocity would not exceed 4ft. per second.

All the proved arrangements for regulating the pressure of the supply in use in Pennsylvania could be adopted. The arrangements of the gas generator, purification, and residual extraction stations would be as follows:—

On an appropriate accessible and central position in the Yorkshire coal fields a plant would be erected capable of converting 3,000,000 tons of coal per annum for lighting purposes, and 1,500,000 tons of coke and 2,500,000 tons of coal per annum for heating and industrial purposes. On the Staffordshire coalfield, appropriately situated and connected with the main trunk line of pipes, there would be constructed a fuel or heating cupola gas generating plant capable of dealing with 4,000,000 tons of coal per annum. In a central position in the South Wales coalfield, and within a short distance from a petroleum storage plant, which would be placed in such a position that the oil could be run direct from tank steamers, there would be erected an enriched water gas generating plant, using the Welsh anthracite for this purpose, and crude American or Russian petroleum oil. This gas would be enriched sufficiently to raise the gas from the Yorkshire station to the required photometric standard.

The main trunk line for leading the illuminating gas from Yorkshire would be joined to the South Wales trunk pipe somewhere in the neighbourhood of Coventry. In the distance between this position and the Metropolis the enriched South Wales gas would be diffused with the poorer illuminating gas generated at the Yorkshire station.

Near the Metropolis, containers would be provided for storing the fuel gas at carefully selected positions, by which the heating gas could be distributed where required in separate and high-pressure mains. The existing gas holders could be utilised for storing the illuminating gas. In all industrial operations, where coke is required for manufacturing and industrial operations, cheap heating gas could be provided, which would be equal to, if not much superior, to coke. For all domestic purposes—for heating and cooking, and for gas engines, &c.—the use of a cheap fuel gas would be a priceless boon; it would relieve the household of one of its most trying difficulties, and command the gratitude of the housewife, whilst it would give the workman facilities for obtaining cheap power that might convert his struggling life into a prosperous one. In fact, the abundant supply of cheap fuel gas would mean a saving, in hard cash, of nearly ten millions sterling a year, and convert this city of smoke and fog, after a few years, into one of the most magnificent cities in the universe in point of architectural grandeur.

Then, as to its hygienic advantages, the system would destroy the edge of the scythe of King Death in his costume of fog and smoke, and instead of the London citizen hurrying off to the Riviera and expending his wealth to support foreigners, he would stay at home. Apart from the one great blot of smoke, the sanitary arrangements of London are very good, and better than those of any Continental city.

What will the Project Cost?

The following is an estimate that will give a sufficiently approximative idea of the cost of the project. It will probably be found to be rather over than under the mark:—

Yorkshire installation	.....	£4,400,000
Staffordshire „	.....	3,140,000
South Wales „	.....	2,140,000

The total cost of the plant for dealing with twelve million tons of fuel per annum would, therefore, not exceed £9,680,000.

The cost of the main trunk lines and metropolitan distributing pipes is more difficult to estimate. It is approximated as follows:—

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Land	£1,500,000
Two sets of trunk lines	1,112,500
Metropolitan distributing lines	1,612,500
The total cost would therefore equal	£4,225,000

Some idea of the magnitude of the existing London and suburban gas companies may be obtained from a consideration of the following salient and startling statistics.

The capital actually invested amounts to close on £17,000,000 sterling, of which nearly £15,000,000 sterling represents the capital invested in the Metropolitan companies. The annual income of these companies amounts to about 5,000,000 sterling, of which £1,500,000 represent net profits. Assuming these companies were brought out at the market value of to-day, taking into consideration the increasing development of electric lighting, the price paid would probably reach £30,000,000 sterling. The purifying and retort and residual recovery plant could be bodily removed to the new coalfield generating stations, which would mean a reduction in the cost of generating installations of at least £2,000,000 sterling.

The actual expense of the scheme can now be fairly realised, and stands as under :—

Amount payable for the Metropolitan gas undertakings	£30,000,000
Cost of coalfield generator installation, less £2,000,000 for present or existing plant	7,680,000
Cost of main trunk lines land, and Metropolitan distributing mains	4,225,000
The total cost of undertakings will therefore amount to	41,905,000

It was calculated that the annual and avoidable cost to the dwellers in the Metropolis of the present system of coal consumption equalled £9,535,400. If this annual amount was equally divided between the corporation that carried out the project proposed and the London County Council or the consumers, as might be decided, the remaining £4,767,700 would alone enable our interest to be paid on the capital expended. To enable the scheme to be easily accomplished, the shareholders in the existing gas companies might be given the preference in the coalfield gas scheme.

Although the amount required appears to be a very liberal one, it is a mere fraction of the capital that has been expended in the trunk railway lines connecting the Metropolis with the North, and it scarcely bears comparison with the capital that has been rapidly raised in the City for loans to untrustworthy foreign Governments.

It is a scheme that deserves the serious attention of all those who love London, and of all those who realise the enormous enterprise by which this modern Babylon, this wonder of the world, has been raised stone by stone, inch by inch, until it gathers and rears under its walls a population equal to that of Scotland and of Wales put together.

An Alternative Scheme.

If the project were carried out independently of the existing gas companies, leaving to the latter the distribution of the lighting gas, and as much heating gas as they chose to supply, the expense of the project would be much reduced, as it would not be burdened with the £30,000,000 sterling necessary to buy up all the interests of the existing gas companies.

Besides, this alternative scheme would not interfere with the existing demand for the four to five million tons of Durham seaborne coal—which is principally converted into gas at the London gas works—and the carriage of which by sea is cheaper than by rail.

The cost of this alternative project to deal with 8,000,000 tons of coal, would be made up as follows :—

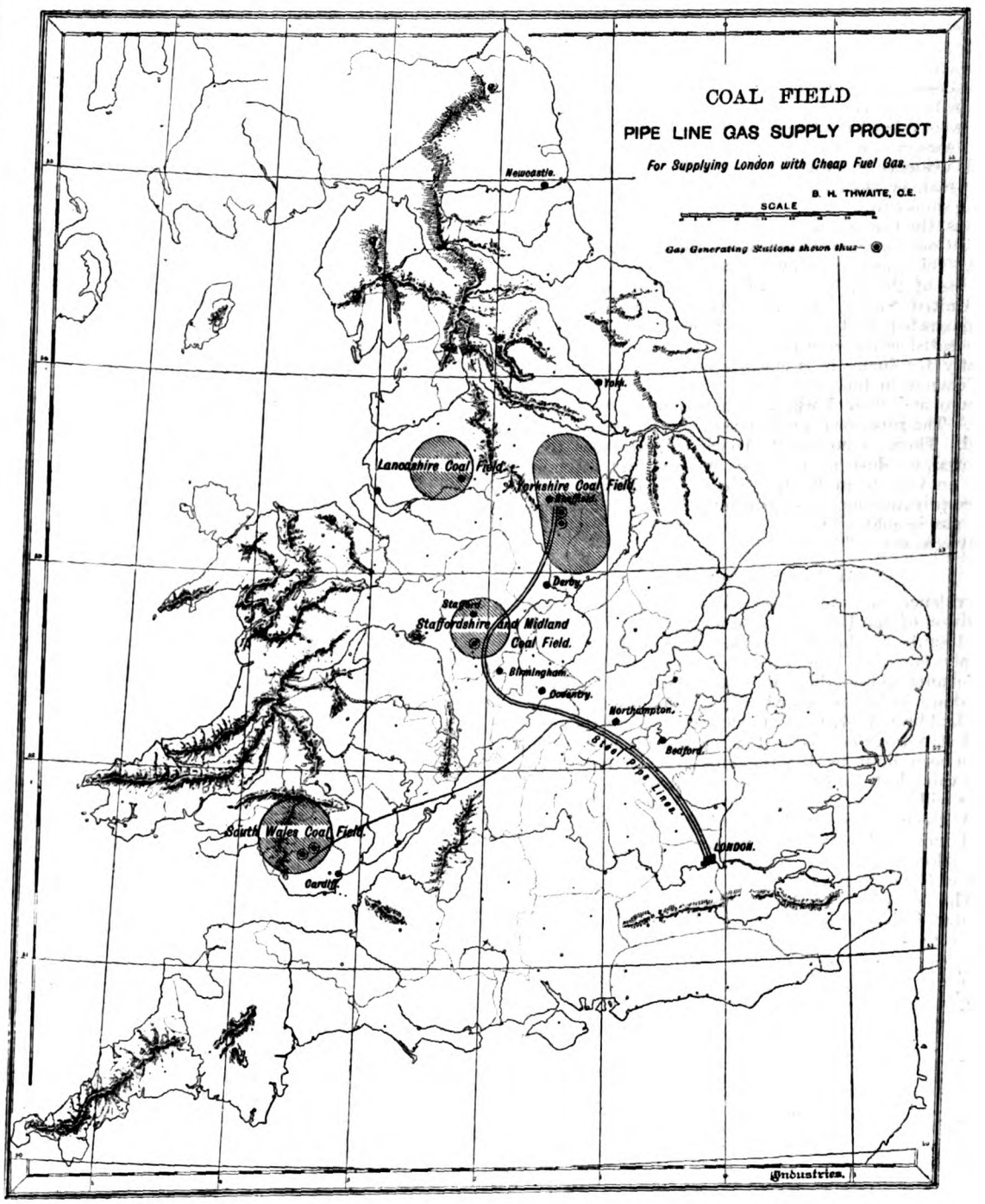
Yorkshire installation		£3,270,000
Midland and Staffordshire installation		1,670,000
South Wales installation		1,425,000
Distributing system, land	£1,500,000	
Two sets of trunk lines	1,112,000	
Metropolitan distributing lines	1,600,000	
		4,212,500
		£10,577,500

The cost of the project would therefore approach 10¾ millions sterling. When this is compared with the 26 millions expended in London improvements since 1856, and with the 15 millions sterling expended on existing London gas plants and distributing mains, it does not appear such a serious obstacle.

The saving in carriage by rail alone would equal £2,780,000. The value absorbed by merchants, carters, and middlemen may be estimated at £2,200,000. The value of the nitrogenous and hydrocarbon residuals may be taken at £1,975,000. The total saving, therefore, equals £6,955,000.

This annual saving would, therefore, more than equal, in two years from the time of completion, the entire cost of the project.

No doubt a revolutionary project of this character will meet with the usual opposition of vested interests. It is stated that many millions sterling are invested in rolling stock—rail and roadway—for the transmission of the coal, which, when once converted into a gaseous condition, will flow like water from its source of emission from the earth to the place of use, and in its gaseous condition—as proved by the experience of the enviable inhabitants of Pennsylvania—it is most advantageous, whether on hygienic or economic grounds. It enables the maximum heat efficiency of the fuel to be obtained, and in such a manner as to be in harmony with the laws of Nature, and were the scheme once carried out London would be adequately provided with a supply of fuel suitable for generating heat and power, without involving an accompaniment of the black demon, smoke.



APPENDIX.

Since the foregoing pages were written, London has been visited with a fog of almost incomparable density, and for weeks trade and industry have been harassed, and the fog has involved the production of untold misery on thousands of poor people. The shopkeepers in the West End have been great financial losers, the shipping trade and railway and 'bus traffic have been dislocated, and the street casualties have been increased. Altogether the fog has been the cause of misery to an untold number of people, whilst the mortality increase is represented by a death-rate during every week the fog lasted of nearly 300 persons more than the average.

In an article on this, last February, the *Lancet* remarks :—

"In considering these gloomy winter clouds, one primary idea which commonly presents itself is that of smoke. Our tingling eyes and our offended sense of smell alike protest against this contact of carbonaceous matter out of place. Analysis confirms the sensible fact. Surely among so much that is foul, though greatly diluted, there is also the means of mischief. There is no question as to the injury to health, fatal too often, which the fog annually brings."

A famous London correspondent writes as follows :—

"From morning to night many millions of people had to breathe as best they could an atmosphere that seemed to be composed of frozen particles of soot and sulphur. Only those who passed the long hours of the dark days in the midst of the terrible fog can realise the suffering which it brought with it. In the streets, in the omnibuses, in the railway carriages, the people seemed to be positively benumbed by the dreadful visitation. They cowered together in speechless misery. Existence itself was painful. No wrappings could keep out the fog, and many hundreds of people were poisoned by it, as certainly as though they had drunk prussic acid or a solution of arsenic."

Another of the journalistic craft writes :—

"Everybody is railing or swearing at or sighing over the fiendish fog that has kept London in its grip during the last fortnight ; the thick darkness has reached a climax ; the trains as they pass across the bridges are exact representations of Mirzah's vision on the hills above Bagdad as they emerge from a mysterious misty region. The palatial halls of the West End are utterly

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deserted. In one of the largest and best known drapers shops in the West End the attendants complain that 'business is at a standstill, and the season's trade is practically lost.' The flower, confectionery, and jewellery trades are also great sufferers by the fogs. It drives the tradespeople to depair, and every where one refrain is repeated — 'The fog is disastrous—ruinous.' The three weeks' fog has done more harm to the tradesmen than a season of industrial depression."

This evidence is valuable as showing in a more adequate manner the enormous loss to Londoners entailed by the smoky fog.

"Gas, the Coming King," is the headline of the *Pitsburgh Commoner*, of December 20th, 1890, recently to hand. This paper gives a very interesting account of the progress of the application of gas for fuel purposes in the United States. It states that—"Experience has demonstrated that coal manufactured into gas gives more satisfactory results than when the coal is used directly for fuel. It is cheaper and more convenient. The change in fuel amounts to a revolution in Boston, Chicago, and New York, and bids fair to do so even here. The superior convenience of gas is readily recognised. There is no coal to be carried, no ashes to be removed, no dust, no noise in building and attending fires, no trouble in lighting them. In Boston, Mass., where private companies furnish the gas, especially cheap fuel gas is sold. Every day sees the carting away of many coal stores."

The London Coal Dues.

Evidence has lately been adduced to prove* that the abolition of the London coal dues has not benefited the inhabitants of the Metropolis, but that the dues have simply fallen or been diverted into the pockets of the merchants and middlemen. The value of these dues to London may be realised when it is stated that, including the building of St. Paul's Cathedral, most of the important structures erected in London since the fire of 1666 have been built by the amounts levied as dues on coal. The value lost to London by the abolition of the coal dues will thus be realised.

By the carrying out of the project outlined the London coal dues would not be lost to Londoners. This advantage alone is a strong argument in favour of the carrying out of the project suggested.

The following is a brief summary of the salient advantages that would follow the carrying out of the project:—

1. The saving of the cost of railway carriage.
2. The saving of the cost of cartage.
3. The saving of the middlemen's profits.
4. The recovery of the valuable nitrogenous and hydrocarbon constituents.
5. Avoidance of loss of coal in transit.
6. Reduction of loss of heat value of coal by exposure to the weather.
7. No labour required in clearing away ashes.
8. Prevention of smoke, and with it the obnoxious characteristics of the London fog.

The carrying out of the project would require six years. By that time London would probably be lighted by electricity, so that the city would be transformed from one of the dirtiest to one of the cleanest cities in the universe.

Notes.

THE INSTITUTION OF NAVAL ARCHITECTS.

In order to encourage the preparation of papers for the Institution, the Council of the Institution of Naval Architects has decided to present a gold medal to any member or associate of the Institution, not being a member of Council, who shall at the forthcoming spring meetings read a paper which, in the judgment of the Council, shall be deemed of exceptional merit. It is to be hoped that this arrangement will help to draw some good papers, as we understand the Council has for some time had some difficulty in obtaining the necessary supply. The ordinary dates for the annual meetings will fall on the 18th, 19th, and 20th of March.

RAILWAYS IN PORTUGUESE WEST AFRICA.

According to an official report the three first sections of railway, from Loanda to Cassoneca, of 88 miles, have been completed and are in actual use. Including the termini there are in all nine stations, and the average rate of running is 12 miles an hour. According to the report, the other sections, which are ultimately intended to join Loanda with the Zambesi, are being actively pushed forward, hundreds of labourers being at work upon them, under the superintendence of Portuguese engineers. Of the fourth section, 25 miles, the embankments and cuttings have been completed. The work on the fifth section of 25 miles is being carried out at twelve different parts by an army of workmen. Work has also been begun on the sixth and seventh sections, and if all this zeal is maintained without flagging there ought by the end of the year to be 180 miles of railway in running order from Loanda towards the interior. There are, we understand, about 3,000 natives employed on the line.

* Report of the Corporation of London Corn, Coal, and Finance Committee, December, 1890.

GENEROUS ACTION OF A JAPANESE SHIPPING COMPANY.

As an argument for Mr. Plimsoll, we cite the following from the *Japan Gazette*:—"The Directors of the Nippon Yusen Kaisha, the largest shipping firm in Japan, have acted very generously towards Mrs. Frahm, widow of the captain, and the other relatives of those foreigners who went down with the steamer 'Musashi-maru.' Mrs. Frahm has been voted the sum of $2,000, and the rest varying amounts." This, the *Japan Gazette* remarks, "does not bring back the dead, but it is a recognition that may in some measure soften sorrow and an instance of substantial and voluntary generosity."

THE MELBOURNE CENTENNIAL EXHIBITION.

The balance sheet of this Exhibition has at last been published. The total receipts from all sources (except, of course, the Government) were £100,241 16s., and the gross cost was £338,026 10s. 8d. Therefore the bill the Victorian Government had to pay amounted to £237,784 14s. 8d. The total cost of the temporary annexes was £125,177 16s. 7d., and they realised only £14,886 10s. 1d. More than £46,000 was spent in alterations and decorations to the permanent buildings. The electric light cost £77,000, and the plant sold realised about £21,000, while gas and gas fittings cost over £8,000. The orchestra and chorus cost over £28,000, and the receipts for admission were just over £9,000. Medals and certificates cost under £7,000.

THE "ELECTROCUTION" OF INSECTS.

A kind of moth or butterfly is said to have become so troublesome and destructive in a forest in Bavaria, that it was necessary to destroy it. Children were employed to collect the caterpillars, and were paid so much per bucketful. This was found expensive and ineffective, so enormous fly papers were tried. These also had no appreciable result. Finally, it is said, that an electric search light in connection with a blowing fan was designed. The insects are attracted by the light and fly near the lantern; they are then drawn into the suction pipe by the air draught, and carried to a sort of mill, which mixes them with a little flour. The resulting compound is then used, we understand, for poultry food.

THE GERMAN SPIRIT TRADE.

Potato spirit forms an important article of German commerce, but the trade is not as flourishing as it used to be. An official report from Dantzig states that the trade in spirits is much hampered by the duty law of 1887, and a general shrinkage of business has taken place since that year. The potato crop in the province of West Prussia in 1888 was a bad one, causing a smaller production of potato spirit in 1889 than in the preceding year. The foreign markets opened unfavourably in the year, and Dantzig's best customer, Spain, is deserting it, the export to that country in 1889 being only about a fifth of what it was four years ago. The new spirit duties imposed in Spain benefited the home production in that country, but did not fill the Spanish treasury, as they were expected to do. After the understanding come to by the German and Spanish Governments with regard to spirits, the export to Spain revived again, but speculative transactions have led to loss.

DOCKING ACCOMMODATION AT NAGASAKI.

The want of good docking accommodation in China and Japan has hitherto been one of the greatest difficulties the owners of large steamers trading to those countries have had to contend with. Now, however, we learn that good accommodation is to be had at Nagasaki, Japan, in the docks belonging to the Mitsui Bishi Company. Recently the British steamer "Afghan" was taken into the docks and scraped, dried by means of torches, given two coats of anti-fouling paint, and made ready for floating out again within ten hours of entering the dock gate. In order to form some idea of the amount of work involved in these operations, it may be mentioned that the "Afghan" is 320ft. in length, and of 2,206 tons gross register. On coming out of dock she commenced to take in Takushima coal, and ten hours afterwards she was ready for sea with a full cargo of 2,818 tons on board, bound for Sydney. For vessels engaged in such a trade accommodation of this kind is of the greatest importance.

IMPROVED POSTAL ARRANGEMENTS.

With the New Year commenced a large reduction in the postal rate to India and the colonies, a boon which will be of great advantage to our industry and commerce. In future a half-ounce letter will be carried for twopence halfpenny between this country and all the British possessions in India and the Eastern group of colonies—Australia, from New South Wales and Victoria down to Fiji and New Guinea, South Africa, the West Indies, and the West Coast of Africa. The relief extends to post-cards as well as letters so far as the Australian colonies are concerned, the rate being twopence instead of threepence, although it is difficult to see why the area for these should be restricted. Greater uniformity and a reduction of charges have also been introduced in the case of unstamped or insufficiently stamped letters. It is impossible to say how far the changes will affect the revenue of the Post Office, but that is sufficiently flourishing to allow of some reduction. It is probable, however, that the increase in the number of letters sent will compensate for the reduction of charges.

MANUFACTURE OF OXYGEN AND HYDROGEN BY ELECTROLYSIS.

At a recent meeting of the Société de Physique Commandant Renard made a most interesting communication relative to the electrolytic production of oxygen and hydrogen for commercial use. Allowing a volt and a half as necessary, and allowing even an efficiency of 50 per cent., 144 c.c. of hydrogen can be produced per watt hour. This means 6,930 watt hours per cubic metre at 3d. per 1,000 watt hours, which makes the cost 1s. 9d. per cubic metre, or, roughly, 50s. per 1,000 cubic feet. This estimate assumes the oxygen to be waste. The two gases come out at 33s. per 1,000 cubic feet. All that is necessary to make the gases on a large scale is to use a large dynamo and large vats. No further experiment is necessary. M. Renard proposes to use caustic soda as electrolyte, as this admits of iron electrodes. Dilute acid would need platinum or lead plates, and lead plates take a high electromotive force to decompose water. Each plate is encased in a porous gas collector, so that the gases are kept separate. M. Renard has already used hydrogen prepared in this way for inflating balloons.

ELECTROSTATIC MEASURING INSTRUMENTS.

There would seem to be some kind of prejudice against the use of electrostatic measuring instruments. Generally, in an alternating current station, we find the high-pressure leads connected to transformers reducing to 100 volts or so, and a hot wire voltmeter employed to read by. The transformer takes, say, 30 watts, probably more, and the voltmeter another 30. This means 500 kilowatt hours per annum wasted. At 2½d. this comes to £5 a year, which is the interest on from £50 to £100. A laboratory electrometer was used in electric engineering by Joubert in 1881, and others have been used occasionally since by Professors Ayrton and Perry, Ryan and Monnier. Sir William Thomson has, however, introduced a number of electrostatic instruments, reading from 100 volts upwards, and engineers who use them do not revert to electromagnetic or hot wire voltmeters. Electrostatic instruments not only take no power, but have no temperature errors, and do not need corrections for frequency, and no doubt they will eventually be cheaper than other forms. They cannot well be used as ammeters, but it is rumoured—with what foundation we do not know—that Dr. Fleming will soon bring out an electrometer wattmeter. Of course, as shown by Professors Fitzgerald, Ayrton, and Perry, a quadrant electrometer can be used to measure power, but unless the fall of potential over the shunt resistance in the current circuit is small, difficulties arise. Probably the electrostatic wattmeter of the future will have a split needle.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

1st January, 1891.

1. Goad & Redman ..... Appliance for use in dyeing, &c., clothes.
3. Wood, W. ..... Apparatus for removing quarry "barings."
4. Pollock, J. F. M. ..... Hydraulic and other high-pressure valves.
6. Moore, J. T. ..... Variable speed gears.
9. Gehrling, J. F. C. ..... Machines for setting tubular rivets.
19. Syer, M. ..... Waste-preventing valve.
21. Reddaway, F. ..... Apparatus for stretching machine belting.
25. Knowles & Stephens ... Snow ploughs.
34. Robinson, T. N. ..... Wood-working machinery.
36. Pankhurst, J. F. ..... Steam ash ejectors. (16th June, 1890.)
42. Thom, J. ..... Steam boilers.
45. Dodd, W. ..... Boat-lowering apparatus.
46. Hornsteiner, R. ..... Cramp keys for securing wheels, pulleys, &c.
57. Granger & Dalby ..... Lace machines.
64. Reed, Smelt, & Ainley... Water taps.

2nd January, 1891.

69. Strudwick, H. ..... Railway fouling bar.
71. Parsons, C. A. ..... Steam boilers.
73. McFerran & Pirrie ..... Ring and traveller frames for spinning wet yarns.
74. Verreker & Yeates..... Starting gear for tramcars.
75. Letalle, L. ..... Loom for the manufacture of chenille.
84. Mayer, C. G. ..... Refrigerating apparatus.
85. Mayer, C. G. ..... Gas pumps.
108. Pinkney, C. W. ..... Hydrocarbon engines.

3rd January, 1891.

110. Carling, J. ..... Gas engines.
112. Williams, H. (of the Illuminating, Heating, and Power Gas Company, Ld.)..... Exhausters and blowers for gas or air.
113. Fey, W. A. ..... Lifting appliances.
120. Martin, J. T. ..... Tools for punching and cutting.
131. Pullman & Smith ..... Apparatus for treating hides or skins.
136. Bayly, J. P. ..... Pulley (*Magers*).
142. Bayly, J. P. ..... Car coupling (*Fish & Cole*).
148. Bayly, J. P. ..... Wood-working machine (*Burrell*).
147. Bayly, J. P. ..... Rotary engine (*Worley & Davis*).
148. Bayly, J. P. ..... Rivet-making machine (*Danks*).
151. Bayly, J. P. ..... Apparatus for cleaning boiler flues (*Smith*).
164. Horn, W. W. ..... Air brakes (*Guillemet*).
167. Popp, V. ..... Air pressure engines.

ELECTRICITY.

1st January, 1891.

12. Bennett & Hides ..... Terminals for telephones, &c.
40. Hookham, G. ..... Electricity meters.
49. Wensky, W. ..... Producing constant electric currents.

2nd January, 1891.

96. Bardot, E. ..... Printing telegraphic apparatus.
100. Johnson & Phillips ..... Suspension insulators for electrical conductors.
105. Haselwander, F. ..... Lightning arresters for electric conductors.

3rd January, 1891.

128. Lee, J. L. ..... Automatically regulating electric currents.

CHEMISTRY.

1st January, 1891.

37. Alzugaray, J. B. ..... Fluxes for use in treating metals, ores, &c.
44. Fewson, H. ..... Treatment of sewage.
59. Wilkinson, H. ..... Purification of oils and fats.

2nd January, 1891.

86. Bedford, C. S. ..... Process of dyeing on cotton.

MISCELLANEOUS.

1st January, 1891.

2. Lapage & Bruce ..... Steering compass.
5. Shapley, F. ..... Apparatus for mitigating the force of railway collisions.
15. Setten & Durward ..... Manufacture of compasses or dividers.
23. Spong, J. O. ..... Apparatus for obtaining chromatic illumination from gas.
24. McFerrand & Pirrie ... Winding wet spun yarns of flax, &c.
65. Jaques, J. ..... Ships' propellers.

3rd January, 1891.

109. Freemantle, G. ..... Pipes and tubes.
117. Noton, W. ..... Bolsters, bushes, and steps of ring spindles.
126. Gorse, F. W. ..... Split cotters or lynch pins.
157. Faber & Joseph ..... Railway chairs.
158. Faber & Joseph ..... Railway chair combined with fish plates.
165. Sailler, A. ..... Manufacture of metal plates hardened at one side.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1890.

179. Styles.
558. Wheeler.
1146. Drake & Gorham.
1685. Michaud.
1709. Heymann.
1807. Storey.
2268. Bartleet.
2356. De Haan & Jacobs.
2580. Lees.
2715. Cooper & Wigzell.
2763. Wise (*F. Mommer & Co.*).
2792. Spear.
2890. Wise (*Berger*).
2898. Read.
3179. Crowe & Massam.
3194. Hattersley & Hill.
3218. White.
3244. Bertham.
3259. Norman.
3274. Orr & Brown.
3285. Sayer.
3359. Cutlan.
3369. Cammell.
3418. Dean.
3497. Hampson & Bagnall.
3525. Schönheyder.
3693. Rhodes.
3726. Horn (*Morey*).
4849. Grenville.
5126. Cox & Gordon.
5242. Nield.
5762. Rocke & Prosser.
7601. Walsh.
9394. Chandler.
9679. Bayly (*Hall*).
11439. Kletzker.
12143. Prosser & Kenyon.
15154. Talbot.
15745. Cashin & Shanklin.
16152. Twigden.
16604. Sanders.
16739. Carter.
16741. Martinot.
16760. Thompson (*Mason*).
17249. Smith.
17734. Schleiff, Sen., Schleiff, Jun., & Ehmke.
18646. Thompson (*Lamp'l*).
18911. Arnold.
19058. Lührig & Cuninghame.
19159. Gingras.
19202. Johns.
19867. Haworth.
19407. Eade & Eade.
19440. Ford.
19457. Thompson (*Lankoff*).
19488. Gundlach.
19498. Debrue.
19570. Thompson (*Ettig*).
19624. Phelan.
19649. Almgren.
19671. Hopkins.
187. Voilin.
947. Urry.
1584. Ellershausen.
1708. Simmons & Tullidge.
1745. Malloch.
2262. Fairbairn & Jones.
2813. Milne.
2357. Davies & Eves.
2601. Heys (*Charpentier*).
2721. Fryer.
2774. Imray (*La Société Nouvelle des Raffineries de Sucre de St. Louis*).
2924. Brett & Hazlewood.
3186. Proctor.
3201. Jackson.
3243. Sanders.
3258. Marples & Lamburn.
3265. Ormerod, Davies, & Haythornthwaite.
3327. Ferguson.
3367. Bertini.
3377. Robinson.
3474. Kiddier, Kiddier, & Kiddier.
3629. Darrah.
3719. Harrison & Howard.
3732. Hopkinson.
4969. Scotson.
5155. The Clayton Aniline Company, Ld., & Hall.
8472. Trench.
9422. Lester.
10905. Piffard.
11831. Lester.
13788. Schott & Dobbs.
15695. Snell & Fletcher.
15752. Redfern (*Koepsel & Wentscher*).
16705. Van Sluys & Steffelaar.
16759. Simmons.
17084. Boulton.
17722. Wright.
17977. Smith.
18090. Boult (*Fussell*).
18491. Kennedy.
18800. Reaney, Parkes, Cole, Turner, & Turner.
19064. Goodwin.
19161. Albach.
19382. Smith & Course.
19406. Hartmann & Braun.
19422. Thompson. (20th June, 1890.)
19465. Webb.
19489. Ryland.
19521. Halls.
19587. Soxhlet.
19643. Marchetti.
19658. Boult (*Eastman*).
19687. Morrill.
19736. Hart.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Jacquard Machines.—*W. Hardaker, Great Horton, Bradford.*—This improvement consists in substituting for the ordinary "neck cord" a single or double wire for attaching the harness to the upright hooks of the machine. This wire has a loop formed at one end, which is passed over the bottom hook of the upright wire of the machine. The wire is then passed through the bottom board in the usual manner, and the lower end, on which a second loop is formed, is connected to the harness. It will thus be seen that by the use of the above arrangement the friction in the bottom board is much less than with the usual "neck cord," there is less wear and tear, and as the loop of the wire is closed on the neck of the harness, there is no risk of their catching each other. Claims: The use of a wire in place of the ordinary "neck cord" usually employed in jacquard machines in the manner and for the purpose set forth.—No. 2072. February 8th, 1890. 4*d*.

Process of Galvanising Tubes and Bars.—*T. L. Thomas & J. B. Hillman, both of Princes End, near Tipton, Staffordshire.*—According to this invention tubes, rods, and the like, after being immersed in the liquid zinc, are withdrawn and as quickly as possible passed between a pair of asbestos dies, so cleaning off all the superfluous metal and forming a smooth surface. The articles are then immediately dipped into cold water. The asbestos dies are fixed respectively to an upper and lower wood block, the latter of which is fixed to a frame or bracket, which is itself fixed to one end of the galvanising bath, and the former is carried by a lever or vertical slide, by which it can be raised or lowered to suit the diameter of the rod or tube. The dies are formed so as to, between them, embrace the entire circumference of the tube or bar, and the one die preferably overlaps the other to some extent at the base, when the dies are closed up, so as to avoid a gap at the joint between them. Six claims are made, embracing the process as described, together with the apparatus and various modifications thereof.—No. 8572. June 3rd, 1890. 8*d*.

Looms.—*J. & R. Lindsay, Dundee, Forfar, N.B.*—This patent has reference principally to the let-off mechanism of looms for weaving. Fig. 1 is a sectional plan, and Fig. 2 a sectional elevation, of that part of a loom showing the modifications according to this invention. A lever A, the upper end B of which touches the warps on the beam, is kept in contact with the warps by a weight C. This lever is fast on a rocking shaft D, as also is a toothed sector E which gears with a pinion F on a shaft G carrying at each end a specially shaped cam H which acts on a link I jointed to a radius lever J and connected to a rod K arranged to transmit the pressure from a weighted lever L to the

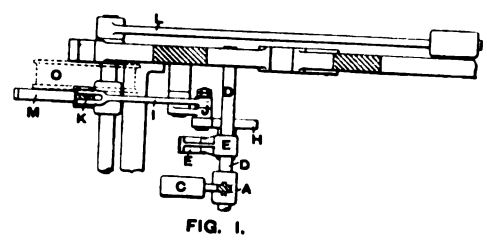


FIG. 1.

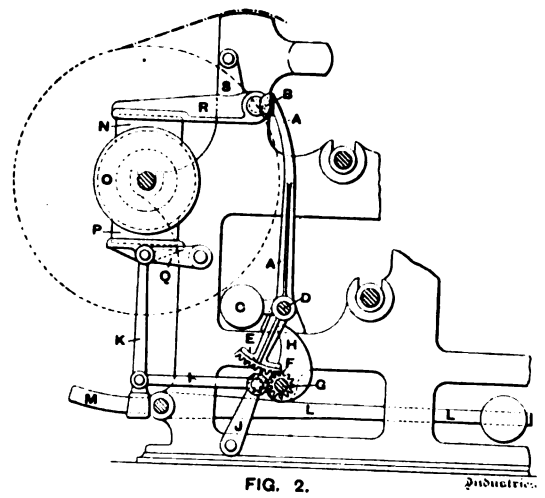


FIG. 2.

frictional appliance. The action of the cam H moves the rod K gradually further from the fulcrum of the lever L as the diameter of the warps on the beam diminishes, and thereby causes the effective pressure on the frictional appliance to be diminished in a manner to keep the tension of the warps practically uniform. The rod K has its lower end fitted to slide upon a curved arm M fixed on the rocking shaft carrying also the weighted lever L. An improved frictional appliance is used, consisting of a fixed brake block N, arranged with an elastic connection, above each friction pulley O, combined with a movable brake block P below, the latter being pressed upwards by L through arm M and rod K, which last has its upper end jointed to the brake block P. The upper end of the rod K is also connected to the framing by a radius link Q. The block N is held by an arm R centred on a stud fixed in the framing to allow of its being raised when placing or removing a warp beam, the arm being locked in position by means of a cod-piece S. To turn back the warp beam, the levers M being relieved, the blocks, beam, and pulleys O descend clear of the blocks N, and the beam rests in end journals in the bracket bearings of the loom framing so that it can be easily turned. Three claims are made, embracing the apparatus as described, with modifications.—No. 1916. February 5th, 1890. 8*d*.

Tubular Shafting.—*G. C. Marks, Birmingham.* (*G. H. Ogilvy, New York, U.S.A.*)—The process of forming tubular shafts embraced by this invention is as follows:—A bar of iron or steel of suitable length, breadth, and thickness is formed, by rolling or otherwise, into a half tube. The edges are then planed or machined until they make a level surface with each other, and at certain intervals along each edge are formed recesses by cutting away the metal below the level surface of the tube edges, so that these edges, when completed, consist of a series of elevated and depressed surfaces. A second tube is then formed in a similar manner, and the two placed together, the depressions of one half receiving the elevated portions of the other. The whole is then temporarily secured together by suitable collars placed over them, and after being turned other rings or collars are shrunk on. Claims: (1) The construction of hollow circular shafting substantially as described; (2) the construction of circular shafting, with bearings or journals shrunk upon same. —No. 1911. February 5th, 1890. 8*d*.

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WATER GAUGES.—*R. Klinger, Vienna, Austria.*—The gauge constructed according to this invention consists of a suitable metal plate having centrally along its length a U-shaped groove. Clamped to the front of this recessed plate is a second plate having a long narrow slot formed centrally in it, which slot is covered by a suitable plate of glass pressed by means of the plate against the flanges or edges of the U-shaped plate, so closing the U-groove, from each end of which the usual pipes connecting the gauge to the boiler project. That part of the back of the glass which covers the U-groove has facets formed in it causing the reflection of the rays of light when only steam is in the U-groove. The rays of light, however, falling on the glass, will penetrate through that part of the gauge where water, which has a greater refractory power, takes the place of the less refractive steam. Claims: In gauge glasses the arrangement of suitable facets, adapted to allow the rays of light to penetrate that part only of the glass which contains liquid to make the colour of the background visible, so that that part of the gauge not containing or in contact with the liquid may have the rays of light entirely or partially reflected on the facets, presenting a bright transparent surface substantially as and for the purpose described.—No. 18273. November 13th, 1890. 6*d.*

GAS ENGINES.—*A. E. Tavernier & E. Casper, both of London.*—This invention has for its object a method of cooling the cylinders and pistons of gas and other engines operated by an explosive mixture. In the annexed illustration is shown a vertical section of a cylinder and piston constructed to embrace the object of this invention. The cylinder A has formed on its outer periphery ribs B, which strengthen the cylinder and at the same time provide a greater cooling surface to be acted upon by the water in the annular space formed by the flanges at each end of A and the cover C formed in halves and clamped together as shown at D (Fig. 2). E is the explosion chamber fixed to A by screws F. G is the piston, which is made hollow as shown, and H are the flanges therein to increase the cooling surface. I is the hollow piston-rod communicating at one end with the interior of the piston by the orifice J and provided at the other end with an arm K, having nozzles L and M, to which flexible tubes or the like for the circulation of the cooling liquid are attached. The arm K is provided with a channel W communicating at one end

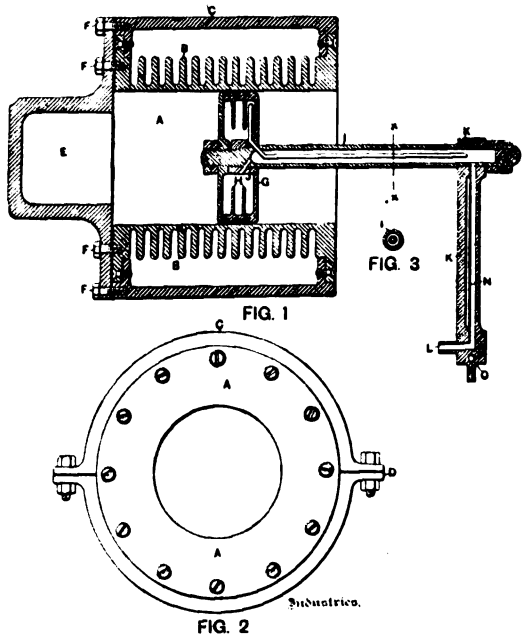


FIG. 1

FIG. 3

FIG. 2

with the interior of the rod I and terminating at the other end in the nozzle L, so that the cooling liquid can pass through the said channel and the rod I into the piston G by the orifice J. The return current passes through a tube arranged in the rod I and connected by a channel O in the arm K behind the channel N to the nozzle M. Claims: (1) An engine cylinder having formed upon its exterior a series of flanges affording a large area of cooling surface; (2) an engine cylinder having formed upon its exterior a series of flanges and surrounded by a jacket substantially as described; (3) an engine piston provided with means whereby a cooling fluid may be passed therethrough; (4) an engine piston having a series of internal flanges, and provided with means for causing a current of cooling fluid therethrough substantially as and for the purpose described.—No. 1586. January 29th, 1890. 8*d.*

STONE SAWING MACHINERY.—*S. Dearden & W. Dearden, both of Nelson, Lancashire.*—For the above purpose the inventors construct a suitable framework of wood or other material. At the top of this framework is mounted a crane for raising and lowering the saw frame, which is suspended at each corner from radius rods attached to chains passing over suitable pulleys and operated by the crane. Opposite one end of this framework is a horizontal driving shaft running in a framework of its own, and having at each end a crank disc, the cranks of which are connected by means of connecting rods to suitable sliding bars sliding in guide-ways formed in a stretcher fixed to the uprights of the framework. To the outer extremities of these slide-bars are fixed vertical heads, which are connected to the saw-frame by means of suitable slide brackets and links. Suitable tension rods are connected to the ends of the vertical reciprocating heads and the slide-bars to render the heads more rigid. Claims: (1) In combination with a horizontal saw-frame, reciprocating heads, horizontal slide-bars operating together with crank and crank-arm device as described; (2) in combination with a horizontal saw-frame, reciprocating heads, and horizontal bars radiating at the lower extremity of radius arm and actuated from the crank and crank-arm device as described; (3) in combination with a saw-frame, a reciprocating head actuated from a steam ram.—No. 2021. February 7th, 1890. 8*d.*

APPARATUS FOR THE PRODUCTION OF CARBONIC OXIDE GAS.—*T. Williams, London.*—In the annexed illustrations Fig. 1 is an elevation and Fig. 2 a plan of a complete apparatus for the above purpose, and consisting of a working cylinder A operating a gas supply pump B and a vacuum pump C. The pump B supplies impure gases from the source of supply to three tanks D, provided with a cupreous chloride solution through perforated openings in pipe E. This solution absorbs the carbonic oxide gas, and they then pass to a second set of tanks D^1. From D^1 the unabsorbed gases escape by pipe F, and the solution charged with

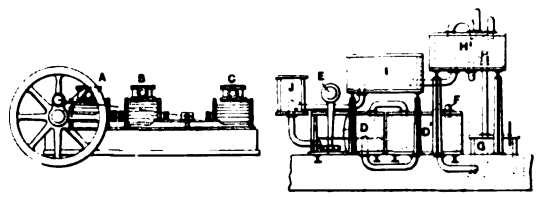


FIG. 1

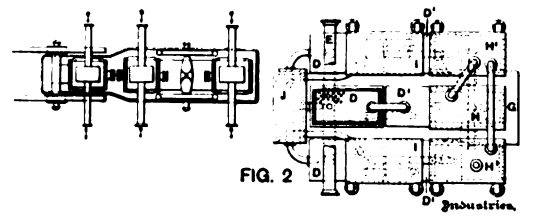


FIG. 2

carbonic oxide flows into a storage tank G. From G, by means of the vacuum pump C, the solution is drawn up into a tank H, and is distributed equally into two other tanks H^1, the pure carbonic oxide gas being freed by the action of the vacuum therein and escaping through the vacuum pump. From H^1 the cupreous chloride solution passes to two other tanks I, and, passing through a cooling tank J, returns by gravity to the tanks D, in which it again commences its work of absorption of carbonic oxide gas from the gases. Claims: The improved means and appliance for the production of pure carbonic oxide gas from coal, coke, or like fuel, the arrangement of tanks, pipes, and machinery constituting a plant, shown in the above illustrations, the parts operating in the manner and for the purposes set forth.—No. 19096. November 27th, 1889. 8*d.*

STARTING MECHANISM FOR TRAMCARS.—*J. Hewins & C. Hardy, both of Great Grimsby.*—The invention consists in machinery for stopping and starting tramcars, to be used instead of tyre or other brakes. On each of the two car axles is a friction wheel adapted to be brought into respective engagement with one of two corresponding friction wheels on shafts journalled in the respective ends of a swinging frame. On each of these shafts are also four pulleys, two geared by two cross chains with respective pulleys on the other shaft, and two having connected to them chains adapted to be wound thereon by action of the friction wheels when the latter are in engagement respectively with one or other axle friction wheel, and so bring into tension springs attached to the other ends of said chains. Lever gear is provided to be operated by the driver to move the frame, so as to bring the friction wheels into respective engagement. The springs, tensioned by the action of the friction wheel of one axle, may thus be made to operate for assistance in starting the car by engagement of the friction wheel on the other axle. Claims: The arrangement substantially as described.—No. 549. January 11th, 1890. 6*d.*

PRINTING MACHINES.—*A. Paton, Leeds, Yorkshire.*—The invention relates to the application of ink-distributing cylinders instead of inking tables in lithographic and letterpress printing machines. In the annexed illustrations, Fig. 1 shows the spring frame with the cam for raising and lowering it, in combination with the inking rollers and ink-distributing cylinders; Fig. 2 is a partial end view of the same, and Fig. 3 details of an apparatus for this purpose. A are the ink-distributing cylinders, having a continuous revolving motion and a transverse motion. B are the

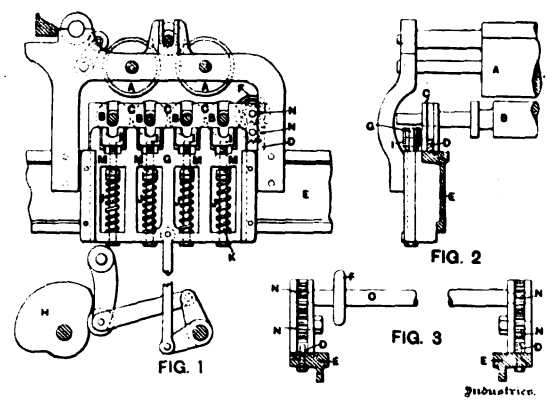


FIG. 1

FIG. 2

FIG. 3

inking rollers in the ordinary bracket C, which has the new method of removing it out of position in order to clean or change the rollers, namely, a rack D, which is placed inside the bottom of the roller bracket the whole length and fastened to E, the side frame of the machine. Two pinions geared into the rack and set inside the end of the roller bracket over the rack are used, so that by turning the hand-wheel F the brackets with the rollers can be removed from underneath the ink-distributing cylinders. G is the rising and falling frame, actuated by the cam H, so that when the frame is raised to the full extent the half-bearings I hold the inking rollers up against the ink-distributing cylinders, having the elasticity of the springs J coiled round the spindles K, which move loose in the frame, being screwed into the half-bearings I, and having adjustable nuts M to give more or less pressure to the inking rollers. Fig. 2 shows the rising and falling frame G as outside the ordinary inking roller bracket C. In Fig. 3 N are the pinions geared together and into the rack. The top pinions are fixed on to the hand wheel shaft O. It is evident that by turning this hand wheel the brackets will be carried along the rack. Claims: (1) The frame G with springs or any elastic matter, or balance weights as the substitute for springs, in combination with the ordinary inking roller brackets and ink-distributing cylinders as described; (2) the frame G acting as a roller bracket and rising frame in one; (3) in combination with the frame G the application of the rack inside, and under the ordinary roller brackets, with pinion or pinions to slide the brackets over the top of the rack as shown in Fig. 3.—No. 20701. December 24th, 1889. 6*d.*

APPARATUS FOR COATING HOOP IRON WITH TIN.—*T. H. Johns, London.*—For the above purpose the inventor arranges a flat perforated tube in a long trough through which the hoop iron is passed, the tin or other metal being kept in a molten state in the trough. The mouth of the flat tube is slightly funnel-shaped for the easy entrance of the hoop iron from the feed rollers, and the outlet of the tube is just below the level of the molten metal, the grease being above. Just outside the delivery end of the trough another tube, having a slot in it, is arranged as a scraper to act upon and scrape both sides of the hoop iron as it emerges from the trough and is carried forward, by means of two pairs of V-shaped and revolving rollers, in housings, in which they can be adjusted by means of set screws. Claims: (1) The apparatus as described, for enabling iron hooping bands and other widths or lengths to be coated, scraped, and drawn from the scrapers without the flat surface being touched after leaving the scrapers; (2) the system of coating hoop and like iron in lengths, consisting in passing it through a tube or guide in a bath of molten metal, then between scrapers, and finally between rollers, which do not touch the flat surfaces during the drawing forward and cooling processes, substantially as described.—No. 1522. January 28th, 1890. 6*d.*

SHIPS' DAVITS.—*W. H. Penligen, Hull.*—The object of the invention is to provide davits by means of which the ship's boats may be more readily and easily lowered. The davit constructed according to this invention consists of a suitable standard carrying a horizontal shaft mounted in suitable bearings, and upon which turns a semi-circular frame, partially toothed upon its circular and lowermost edge. This frame has an upward extension or bracket, to which, as well as to a portion of its lower circular edge, is riveted the davit proper, this davit being curved at the top in the usual manner and braced thereat by means of a diagonal bar. The standard carrying the horizontal shaft carries upon a lateral extension, as well as on its centre, the axis of a worm wheel gearing with the teeth of the semi-circular frame, and actuated by means of a suitable crank handle. Suitable tackle falls and sheave blocks are provided to hoist and lower the boat. Upon the upper part of the semi-circular frame chocks are formed in which the boat may be set, the outer sides of the chocks being so arranged that when it is desired to release the boat these sides may be caused to fall flat, so freeing that side of the boat. Claims: (1) The improved ships' davit arranged and constructed substantially as described; (2) the mechanism for turning the boat overboard without hoisting, consisting of a toothed semi-circular frame gearing with a pinion actuated by a handle in combination with a standard; (3) in ships' davits holding the boat between a fixed and movable chock, the latter being actuated by a crank lever pivoted on the shaft upon which the davit turns.—No. 6822. May 2nd, 1890. 6*d.*

AUTOMATIC LUBRICATOR.—*J. McDonell, Limerick, Ireland.*—The lubricator constructed according to this invention is for use with semi-solid lubricants, and consists of a cylinder of suitable dimensions provided on its inner circumference with two spiral grooves, forming a double-threaded screw, and within this cylinder is arranged a diaphragm, the periphery of which is provided with spiral projections, corresponding with and engaging in the spiral grooves in the cylinder. On the upper end of the cylinder is arranged a suitable box containing a coil spring, one end of which is secured to the box and the other end to a central spindle. The latter extends through the top of the box, and is fitted on its outer extremity with a lever handle, while its inner end, passing through the bottom of the box, is connected with the diaphragm by means of a hinged rod, so that, as the spindle is rotated by the spring, the diaphragm will also be rotated, and so, following the spiral grooves in the cylinder, caused to descend and force the lubricant out of a central hole in the bottom of the cylinder. The bottom end of the cylinder is fitted with a movable cover for inserting the lubricating material; this cover also forms a shank for fixing the apparatus in position. Claims: The use and application of an apparatus for lubricating purposes, constructed, arranged, and operated in the manner described.—No. 49. January 2nd, 1890. 6*d.*

PILE-DRIVING MACHINERY.—*H. C. Lobnitz, Slip Dock, Renfrew, Renfrewshire, N.B.*—The object of the invention is to provide a reliable device for engaging and disengaging the rams or strikers for pile driving, rock cutting, and similar machinery. For this purpose a weight, externally of a rectangular or other suitable shape, is used. This weight is made with a cavity at its lower end, the cavity having a wide bottom mouth and inclined sides converging to an upper narrow part so that when the weight descends the inclined sides of its bottom cavity causes it and the head of the ram to assume proper and concentric positions relatively to each other. A deep slot is formed across the top of the weight and in it is placed a lever-hook centred on a pin fixed across the slot and passing through the sides of the weight. Embracing this pin at each side of the lever is the bridle by means of which the weight is raised. The straight part of the lever hook extends out horizontally, when the opposite or hooked part is engaged with the bridle of the ram or striker, and an eye is formed in the end thereof for the attachment of a rope for operating the hook. The hook of the lever is made with a tail inclining downwards, and works in a continuation of the slot in the weight, and its end encounters a part at the bottom of the slot and acts as a stop to limit the inward movement of the hooked part of the lever. A spring is applied to the horizontal part of the hooked lever to tend to keep the lever hook in the closed position. When the weight descends the inclined inner sides of the tail formed on the hook encounters the strap on the ram or strikers, and the action of the strap causes the tail or the hook to be pressed outwards and the top of the strap on the ram

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enters upon the hooked part of the hooked lever. As soon as this takes place the spring causes the lever hook to close again, and the engagement is thereby affected. Claims: Hooking or disengaging mechanism for rock cutting, pile driving, and analogous purposes, such mechanism having, in combination with a lever hook, a spring, or counter-weight to close same, an inclined tail formed on the lever hook for opening it, and a weight to which the lever hook is jointed and which is made with an incline-sided cavity, the parts operating together as and for the purpose set forth.—No. 17978. November 8th, 1890. 6*d.*

PRINTING MACHINERY.—*A. Paton, Leeds.*—The invention relates to the shortening of lithographic or letterpress printing machines by the application of a smaller cylinder than hitherto used, on to which the sheet is fed. Grippers are used for this purpose which bite the sheet out independently of the cylinder, the grippers standing out almost in a straight line from the centre of the cylinder and biting the sheet there. These grippers are opened and closed by a segment of a wheel toothed and fixed on the end of the gripper shaft, and geared into a larger segment working on the end of the cylinder, which has a gripper-pulley on it to run on a path which is raised or lowered at the proper times by a cam or eccentric, thereby opening and shutting the grippers. As the cylinder is coming to a stop the grippers are made to stand out to a position almost in a line from the centre of the cylinder, the grippers being apart so as to receive the sheet to be printed. The top gripper then closes, and the grippers holding the sheet are, as the cylinder revolves, gradually brought closer to the cylinder until they touch same at the top. Claims: (1) The method of feeding a sheet on to the side of a printing cylinder horizontally with its axis, with a double gripper standing out of the cylinder and biting the sheet there clear of the cylinder as described; (2) the combination of a path-bar with two segments and a cam as described; (3) the application of springs to the double grippers to hold them together while biting the sheet, and a tail-piece to keep the grippers apart while the sheet is being fed.—No. 20683. December 23rd, 1889. 6*d.*

MINING MACHINES.—*W. B. Brain & F. Baker, both of St. Kilda, near Melbourne, & A. J. Arnot, Melbourne, Victoria, Australia.*—The invention consists principally in the employment of a number of elastic bands or springs, as connections between a reciprocating collar, to which the primary motion is given, and the spindle of a percussive drill spindle to prevent undue shocks to the machine. In the annexed illustrations Fig. 1 is a vertical section, and Fig. 2 a plan of a mining machine so fitted. The

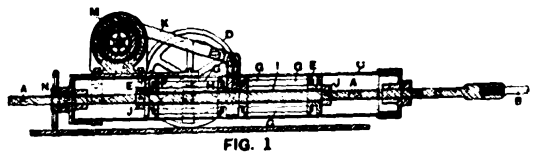


FIG. 1

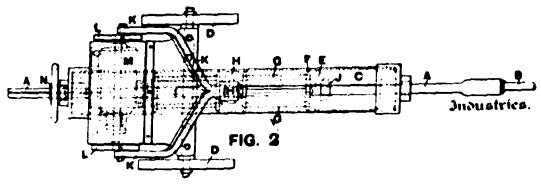


FIG. 2

spindle A carrying the mining tool B is mounted centrally in a bearing in each end of a tube C carried by two wheels D. Fixed at a suitable distance apart upon a tube I fitted on A are two collars E, having radial T lugs F, around which pass elastic bands G, whose opposite ends are secured to similar T lugs on a collar H sliding loosely upon the tube I. At each end of I are collars J fixed to A. The collar H has an upwardly projecting arm H^1 projecting through C and connected by a forked rod K to crank discs L on each end of an electric motor M fixed to C and suitable framework carried by the wheels D. The spindle A can be revolved so as to cause the operating tool B to cut a circular hole by means of a wheel N carrying a suitable feather which slides in a longitudinal slot in A. From the above it will be seen that the motive power from M is transmitted through the elastic bands G to the spindle A, so preventing shocks. Claims: (1) In a mining machine the combination with a reciprocating drill spindle of a collar adapted to slide freely to and fro upon such spindle, together with a number of elastic springs connecting said sliding collar with a pair of collars secured upon the spindle in such a manner that the latter is free to turn in said collars, whilst at the same time it is prevented from sliding longitudinally through them, for the purpose described; (2) in a mining machine the combination of a cylinder, through which can slide the spindle of a reciprocating drill with an electromotor mounted upon said cylinder in such a manner as that the centre of inertia of said motor is immediately over the axial line of the drill as described.—No. 12998. August 19th, 1890. 6*d.*

PORTABLE DRILLING MACHINES.—*W. Settle, Darcy Lever, near Bolton.*—The object of the present invention is to construct a portable percussive drill for boring or "holeing" in mines. The apparatus consists of an electromotor of suitable power upon the shaft of which is fixed a cam or tappet-wheel, which works against a projection upon a rod sliding in suitable bearings in a cylindrical casing and carrying at its outer end the drilling or "holeing" tool. Between one end of this casing and an enlargement on the sliding rod is a spiral spring, which, as the rod is raised, is compressed, and when the rod is released forces same forward, so causing it to act percussively. A handle is fixed to the upper end of the sliding rod so that the latter can be revolved. The cylindrical casing is carried and fed forward in the following manner:—A suitable iron framework is clamped to a horizontal shaft, carried in any suitable manner. Running in bearings in this framework is a vertical screwed rod which can be revolved by means of a worm-wheel fixed to one end of it, and into which gears a worm, actuated by means of an ordinary crank-handle running in a bearing in a bracket fixed to the framework. An internally screwed lug projecting from the cylinder embraces this screwed rod, so that by revolving the latter, the cylinder, together with its sliding rod, can be fed forward as the hole is cut. Four claims are made.—No. 1264. January 24th, 1890. 8*d.*

ELECTRICITY.

FIRE INDICATOR.—*T. R. Douse, London.*—Fig. 1 is a part sectional elevation, and Fig. 2 a general view of a fire indicator constructed according to this invention. A metal ring A fixed to the ceiling of the room in which the indicator is placed carries an insulating ring B, in which are placed the two binding screws C C^1. The screw C is electrically connected with a screw D fixed in A, and projecting downwards in B until nearly in contact with a concentrically corrugated metallic diaphragm E held between the end of B and a metal bridge F. Carried by means of a screw G passing through the lower central part of F is a hermetically closed metallic box composed of two thin concentrically corrugated discs H, connected at their outer peripheries by band

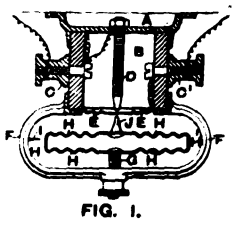


FIG. 1.

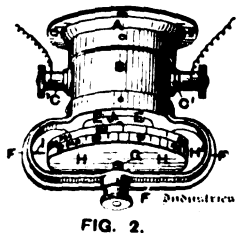


FIG. 2.

H^1. In the centre of the upper disc H is a point J, which can be brought near to or further from E by revolving the box H, and so turning the screw G in F. Fixed on F is a pointer I, by means of which and divisions on the band H^1, the distance of the point J from E can be regulated according to the temperature at which it is desired that the apparatus shall be operated. The screw C^1 is electrically connected with E and the bridge F. It will thus be seen that as the air in the box H expands by heat, the point J will force the diaphragm E into contact with D, so completing the circuit from C to C^1 and ringing the bell, or bells, in said circuit. Four claims are made.—No. 15741. October 4th, 1890. 8*d.*

AUTOMATIC ACCUMULATOR SWITCHES.—*W. S. Boult, Liverpool.*—This switch is designed for use especially in connection with electric accumulators or secondary batteries, its purpose being to maintain a nearly constant pressure in the mains in connection with the accumulator by varying the number of cells of the latter included in the electric circuit so as to compensate for variations of electromotive force in the battery. Fig. 1 is a plan not including either the "switch proper" or the pressure-meter, Fig. 2 a side elevation of the same, and Fig. 3 a front elevation showing also a "switch proper." B is a switch shaft held in bearings C and carrying loose sleeves shown by dotted lines (Figs. 1 and 2). Each sleeve carries rigidly attached to it a bevel wheel D, ratchet wheel E, and three-toothed ratchet wheel A. A chain wheel F runs freely between A and E, and carries a pawl G engaging with the latter. F is thus free to move in one direction for "winding up" without turning the sleeve, &c.,

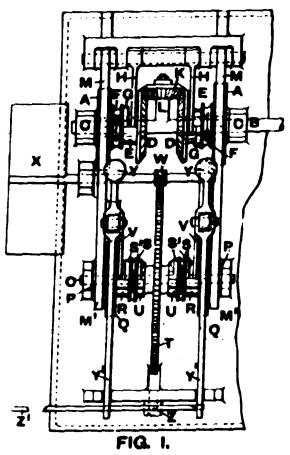


FIG. 1.

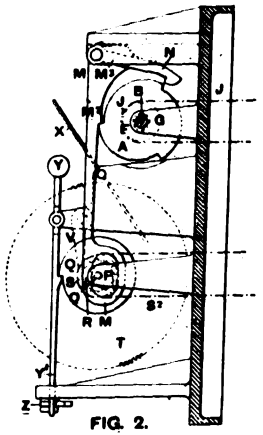


FIG. 2.

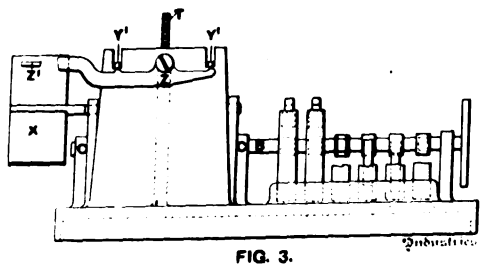


FIG. 3.

while, in the direction of the arrow, it carries these latter with it. A pawl H engaging with E permits motion only in the direction of the arrow. Chains J engage with the wheels F, which, by means of suspended weights, they tend to turn with the arrow. In gear with wheels D is a third one K carried on a stud L. M M^1 are levers pivoted at the end M, and having a slot or fork M^1 at the other end. A projecting tooth M^2 is formed to engage with ratchet wheel A, and a shoulder M^3 serves to lift off the pawl N. O is a fixed shaft on which, free to revolve, are the two eccentrics P, the two single-toothed ratchet wheels Q, the two ratchet wheels R (in each case, P, Q, and R being rigidly connected together), the two chain wheels S with pawls S^1, and the large toothed wheel T carrying the two ratchet wheels U. V V are pawls engaging with ratchet wheels R. This arrangement permits of the "winding up" of chain S^2. Wheel T is in gear with pinion W and rotates fly X. Y Y^1 are pawls for holding wheels Q carrying balance weights Y at one end and lengthened out as shown at Y^1. Z Z^1 is a lever for lifting the pawls Y^1, pivoted at Z and having its outer end Z^1 connected with the solenoid core above mentioned. The action of the apparatus is as follows:—Suppose the electric pressure in the mains gets too high. The end Z^1 of the lever Z^1 Z is lowered, the right hand pawl Y^1 is lifted, releasing wheel Q. Chain wheel S (driven by the chain S^2) now rotates, carrying with it T, U, R, and P. As P rotates, it lifts M^2 and allows N to be pressed by a spring against A. When Q has made nearly half a revolution, M^2 clears A, which, driven by F, at once flies round until the tooth just released by M^2 is arrested by N. Q, completing one revolution, again displaces N, at the same time pushing in M^2 immediately in front of the next tooth of A. Thus, as A is fixed to D, the latter is revolved one-third of a revolution, so rotating B through one-sixth of a revolution, and forces a contact arm on B out of contact with one of the terminal plates connected to one cell of the battery, the arms on B being spaced helically around same. When the pressure falls too low the other pawl Y^1 is lifted, and the other half of the apparatus generally is brought into play. Seven claims are made.—No. 1026. January 20th, 1890. 8*d.*

ALTERNATING CURRENT METERS.—*H. H. Lake, London.* (*E. Weston, Newark, New Jersey, U.S.A.*)—In the annexed illustrations Fig. 1 shows a plan, Fig. 2 a central section at right angles to Fig. 1, and Fig. 3 a detail section at right angles to Fig. 2, of a meter embodying the principle of this invention. A is the base of the instrument suitably recessed to receive the two bobbins B, placed end to end and surrounded by coils of fine insulated wire connected in series. The bodies of these are

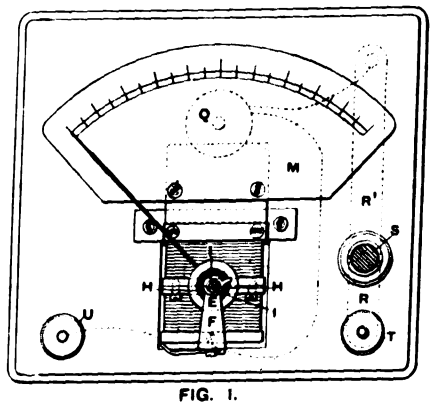


FIG. 1.

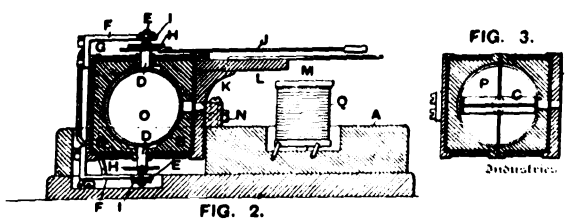


FIG. 2.

FIG. 3.

hollowed out to form a spherical cavity (Fig. 3). C is a circular frame of insulating material, on which is wound a coil of fine wire, the terminals of which are connected to the pivot pins D secured to said frame. These pins are journaled in the bodies of B, and have their bearings in adjustable steps E, supported upon the metal arms F. These arms are secured to an outer cover G. Surrounding the pivot pins D are spiral springs H, the inner ends of which are connected to said pivot pins, and the outer ends of which are connected to arms I, pivoted at the extremities of F. By turning these arms on their pivots the springs H H^1 may be contracted or expanded. Supported on the upper pivot pin is a light metallic disc, which carries an indicating needle J. The covering plate K carries a horizontal plate L, to which is secured a scale plate M, the whole being fixed to A by cross-piece N. Within the ring C is a sheet of mica O. This sheet passes through an opening in a diaphragm P of non-conducting material, held between the spools B, and extending diametrically across the spherical cavity in the latter. Q is an ordinary resistance coil, supported as shown. The two springs R R^1 of the contact push S are connected to binding post T and to Q as shown. The circuit of the instrument proceeds from binding screw U, through the coils of B, thence through movable coil on C, and from thence through Q to spring R^1. It will thus be seen that any reversal of the current will take place in all the coils, hence the needle will always be deflected in one direction. Claim: The meter substantially as described.—No. 12221. August 5th, 1890. 6*d.*

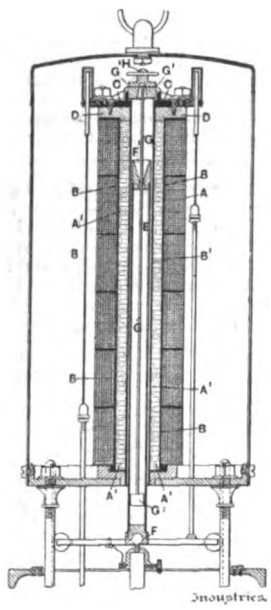
ELECTRICAL PRIMERS.—*A. Longsden, London.* (*F. Krupp, Essen, Germany.*)—The primer constructed according to this invention consists of a metal plug of cylindrical form, and having formed on its outer periphery, about equal distances from each end, a screw thread of a length equal to about one-third of the entire length of the plug. One end of this plug is enlarged, and is milled, and answers the purpose of a handle, the other or inner end being reduced in size to allow it to pass through the screwed hole in the breech block or other part of the gun. The plug has formed through its centre a hole, which is enlarged at its inner end. Passing through the smaller hole is an insulated wire connected at its inner end to an enlarged end of a cylindrical metal rod, which passes first through a suitable primer, pressed into paper and fitting the enlarged hole in the plug, and then nearly through a charge of powder. Around

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the inner end of the smaller hole is a suitable ring of pasteboard, which forms a perfect tightening against the powder gases. A platinum wire is connected to the inner end of the plug, and projects upwards through the powder charge, and is connected to the end of the metal rod. To fire the gun, therefore, after the plug has been fixed, it is only necessary to connect one wire from the battery to the insulated wire passing into the plug and the other wire to another part of the gun. The electricity will be thus compelled to pass through the platinum wire, so heating it and exploding the powder charge. The inventor also describes a primer of a modified construction, in which the powder charge is fired by frictional electricity. Two claims are made.—No. 16534. October 17th, 1890. 6*d*.

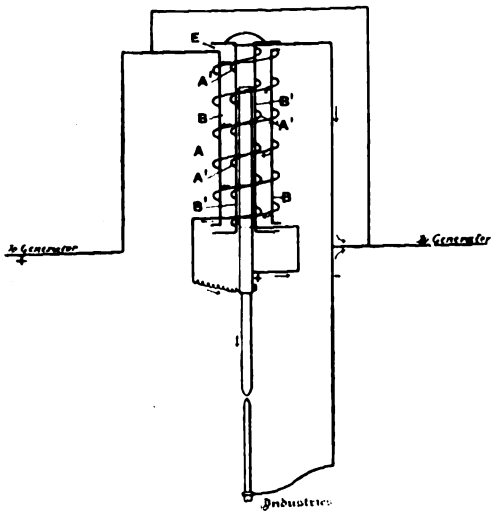
ARC LAMPS.—*H. Harper, London.*—The invention relates principally to electromagnets or solenoids adapted for use with arc lamps. In the accompanying illustrations Fig. 1 is a vertical section of an arc lamp (one of a set connected in "series") embracing the principle of this invention, and Fig. 2 is a diagram

FIG. 1.



of the winding thereof. The solenoid proper consists of two bodies A A^1 of wire arranged concentrically but wound so as to conduct the current in opposite directions. The outer "series" coil A in the circuit of the lamp is wound upon a brass tube B. The inner "shunt" coil A^1 of fine wire is also mounted on a brass tube B^1; this coil, however, may be dispensed with when the lamp is connected in parallel. The upper part of B^1 is connected direct to a metal carrying plate C, and the tube B is also connected thereto by means of an insulating plate D. The core E consists of a soft iron tube of about the length of B. This tube is closed at the lower end by means of a plug F, and is provided at its upper end with a funnel-shaped and axially-perforated plug F^1 through which works a rod G. This rod is freely suspended at its upper extremity on a transverse pin G^1 mounted in a cap H above the carrying plate C, whilst attached to the lower extremity of the rod is a plunger G^2, preferably of barrel

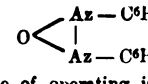
FIG. 2.



shape and fitting loosely within the tube E. Through the funnel-shaped plug the tube E is charged with glycerine or other suitable liquid, which acts as a dash-pot to prevent flickering in the lamp. The various connections are made substantially as shown in Fig. 2, and it will thus be understood that the attractive force of the solenoid upon the core varies inversely with the resistance of the arc. Five claims are made.—No. 13389. August 24th, 1889. 8*d*.

CHEMISTRY.

COLOURING MATTER.—*J. Imray, London.* (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis & Dr. Chapuis, all of Paris, France.*)—The invention relates to the production of soluble blue colouring matter of the induline series derived from para-azoxyaniline—



The general mode of operating is as follows:—A mixture of azoxyaniline, hydrochlorate of aromatic amine and amine is heated to 160°-180° C. When cooled it is treated with water and hydrochloric acid, and the hydrochlorate of induline thus formed is precipitated by salt and zinc chloride. Example: 1 kilo. para-azoxyaniline, 0·7 kilo. dry hydrochlorate of aniline, and 0·4 kilo. free aniline are heated gradually to 160° C., and kept for one hour between 160° and 180° C. The mass is poured into water, then treated with boiling water and hydrochloric acid and filtered. The solution is precipitated by salt and zinc chloride. Claims: The production of soluble colouring matters of the induline series by fusion of para-azoxyaniline in admixture with hydrochlorates of amines and aromatic amines, substantially as described.—No. 1874. February 4th, 1890. 4*d*.

MISCELLANEOUS.

MEASURING TAPS.—*J. Baker, Oldham, Lancashire.*—In the accompanying illustrations Fig. 1 is sectional elevation, Fig. 2 a plan, and Fig. 3 a transverse section of a tap constructed according to this invention. The casing A is connected to the supply pipe through hole B, and has connected to it a delivery cock C opening into a recess A^1 in A. Working in A is a hollow plug D, large enough to contain the maximum quantity of liquid to be measured. Formed in D is a supply opening D^1 and escape slots D^2 formed substantially as shown in Figs. 1 and 3. Fixed in the top of D is a plug containing a valve E, through which the air is expelled as the liquid rises in D, until the ball float F, which normally rests upon wires G, is raised by the liquid and closes said valve. Also fixed to D is a handle H, by means of which the former may be revolved, so cutting off the supply from B, and bringing one of the slots D^2 opposite the recess A^1, so allowing a definite quantity of liquid to escape. The handle H also carries a segmental rack I, which gears with wheel J operating the registering apparatus K, and also a pin L, which is forced by means of a spring against the outer periphery of a ring M, fixed to A, and in which are formed notches, so situated that when the pin L becomes inserted in one of them the plug D will be so situated that one of the slots D^2 will be opposite A^1. Three claims are made.—No. 11215. July 18th, 1890. 8*d*.

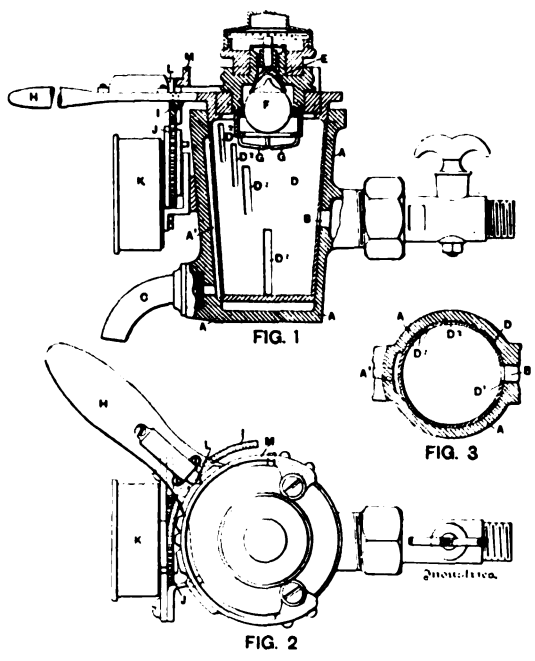


FIG. 1

FIG. 3

FIG. 2

PRESSURE GAUGES.—*W. M. Jackson, Manchester.*—It is well known that when testing the pressure in a closed vessel, containing compressed gas such as oxygen, hydrogen, &c., by means of a pressure gauge, the gas occupying the tube of the gauge is, when the cock which allows of communication between the vessel and gauge is opened, suddenly compressed and correspondingly heated, and so often causes an explosion. To prevent this the inventor introduces into the foot or other part of the shank of the gauge a suitable check or diffusing medium to prevent the sudden passage of the gas to the gauge, so that the pressure therein rises gradually. The checking plug for this purpose may be of any suitable form, one form being a metal plug screwed into the shank of the gauge. This plug has drilled centrally through it a fine hole, and has placed upon the top of it a number of alternate discs or layers of copper wire gauze or perforated metal and felt cloth or other pervious textile material. Claims: As an adjunct to pressure gauges interposing compressed layers of packing of suitable material in the conduit connecting the gauge to the compressed gas cylinder as described; (2) in pressure gauges an adjustable needle valve for the purpose as set forth.—No. 2314. February 10th, 1890. 8*d*.

COMPOUND ARMOUR PLATES.—*J. E. Bott, Eyam, Derbyshire.*—This invention relates to the manufacture of compound armour plates by casting steel or alloy of steel with other metals on to a base of wrought iron. The wrought-iron portion of the plate is first made in the usual manner, and after being cleaned or pickled, is coated with nickel, aluminium, or other slowly oxidisable metal or alloy by electrical deposition. The said plate is then placed in a suitable mould after being raised to a welding heat, and steel or alloy of steel and other metal is then cast on. If it is desired to give the plate a still harder coating, a hard steel face is cast on the top of the compound plate as follows:—The plate is heated to a welding heat and the required amount of steel poured on if the said plate has had a coating of steel or alloy having a percentage of nickel or other alloy which is sufficient to prevent oxidisation. If it has not had such a coating, the plate is pickled and then coated with nickel as before. Claims: (1) The process of manufacturing compound armour plates by preparing a wrought-iron plate, cleaning same, coating it with nickel or other slowly oxidisable metal, heating it to a welding heat, and casting thereon a coating of steel or alloy of steel and other metal; (2) the process, after the above operation, of again cleaning, coating with nickel and heating, and then casting a second and harder coating of steel thereon; (3) the employment in the above operation of the process of plating with nickel or other metal as described.—No. 20380. December 18th, 1889. 4*d*.

MANUFACTURE OF COPPER.—*T. Twynam, London.*—This invention relates to improvements in the production of blistered and refined copper from copper mattes, coarse metal, cupola metal, and other cupriferous material containing a large percentage of iron. For the above purpose the inventor uses a Siemens furnace or an ordinary reverberatory furnace, furnished with a lining of chrome iron ore made coherent, as described in patents Nos. 8358 and 8359 of 1886. Suitable silicious material is charged with the copper "mattes," or coarse metal, to form an easily fusible silicate of iron slag. For this purpose silicious copper ores or slags are suitable. When a reverberatory furnace is used, an air blast should be used to assist the oxidation of the iron. The silicious slag is skimmed off from time to time, more silica being added if required to carry off the oxidised iron as silicate. When the iron is removed the copper is in the state of white or pimple metal, the addition of silicious material is stopped, and the silicious slag removed, the air blast being continued, and a little lime or limestone added to form a basic slag. The charge may be tapped when so converted into blister, or it may be worked into refined copper in the same furnace. Claims: The treatment of coarse metal, cupola metal, and other copper mattes, in furnaces lined with chrome iron ore in presence of a silicious slag with subsequent treatment in presence of a basic slag, substantially as described.—No. 560. January 11th, 1890. 4*d*.

JOINING LEAD PIPES.—*C. H. Smith, Irk View, Rhodes, Middleton, & B. Cooper, Manchester.*—To effect the above the inventors form on the respective ends of the pipes to be joined a right or left hand thread respectively, or both, the two being then joined together by means of a white metal coupling, the interior of which is correspondingly screw threaded. When the ends of the pipes are formed with a thread of the same sense, they are brought to bear against each other by means of suitable lock-nuts. When forming the pipe ends respectively with a right and left hand thread the ends are bevelled off so as to fit against a corresponding surface formed in the interior of the coupling. Instead of bevelling the ends of the pipes a rubber or leather ring may be employed, against which the ends of the pipes are screwed, so effecting a perfect joint. To effect the screw threading of the ends of the pipe the inventors first reduce the ends of the pipes by means of a reducing die formed with a cylindrical hole, the mouth of which corresponds with the diameter of the pipe before compression, and the inner end with that after compression, there being a conical shoulder formed between the two diameters, which effects the gradual compression of the lead pipe on the die being forced thereon. After reducing the end of the pipe the reduced end is placed in a die screwed internally with a thread corresponding to the thread to be formed in the pipe. The end of the pipe is then expanded by driving a conical plug into same, so forming a thread on the outer surface thereof, as will be understood. Claims: (1) The method of forming a thread on the respective ends of lead pipes by compressing and afterwards expanding the same, or by expansion only; (2) the lead pipe compressing or reducing die formed with a cylindrical hole of two different diameters substantially as set forth; (3) the expansion die formed internally with a thread, against which the pipe ends are expanded by suitable means as set forth; (4) the expansion die in combination with a conical expansion plug substantially as described.—No. 8942. March 13th, 1890. 8*d*.

APPARATUS FOR TREATING ORES.—*T. Young, Glasgow.*—The apparatus constructed according to this invention is for the purpose of treating ores to obtain precious metals. The apparatus is combined with an ordinary filter tank, into which the ores, after treatment with chlorine and the solution formed thereby, are emptied from a chlorinating vessel. The solution passes through a filter bed into a space beneath a false bottom at the lower part of the tank, and this lower space is put, by means of a pipe, in communication with an air-tight vessel, made preferably of iron or steel, protected internally by rubber. The air-tight vessel is fitted with an inlet pipe and stop-cock for steam, an outlet valve for air, and a pipe dipping down to or communicating with the lower part of the vessel, and leading to a position where it can be connected to a filter press. When a charge of material is about to be dealt with a vacuum is formed in the air-tight vessel by blowing steam and allowing it to condense, protosulphate of iron having been first put into the vessel either in solution or in crystals to be dissolved by the steam blown in. A stop-cock on the pipe communicating with the filter tank is then opened, and the chlorinated solution is rapidly drawn through the filter bed and into the air-tight vessel, in which the precious metal is precipitated by the action of the protosulphate of iron. When the reaction is completed steam is again admitted to the upper part of the air-tight vessel, so forcing the liquid and its suspended precipitate through the communicating pipe to the filter press, where the precipitate is separated from the solution Claim: The process of treating ores to obtain precious metals substantially as described.—No. 20181. December 16th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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PORTABLE HAULING AND WINDING ENGINES.

CONSTRUCTED BY MESSRS. JOHN WILD & CO., LIMITED, FALCON IRON WORKS, OLDHAM.

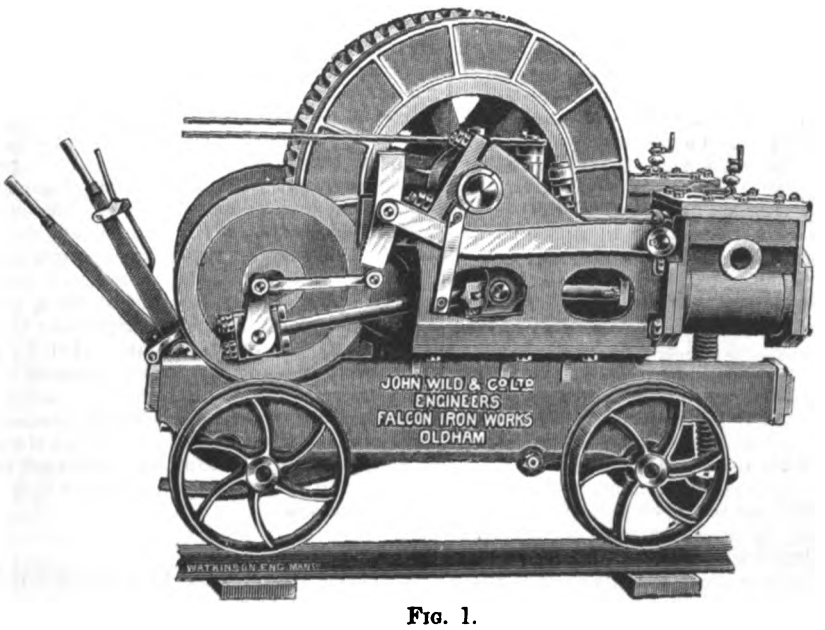


FIG. 1.

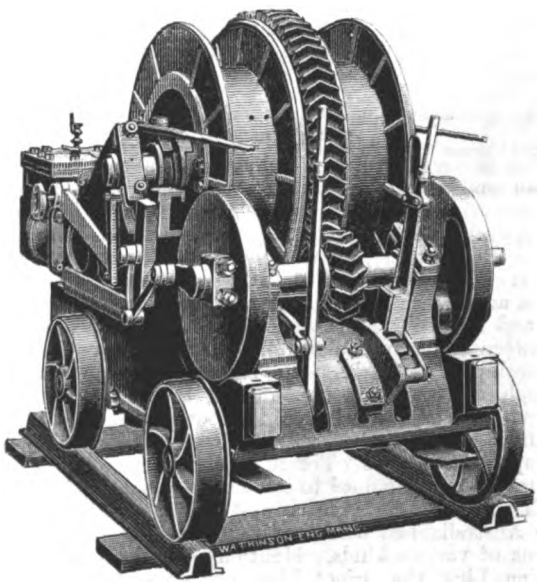


FIG. 2.

PORTABLE HAULING AND WINDING ENGINES.

THE accompanying illustrations, Figs. 1 and 2, represent front and end elevations respectively, and Fig. 3 a diagrammatic illustration of the valve motion of a compact pair of portable hauling and winding engines, as made for the Glamorgan Coal Company by Messrs. John Wild & Co., Falcon Iron Works, Oldham. They have been specially designed for underground work, and to stand rough usage by unskilled workmen. The leading dimensions of these engines are:—Height, 4ft. 6in.; length, 5ft. 4in.; and width, 3ft. 3in. The gauge of the road is 2ft. 9in., the diameter of the cylinders 7in., with a stroke of 10in., and the diameter of the winding drums is 2ft. It will be noticed, by referring to Figs. 1 and 2, that there is an absence of eccentrics, and that the slide valves receive motion by means of return cranks, actuating slotted links. This is a simple arrangement, and one which, we understand, gives very satisfactory results. Referring to Fig. 3, O represents the centre of the crank-shaft, C D the return crank, A the travel of the crank-pin, B the travel of return crank-pin, and the points F H E the travel of the pin in the link. As regards the brake, it consists of a cast-iron ring turned and fitted into a suitable recess in the drum, and arranged so that when pressure is applied to the lever the ring is expanded, so as to cause frictional contact with the drum. The slide valves are of an improved balanced type. These engines, we are informed, are made in various sizes.

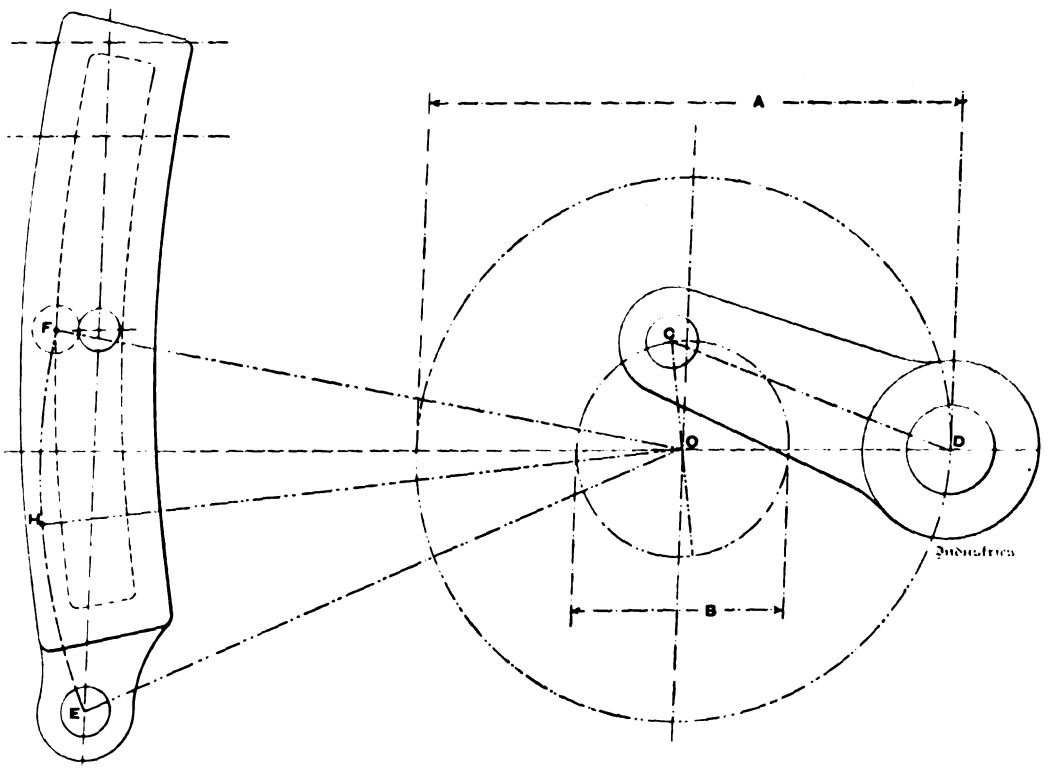


FIG. 3.

THE INSTITUTION OF CIVIL ENGINEERS.

AT a meeting on the 13th inst., Sir John Coode, President, being in the chair, a paper was read on "Auxiliary Engines in Connection with the Modern Marine Engine," by Mr. William Henry Allen, Assoc.M.Inst.C.E. The paper dealt with the early introduction of auxiliary engines for marine engines, beginning with the year 1870, when the surface condenser was fairly established and the marine engine had assumed the form of the twin compound engine.

Circulating Pumps.—Descriptions were given of the form of circulating pump used first in the "Arizona," which reached its maximum size in the engines on board the "Umbria," and also of the pumps which had been adopted for the large triple-expansion engines of the North German Lloyd fleet, and it was shown that the quantity of water required for condensing purposes had been reduced from 20lb. per i.h.p. per minute in the compound engine to 11lb. in the triple-expansion engine. The author recommended that the speeds for centrifugal pumps for large vessels should be 150 revolutions per minute, so that the machines should be fairly light, and yet possess full security from breakdown. The custom of duplicating had fallen into disuse, and most of the boats at the present time were fitted with single engines. Cast iron was to be preferred for centrifugal pumps in lieu of gun-metal, experience having shown that it was proof against the action of sea water. So far as the author knew, no experiments had been carried out on the condensing plant of marine engines, and consequently the data for regulating the size of the machines must be those obtained from practice. The author had found the friction of the condenser tubes, together with the velocity of entrance, as well as the friction of the circulating pipes themselves, to be equivalent to a head from 5ft. to 10ft.; that was to say, that in calculating from the speed of the centrifugal pump, as well as the quantity of water known to be delivered at this speed, from 5ft. to 10ft. of water was the pressure against which he had found it necessary to work. Comparing the quantity discharged with the indicated horse-power, the efficiency, with this head and with the moderate number of revolutions at which these pumps were operated, was found to be 50 per cent. This result was with a velocity of water of from 9ft. to 10ft. per second through the circulating pipes, which was usual in ordinary merchant steamers. In the Navy much higher velocities had been used—in some instances 15ft. per second, at which speed the duty of the centrifugal pump would be considerably diminished. The above efficiency must be considered fairly good when the large range of power for which the engines were constructed was taken into consideration. In twin-screw steamers safety of working was in a large measure assured by cross-connecting the circulating pumps, so that in case of emergency either of them could be employed for condensing the steam from both engines. This method had been recently carried out in the new mail boats, "Empress of India" and two sister vessels, for the Canadian Pacific Railway Company. In this ship the circulating pumps were attached to both condensers by cross-connections, with a system of valves. Each pump was provided with two engines, either of them being powerful enough to provide water for its own condenser for circulating, and the two together capable of working the pump at a sufficiently accelerated speed to provide water for both condensers. This method had the advantage of keeping down the area of the cylinders for circulating, while still retaining full power for bilging also.

Separate Air Pumps.—The practice of entirely disconnecting the air and feed pumps from the main engines and working them by their own steam cylinders was one which had not been universally adopted, but there were several instances of such separate sets of engines at work, giving great satisfaction. They

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consisted of inverted cylinders working the necessary air pumps direct, and having connections to feed, bilge, and sanitary pumps on the cross-head, the strain acting through the piston rod and cross-heads directly on the pumps, an intermediate three-throw crank of ordinary description and fly-wheel on either end making the complete machine. These had been found to work very satisfactorily in the "Normannia" and other steamers of this class where they had been employed.

Fans for Forced Draught.—Fans for forced draught had been introduced on a large scale, in the City of Dublin Mail Steam Packet Company's Line running between Holyhead and Dublin, in the year 1883, and had since then been fitted to the vessels of the following lines:—The boats running between Belfast and Glasgow, the Liverpool and Isle of Man boats (4), Liverpool and Llandudno (2), Holyhead and Dublin (4), City of Dublin Steam Packet Company's (5), London and North-Western new steamers (2), Great Western boats running between Weymouth and the Channel Islands (3), Brighton and South Coast boats running between Newhaven and Dieppe (2), Chatham and Dover boats running between Dover and Calais (3), and the Netherlands Steamship Company's boats running between Queenborough and Flushing (4). From this list it would be seen that all the principal lines of passenger steamers running from England to neighbouring shores had been supplied with fans. Forced draught, however, had by no means been confined to coasting steamers, as recently all the Atlantic liners, as well as some boats trading to Australia, had been equipped with assisted draught fans of various kinds. Mention was made of Holt's China Line, the Orient Line, and also of the "Majestic" and "Teutonic," in which fans for assisted draught were applied. At present the pressures for forced draught varied from ½in. of water upwards according to the system, but until further progress was carried out in high-pressure boilers the author was of opinion that a pressure exceeding ¾in. of water in the ashpit was not advisable, as it involved leakage in the tubes and other troubles. Experiments made both in England and abroad showed that the large variation in the quantity of air required in the different systems made it almost impossible to give any proper rule. An instance of this might be found in the introduction of forced draught. The fans supplied to the later Queenborough and Flushing boats were some 18in. less in diameter than those of the earlier ones, and gave equally good results. These fans were employed only for assisted draught, but considerable benefit had been obtained with them, particularly when the wind was abaft the funnel, as the stokers then found the greatest difficulty in maintaining the pressure. The same might be said of steamers which travelled in the trade winds. All these fans were driven direct from their own engines, as it was impossible to work a high-speed belt properly when it was placed longitudinally with the ship, which was generally the most convenient way of arranging the fans. This, together with the proximity of dust and grease, rendered the system an unsafe one. All fans for high-speed engines should be secured to a substantial foundation. To bolt a high-speed fan against a thin plate bulkhead, without supports, would largely increase vibration, and possibly fracture the base-plate. The speed proper for the fans depended upon their diameter and the amount and pressure of air required; but as these had to be accommodated to the maximum speed which could be obtained without excessive wear and tear, for quick-running engines a speed of from 250 to 350 revolutions per minute might be regarded as the most satisfactory for long voyages. The efficiency of the combined fan and engine was not high, the best results obtained by the author being only 42 per cent., with fans of from 4ft. 6in. to 6ft. in diameter, suitable for steamship purposes. It was highly desirable to keep up the areas of the cylinders, so that, in the event of the steam pressure dropping, the cylinders should be sufficiently large to maintain the full speed required by the fan, and thus recover the pressure. For calculating the areas of the cylinder, an efficiency of 35 per cent. would ensure the engines being of ample power.

Reversing Engines.—At about the time centrifugal pumps were introduced, the auxiliary engine employed for the purpose of operating the reversing links of the main engines came into use. The form of engine first employed, and which was now in common use on small steamers, was that known as the "round-about engine." It had a cylinder of from 5in. to 8in. diameter, working the ordinary wheel motion. The crank on the second shaft was connected either to the weigh shaft of the main engines or to the links themselves, and arranged so that the links might be reversed ahead and astern. The reversing action took place by turning the steam into the exhaust by the ordinary central valve. For engines up to 150 i.h.p., where there was plenty of room, this arrangement answered the purpose well. It was also useful for heating up the main cylinders before leaving port by starting at slow movement, when a small volume of steam would be admitted on both sides of the main piston by the fact of the reversing engine bringing the links backwards and forwards from ahead to astern. While this form had been generally adopted for small engines, it had been almost entirely superseded in large ones during the last ten years by the direct-acting reversing engine. This was known as the hydraulic reversing engine. It consisted of a steam cylinder, the movement of the piston of which was controlled by an oil cylinder. These reversing engines were always fitted with automatic cut-off gear, so that the movement of the small hand-lever which controlled the steam valve was followed by the motion of the reversing engine only so far as was necessary, the automatic gear cutting off the steam and oil at the position corresponding to that in which the engineer placed the handle. This automatic cut-off controlling gear consisted of a set of differential wheels and levers which were positive in action; they were either connected to the weigh shaft or to the cross-head of the reversing engine, and by links and levers to the valves on the reversing engine. The operation of altering or reversing the position of the links having been accomplished, the hydraulic cylinder took upon itself the function of a locking gear, a valve preventing the oil from passing from one side to the other, and so securing the piston in the required position. The liability to thrusting of the link blocks was greatly lessened by the employment of the oil cylinder.

Electric Lighting Engines and Dynamos.—These were among the latest additions to the engines placed under the care of the sea-going engineer, but they had come into use so rapidly that it was now the practice to fit up cargo steamers, as well as passenger steamers, with them. The difference in the comfort of a ship furnished with electric light, instead of oil lamps, could only be judged by those who had had experience of both. A paper on this subject was read before the Institution by Mr. Jamieson, in 1884, since which time considerable advances had been made in perfecting the engine and dynamo for ship work. In the interval, nearly every variety of engine had been tried—turbine, three-cylinder, rotary, single and double acting, open and closed, high and low speed; but the general opinion appeared to be that the double-acting engine, specially constructed for driving dynamos, was the form which would find the most favour for marine work. At the present time, electric light machinery might be classed under two heads—viz., that specially suitable to Admiralty purposes, where the highest economy and efficiency were the principal qualities required; and that appropriate for ordinary merchant steamers, where a good, practical engine and dynamo were looked for before economy, except in some of the best Atlantic liners, where combined engines of economical form might be found. The question of driving dynamos direct from engines or by rope gearing had, the author thought, been settled by the general adoption of the direct-working machine, the advantages of dispensing with belting and gearing where oil, grease, and water were sure to be present being very great.

The author was of opinion that progress had been largely accelerated by the close specifications issued by the Admiralty, without which latent ability would not have been developed and such great improvements effected in so short a time. The economy of engines and dynamos had been improved, both by increasing the efficiency of the dynamo and by reducing the quantity of water required by the engine itself. Naturally, with a higher pressure of steam, combined with the use of the condenser, considerable reduction could be made by way of economy. It would also be seen that open engines had in themselves several advantages over closed engines—namely, accessibility, simplicity, and fair economy, combined with the all-important point of durability. It must not be forgotten that the twin-engine with cranks at opposite angles, such as was exclusively used at the Admiralty, had the advantage of working with considerably less vibration than the single-cylinder engine. For the mercantile marine, however, an altogether different type seemed to be preferred. With the exception of some of the largest liners, nearly all vessels were at present being fitted with single-cylinder direct-acting engines and dynamos, the object of the owners being to secure a machine which should run constantly without repair or breakdown, and one which could be readily understood by ordinary marine engineers, and repaired by them when necessary. The ship-lighting dynamo had been greatly improved during the last year or so, and the drum-wound armature machine was one which had been found to work satisfactorily. The armature consisted of a cast-iron hub mounted on a steel spindle, having laminated plates for the core, the whole being drum-wound on the outside. Every part at all likely to get out of order was visible, and could be readily repaired by those in charge of the machine. The voltage at which the author had found it most convenient to work in merchant ships was 60 volts, which was suitable for glow lamps as well as for projectors. Bearing in mind that the electric light engine had generally to work harder and longer than any other in the ship, the light being required both when in port and at sea, the matter of economy was of some importance. The efficiency of ordinary ship-lighting dynamos, such as those which had been constructed by the author with double-acting engines, was in some cases as high as 83 per cent. It would be observed from the table given that the efficiency of dynamos of the ordinary mercantile form was over 81 per cent. This result had been obtained from a number of machines of similar size, the curve showing the efficiency of engine and dynamo combined, from no load to full load.

The above description of auxiliary engines did not by any means exhaust the list of those which were to be found in the marine engine-room of the present day, as mention might be made of the present form of feed pump, which was generally of the duplex pattern without fly-wheel; also the evaporator with Weir's hot-water feed pumps; refrigerating apparatus, which had generally the horizontal compound engine with air pumps opposite to same; the steering gear, which was sometimes placed in the engine-room; the small engine for turning the engines round when in port; the distilling machinery; the air compressors employed when the cabins were ventilated by nozzles; and the ash hoists. The paper had, however, extended so far that it would be impossible to embody all the details of these engines, and the author had preferred to confine himself to the four classes of engine which were within his own experience.

A NEW PROCESS FOR GENERATING AND CUTTING THE TEETH OF SPUR WHEELS.*

The theory of the interchange system of gearing according to the solution first given by Professor Willis, in his treatise on the "Principles of Mechanism," is, "that in a set of wheels of the same pitch, having a constant generating circle for the flanks and faces of the teeth, any two wheels of the set will work correctly together;" and as a rack is a gear so infinitely large that its periphery forms a straight line, it follows that, if the rack teeth are also described with the same circle as that used for the wheels, any one of the set will run correctly with the rack.

The diameter of the generating or describing circle which gives one of the best forms of teeth for a set of wheels is equal to the radius of the pitch diameter of a 15-tooth pinion, making a 7½in. generating circle for one diametral pitch. The flanks of a 15-tooth pinion being radial, a 12-tooth pinion, which is the smallest generally used in practice, will have the flank of one tooth nearly parallel to that of the tooth following, thus allowing the space between the teeth to be cut with the regular gear cutter.

It was thought at the time this system was first brought out that its use would be very limited, as in the case of change gears for lathes and where it was found necessary to construct a train of gear wheels, but time has shown that it has many advantages over other equally correct systems not on the interchangeable plan, and it has been constantly growing in favour, until it is now almost universally adopted, especially among those using cut gearing.

Professor Edward Sang has also solved the same problem in another way, by taking the rack for the foundation of all curves for a set of interchangeable gear wheels. In the Sang theory, instead of using a constant describing circle, the rack acts as a constant generator, and the faces and flanks of all teeth throughout the whole set of wheels are described by it; therefore it is evident that, if the constant generating circle which is used for a set of wheels according to the Willis theory is also used to form the teeth of a rack, this same rack can be used in accordance with the Sang theory to generate another set of wheels, and any gear of one set will work correctly with the other.

For many years, one of the foremost mechanical problems in gearing has been to reduce these well-known theories to practice, and produce gear teeth having contours that correspond as nearly as possible to the theoretical curves. At first the teeth were drawn on paper or sheet metal, using arcs of circles which approximated the true curves, and then templets were made to these drawings by which the cutters were shaped; but it was found that cutters made in this way would not give as good results as desired, and afterward curves which were very much nearer the theoretical lines than arcs of circles were laid out by means of Professor Robinson's "Templet Odontograph," and cutters made from them with much better results. Later, the curves of coarse pitch teeth were laid out, and sheet-steel formers shaped to the lines as nearly as possible. These formers were then placed in a pantagraph machine, and cutters of the different pitches made from them; but it was found impossible, even with the large drawings, to make the formers sufficiently accurate. The epicycloidal milling engine was then constructed for generating and milling the curves of one diametrical pitch upon a steel plate, and, with these formers as a basis, cutters of any pitch were made. Thus step by step the process of making gearing with special cutters for each wheel, according to the Willis theory of the interchange system, has been brought to great mechanical perfection.

In the new process, which is the subject of this paper, instead of making all gears so that they will run in a rack, the rack is transformed into a cutting tool, and by it the teeth of wheels of any diameter are generated and cut at the same time.

Fig. 1 illustrates a gear-generating and cutting engine, designed and constructed by the writer, for the purpose of reducing to practice the principles of this process. The cutters are shown in position as they appear in the machine when the teeth are cut

* Read by Mr. A. Swasey before the American Society of Mechanical Engineers. The illustrations are taken from our American contemporary the *Engineering and Mining Journal*.

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partly across the face of the wheel. The cutting spindles and the main spindle which carries the wheel are connected by means of change gears, the number of teeth to be cut in the wheel determining the proportion between the two on the same principle as the change gears of an engine lathe, which gives the cutting spindle as many revolutions to one of the main spindles as there are teeth in the wheel.

The cutting tool is composed of a series of cutters rigidly connected, which revolve and at the same time move longitudinally or endwise at right angles to the axis of the wheel to be cut; and, at the same speed, it is continually revolving at the pitch line, the motions being the same as in the case of a rack engaging with a revolving gear.

As it would be impracticable to continue moving the whole series of cutters endwise, they are bisected, and these segments are connected in series forming two sections, which revolve upon a common axis, and each section is given an independent endwise motion by means of a cam. When one section is engaged in cutting, it is carried endwise in the same direction and at the same velocity that the pitch line of the wheel is revolving, until disengaged from it, when the cutters, while continuing to revolve, are carried back by the cam to their original position, ready for the next tooth. By means of both sections, as they continually revolve and alternately slide forward while cutting, and back when disengaged, there is a continuous cutting and generating process of the teeth in the revolving wheel. The head carrying the cutters is automatically fed across the face of the wheel, and when the cutters have proceeded once across the gear is completed.

Fig. 2 is a side elevation of a bisected cutter, and Fig. 3 shows a series of six cutters, the end one being in elevation and the others in cross-section—these having cutting portions, which in cross-section represent the teeth of a rack, with the addition to the diameter of a given proportion of a pitch by which the clearance and fillets at the bottom of the teeth are made. If their cutting portions are formed of cycloids, then the whole set of gear wheels cut with them will be of the epicycloidal or double-curve system. If they are formed simply of straight sides, then a set of involute or single-curve gears will be generated and cut, or their cutting portions may be composed of both straight lines and cycloids and produce Professor McCord's recent system of gearing, which has composite teeth with the contours partly involute and partly epicycloidal.

All the cutters in a series are made exactly alike and interchangeable, the thickness of each or the distance from the centre of one to the centre of that adjoining being equal to the pitch of the gear to be cut. As indicated in Fig. 2, the two segments of the cutter are first made whole, with four holes in equal distance from the centre through which the rods pass that fasten them together. After the cutters are nearly completed, they are bisected with a narrow tool, leaving two holes in each segment.

Fig. 5 is a cross-section of the head, showing the mechanism for revolving and reciprocating the cutters. The rods which extend through the cutters serve not only to hold them firmly together, but to revolve them, and at the same time act as slides for the reciprocating motion. The spindles on both sides of the cutters through which the rods extend, are revolved independently and at the same speed by means of a parallel shaft having a pinion at each end which engages with a large gear on each spindle. By this means the four rods carrying the two cutter sections are revolved from each end, thus avoiding the torsional strain which would result if driven from one end only. The pair of rods for each section, after passing through one of the spindles, terminate in semi-cylindrical blocks. From these blocks studs extend, on which are journaled rolls, which engage with a cam held rigidly on the head. This cam is shown in Fig. 4, the working portions being made in the form of a screw thread, which, if extended all the way round, would have a lead equal to the thickness or pitch of the cutter. As each section of the cutters engages with the wheel only three-fourths of a revolution, the thread portion of the cam which carries the cutters forward extends only three-fourths of its circumference, leaving the other one-fourth for the reverse curves of the cam to bring the cutters back to their starting point. Provision is made for adjusting one section of cutters so as exactly to coincide with the other, making the spaces and teeth of the wheel equal, or, as is often necessary, the space can be made wider than the teeth by setting one section past the other. The variation of the spacing from one tooth to another is reduced to a minimum as the series of cutters act upon both sides of a number of teeth at the same time, and serve to average and eliminate any local inaccuracies in the division of the index and driving gears; also to obviate any tendency to crowd the wheel from one side to the other. The forward motion of the cutters and the revolution of the wheel at the pitch line being constant, the process of generating and cutting the teeth goes on continuously and uniformly around its entire periphery, so that one part is not heated more than another, but all the teeth are cut under exactly similar conditions, and when the revolving cutters have once passed across the face all the teeth in the gear are completed and given the correct form for each diameter of wheel, and as by the Willis theory all gears are cut to run in a rack, so by this process the same theory is put into practice and a rack is made to cut correctly all gears.

SWASEY'S METHOD FOR CUTTING THE TEETH OF SPUR WHEELS.

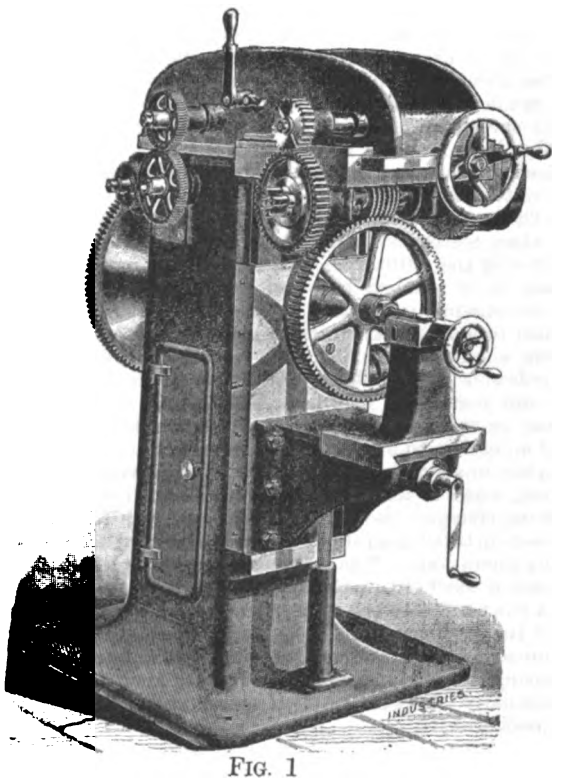


FIG. 1

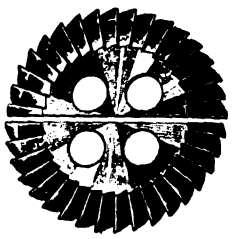


FIG. 2

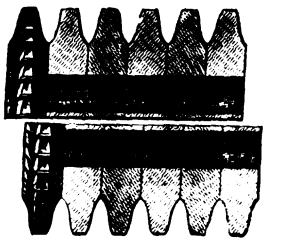


FIG. 3

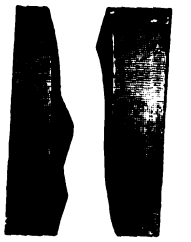


FIG. 4

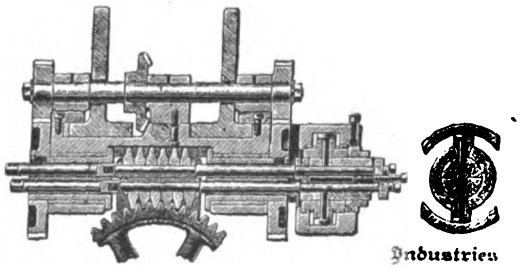


FIG. 5

MECHANICAL AND CHEMICAL EQUIVALENTS.*

Mechanical Equivalents.—The expression "mechanical equivalent" is very frequently used, but imperfectly understood. This may arise, in part, from the fact that the term is incapable of definition. The next best thing to a definition is a good example. But it is not even possible to give an instance of a mechanical equivalent, which would be of universal, or even of general application. A device which is a mechanical equivalent in one combination may not be so in another.

The subject of "mechanical equivalents" should be approached in two distinct ways. The doctrine is applicable for two purposes only:—(1) On questions of infringement; (2) on questions of subject matter—viz., to raise a presumption that there is no invention required sufficient to support valid Letters Patent.

* Abstract of a paper read by Mr. G. R. Ellis, Solicitor and Patent Agent, before the Institute of Patent Agents on the 17th ult.

Dealing for the moment with the first branch of the question (that of infringement), there can be no doubt that a man who makes an invention consisting of a combination is entitled to restrain not merely persons who take the whole combination, but also others who take certain parts, and for the omitted parts substitute mechanical equivalents. A patentee need not, in his specification, claim mechanical equivalents expressly. Accuracy in claims is greatly to be desired; in fact it is impossible to bestow too much care or attention on the draftsmanship of claims. At the same time no amount of accuracy will be able to cover the inventive genius of the infringer. The inventor states how to carry out his invention. The infringer usually has another mode of doing the same thing. Moreover, a claim for a combination cannot do much more than claim the combination. A claim can direct the attention of the public to the features of the invention; but it is no province of the claim to describe the parts or their mode of action. The description of the parts and their action belongs to the specification; hence it is a well recognised rule, when dealing with claims for combinations, to make reference to the specification itself to ascertain what the invention is.

One of the most difficult problems that come before our notice is the question whether one combination is an infringement of the combination described and claimed. One difficulty lies in the fact that a claim for a combination cannot satisfactorily express the invention described. Another difficulty in our way, when determining whether a combination is an infringement or not, is due to the state of public knowledge. It has been said that in the construction of specifications regard must be had to the state of manufacture. It follows from this, therefore, that equivalency depends upon the state of public knowledge. At one time, and with one state of public knowledge, a combination might be held to be an infringement, whereas at another time, and with a different state of public knowledge, it might be held to be no infringement. Where an invention consists in an entirely new manufacture, devices which effect substantially the same object would probably be held to be within the ambit of the claim and to be equivalents of the devices used. Where, however, an invention consists in improvements on an old machine, the claim is more strictly limited to the devices specified, and the doctrine of equivalents has little or no bearing. In a certain sense, the question whether one device is a mechanical equivalent of another, is a question of fact; but it will be seen that, in reality, it is a mixed question of fact and law. It becomes a matter for the Court, eventually, to decide whether or not the alleged infringement is substantially the invention described in the specification, and *claimed* in the *claim*.

It has been judicially remarked that few infringers take the exact combination. The aim of an intelligent infringer is to take the substance of the invention, but to vary it in *form* and *detail* as much as practicable. In a recent case an infringer stated in open Court in support of his case (and utterly regardless of the rules of evidence), "I told my man not to make it *like* the patented machine." This remark would not be worth recording except for the fact that it exemplifies one view of the subject, namely, that a patent (at the least) covers all those modifications which a mechanic could make, merely using his mechanical knowledge. A change in form often alters the appearance of a combination. When, in addition to an alteration in form, there is an entire omission of certain parts and a substitution of mechanical means for effecting the same object, difficulties arise in determining whether there is an infringement or not:—

The following suggestions will materially assist in determining whether the combination be an infringement or not.

(1) In the first place study the specification and ascertain exactly the invention *claimed*.

(2) Examine the infringement and compare it *part by part* with the invention claimed.

If there be identity in the several parts the question is solved. If not, a further investigation must take place, namely:—

(3) Are the omitted parts material?

(4) Are the substituted parts in the infringement material?

(5) Do the material substituted parts perform the same function as the omitted parts?

It may be that the substituted parts not only perform the functions of the omitted parts, but either perform them better or perform others in addition. This does not make it the less of an infringement, although it might form the proper subject matter for a subservient or dependent patent. It would be a false deduction to say that a device is necessarily the equivalent of another merely because it effects the same result. An illustration will, I think, demonstrate that this is the case. There have been in recent years many inventions relating to "feed heaters," yet, from the mere fact of their performing the same work, it would be hasty to conclude that one was the equivalent of the other. I am, of course, using the word "equivalent" in its strict legal sense from a patent lawyer's point of view. The question is not so much whether the whole combination effects the same result, as whether the substituted parts perform themselves the same function in the combination as the parts that are omitted. It will be seen from this that the question of mechanical equivalents has an intimate relation with the parts in which they are combined, and this is the reason why it is impossible to give an illustration of a mechanical equivalent which is capable of wide application. In some combinations a spring and weighted lever would be mechanical equivalents, and in other combinations they would not. Or, again, in some combinations, toothed gearing and pulleys and straps would be mechanical equivalents, whilst in others they would not be so. If a universal instance were possible, it would probably be found that the two devices would cease to be mechanical equivalents, but would be found to be identical.

Subject Matter.—A favourite mode of impugning the validity of a patent is to allege that the patented invention is the same as one previously described, or differs therefrom merely by the substitution of mechanical equivalents. It will readily be seen that there is a great distinction in the doctrine of mechanical equivalents when viewed from the standpoint of infringement and that of subject matter. In the former case the principal question is, Does the substituted part effect the same result? The question in the latter case is, Does the substituted part, although performing the same function, perform others in addition, or render a combination generally more useful or of wider application, and was there any invention in making the substitution? There are many inventions which, although infringements of existing patents, are themselves proper subject matter for Letters Patent. In fact, all inventions for improvements must be infringements of the patented machine of which they are improvements.

Chemical Equivalents.—As you are aware, the law relating to mechanical inventions differs in many important respects from that relating to chemical inventions. These differences occur

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more with respect to the "subject matter" of Letters Patent than to infringement. What I have said with regard to mechanical equivalents and their application to infringements applies also, in some measure, to chemical equivalents. There can be no doubt that in patents for chemical processes the substitution of chemicals which are known to chemists to have the same result would constitute an infringement of the patented process. It is possible, however, to give an instance or two of chemical equivalents which may be said to have a universal application. For instance, if in the prescribed process the use of an alkali was prescribed, say potash, an infringer would not be able to use the process merely substituting soda. In nine cases out of ten the two substances can be substituted in a process. Again, in some processes where treatment of sulphuric acid, for example, is directed, you find express directions to heat or keep heated at, say, 100° for four hours, with acid of a specified strength. It is well known that by using a stronger acid the operation will be completed in less time; or by using a weaker acid, the same result can often be obtained by an increase in the time employed; or in the same time by an increase of heat. This really amounts to mere compensation; and an infringer cannot escape the charge of infringement by altering a process in this way, even although, by his so doing, the product may be a superior one. I am assuming in this instance that the product of the reaction is the same or substantially the same. It sometimes happens that a variation of temperature, proportion, or strength of acid produces a different result; for example, a disulpho acid in lieu of a monosulpho acid, or a disulpho acid isomeric with the one originally described.

Dealing now with chemical equivalents, I should like to mention for discussion the question of "isomeric" bodies, and how far a claim for one isomer will cover another. I will state two problems with a view to discussion. An inventor X brings into existence, after many experiments, a *new acid*, which we will term A; which acid is capable of acting on a whole series of organic bodies, which, for convenience, I will refer to as B^1 to B^{12}. The result of the reaction in each case being a colouring matter. We will assume that A is an entirely new chemical substance at the date of the specification. Other investigators in chemistry are attracted by this discovery. One of them, Y, ascertains first that A is not a single chemical body, but is composed of, in reality, two substances, which I will call A^1 and A^2; and he describes means for separating these two bodies, and states that A^2 is comparatively useless, and that A^1 when combined with B^1 to B^{12} gives very fine colouring matters. Another investigator (Z) ascertains that there are bodies isomeric with A^1 and A^2, and which also yield colouring matters when brought into chemical relation with B^1 to B^{12}. Two questions arise in each case. Are the inventions of Y and Z patentable, and, even if patentable, can the use of them be restrained by A? In one sense (but a limited one) isomers are chemical equivalents—equivalent in the sense that analysis cannot show them to be different. Morphine and piperine are both represented by the formula $C_{17}H_{19}N.O_3$. Their action on the human body is, of course, very distinct.

IRON AND STEEL CONSIDERED AS BUILDING MATERIALS.

A PAPER was read before the Society of Architects on the 13th inst., by Mr. T. Claxton Fidler, M.Inst.C.E., on the above subject. In introducing his subject the author said that, while in relation to house building iron and steel have only occupied a subordinate position, yet in greater structures they have often been selected as the only available materials for the work to be performed. These structures, though designed by the engineer, properly belong to the domain of architecture, and often, in overcoming the structural difficulties, and properly proportioning the members to resist the stresses brought upon them, the designer has sinned grievously against the rules of æsthetic propriety. The property of strength, which is that which renders iron and steel so valuable to the engineer, is a complex thing. In this respect the various descriptions of iron differ widely, and though this variety is formed by the presence or absence of certain chemical impurities, yet chemical analysis does not adequately explain the widely different mechanical properties. Indications upon this point are to be found in the appearance of a fractured specimen. In a great measure, the capacity for enduring stresses is imparted to the metal by the mechanical work which is done upon it. With regard to the resistance of bars to direct tension, it is found that it varies from about 7 tons per square inch in cast iron to ten times that amount in strong steel. This, however, does not take into account the capacity of the metal of yielding to the stress without breaking, and if the ultimate breaking weight be multiplied by the yield and expressed in inch-tons, a bar of very mild steel will come at the top of the new list of strengths. First-class Yorkshire iron will run this steel closely. In dealing with rectangular beams, another circumstance has to be taken into account—viz., the difference between the results of experiments, and the assumptions as to what these should be as deduced by the most careful calculations from the known elastic stretching produced by directly applied stress. Theory failed to solve this problem, but experiments undertaken have led to the adoption of flanged girders, the metal being thus employed in a more economical fashion than when in solid beams. A new series of conditions again obtain in columns or other members subject to direct compression, the strength of short cubes of any material giving little indication of the resisting power of long columns of the same, on account of the tendency of the latter to bend. Beginning with the cubes, those of the hardest steel are found to be the strongest, but these are unsuitable for ordinary constructional purposes, and, omitting them, good cast iron is found to take the highest place, with a resistance of 35 to 40 tons per square inch, and then the medium and milder forms of steel—the lowest place being taken by wrought iron, which will only withstand some 16 tons per square inch. But, in a long column, cast iron is found at the bottom instead of at the top of the list, and the reason for this is found in its low resilience. The power of resisting direct compression, however, is always important, except in the most slender columns, and these should be avoided. This can be most readily and economically done by removing the metal from the centre and spreading it out as far from the axis as possible, either in the form of a thin tube, or in four legs braced together, when its efficiency will be found to be increased from tenfold, to fiftyfold, or even more.

The author said that, in considering the application of these materials to the construction of buildings, it is not only the utilitarian point of view from which they have to be studied, but also the æsthetic; and a few commonsense rules may be laid down, the first and most prominent being that untruthfulness of construction should be avoided, such as the copying of forms applicable only to brick and stone in this widely different material. This fault, however, is an old one, as may be well seen in the Lycian tombs, where the forms of an earlier timber construction are found to be copied in the unyielding stone. Similar things were done with iron when it was first introduced, but this is already being changed, though the transformation has hitherto been dictated entirely by scientific, and not by æsthetic, considerations. The construction, though, which has been worked out by the engineer, is evidently that which is most fitted to the material, and the iron architecture of the future will not be an architecture of masses or of broad surfaces, but one of lines, marking and emphasising the principal lines of stress, as similar lines were similarly marked in the stone architecture of the mediævalists.

POWERFUL CORLISS MILL ENGINE.

OUR illustrations on page 77 represent a side elevation and plan of a horizontal single cylinder Corliss engine of very large dimensions, constructed by Messrs. Robert Wetherill & Co., Chester, U.S.A., for driving a new beam train at Messrs. Carnegie, Phipps, & Co.'s Homestead Steel Works, Pittsburgh, U.S.A., which works we recently illustrated in connection with our description of the visit of the Iron and Steel Institute to America. The cylinder is 54in. diameter, with a stroke of 72in., and the estimated power of the engine is 3,500 h.p. The bed-plate is of the Tangye type, having the plummer block cast in the bed. The crank shaft, which is an open-hearth steel casting, is 27in. diameter in the journals and 30in. diameter in the wheel seat. The journals are 48in. in length, and are provided on either side of the shaft with adjusting wedges and screws. Power is transmitted directly from the engine shaft to the rolls by clutch couplings, which are also open-hearth steel castings. The fly-wheel is 27ft. in diameter, weighs 80 tons, and is made in segments planed and fitted together. An idea of the proportions of the engine may be obtained from the dimensions of the crank disc, which is 9ft. 4in. diameter, with a crank-pin 16in. diameter. The guide surfaces are cast independently of the bed, and bolted on. The cross-head is an open-hearth steel casting with a pin of forged steel. The trip arrangement is of an improved type, reducing the effort on the part of the governor in releasing to a minimum. The valve gear is proportioned for the unusually heavy service for which the engine is used. A distinctive feature will be observed in the arrangement of the valve levers connecting to the steam and exhaust valves, all of which are of the double-arm type, thus avoiding overhanging pins. For closing the steam valves vacuum pots are used, mounted on brackets secured to the steam cylinder. For convenience in starting and stopping the engine a by-pass valve is attached to the side of the main stop-valve chamber. The main stop-valve is fitted to an 18in. steam pipe. The exhaust opening in cylinder is made for a 20in. pipe. The valve-gear and valves being too massive to be moved conveniently in starting and stopping by the usual method of a lever entering the wrist-plate, a hydraulic attachment is connected to the wrist-plate for moving the valve gear, and in the event of the material fouling in rolls the engine can be stopped and reversed by the same attachment. The open-hearth steel castings used in the construction of the engine were furnished by the Standard Steel Casting Company, of Thurlow, U.S.A. We are indebted to our American contemporary, *The Iron Age*, for our illustrations.

A NEW LEAD PIPE JOINT.

WE illustrate herewith a new and ingenious method of making lead pipe joints, which has been patented by Messrs. Smith & Cooper, and which is likely to be extensively used. It is being introduced by Mr. B. Cooper, of Rhodes Mill, Middleton, Lancashire. The joint is made by forming on the two ends of the piping to be joined right and left handed threads, and then joining them by means of a coupling nut. To accomplish this a small case of tools, which can easily be carried in a workman's pocket, are provided. These consist of a diminishing tool, having an internal conical recess, which is driven

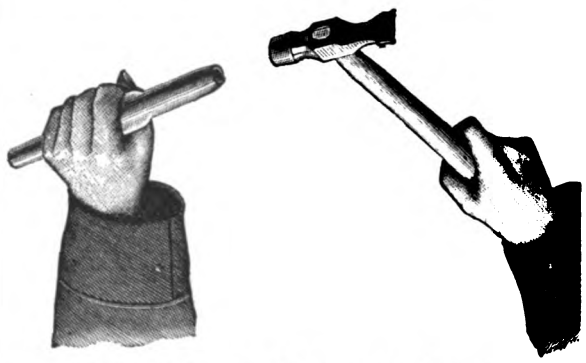


FIG. 1.—PROCESS OF DIMINISHING LEAD PIPE.

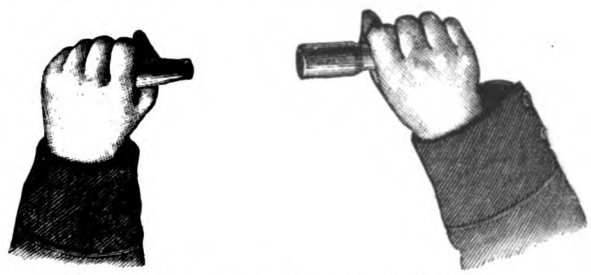


FIG. 2.—SKETCH OF LEAD PIPE DIMINISHED.

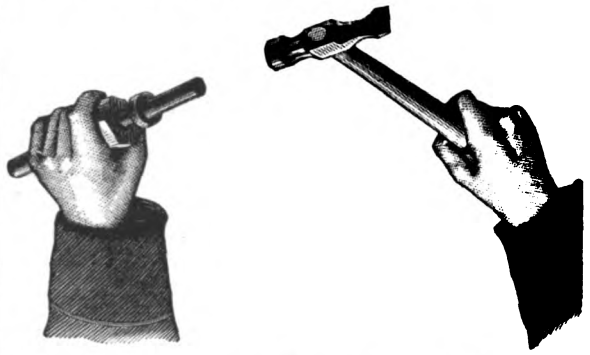


FIG. 3.—PUTTING THREAD ON LEAD PIPE.

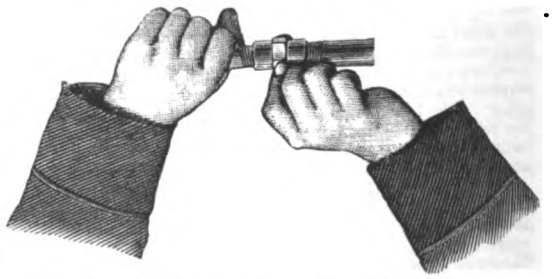


FIG. 4.—SHOWING JOINT WHEN COMPLETED.

upon the end of one of the pipes as shown in Fig. 1, thereby compressing it into a diminished conical shape, shown in Fig. 2. An internally screwed nut of the required size, and open at both ends, is placed on the taper end of the pipe, and into the latter a plug is driven (Fig. 3), which forces out the sides into the thread of the nut, thereby moulding a similar thread on the pipe. This process is repeated with a left hand threaded nut on the end of the other pipe, and afterwards the coupling is applied, as shown in Fig. 4. The maker claims that by this means a joint may be made in about one-fourth of the time required by the soldering process, that it does not require a skilled workman, and that the total cost of the new joint is considerably less than joints made by any other process. For removal purposes the joint may be uncoupled and remade by simply unscrewing or screwing up the nut. We are informed that the Manchester, Salford, and Heywood Corporations have granted permission to use these joints, in connection with their water supply.

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POWERFUL CORLISS MILL ENGINE.

CONSTRUCTED BY MESSRS. ROBERT WETHERILL & Co., ENGINEERS, CHESTER, U.S.A.

(*For description see previous page.*)

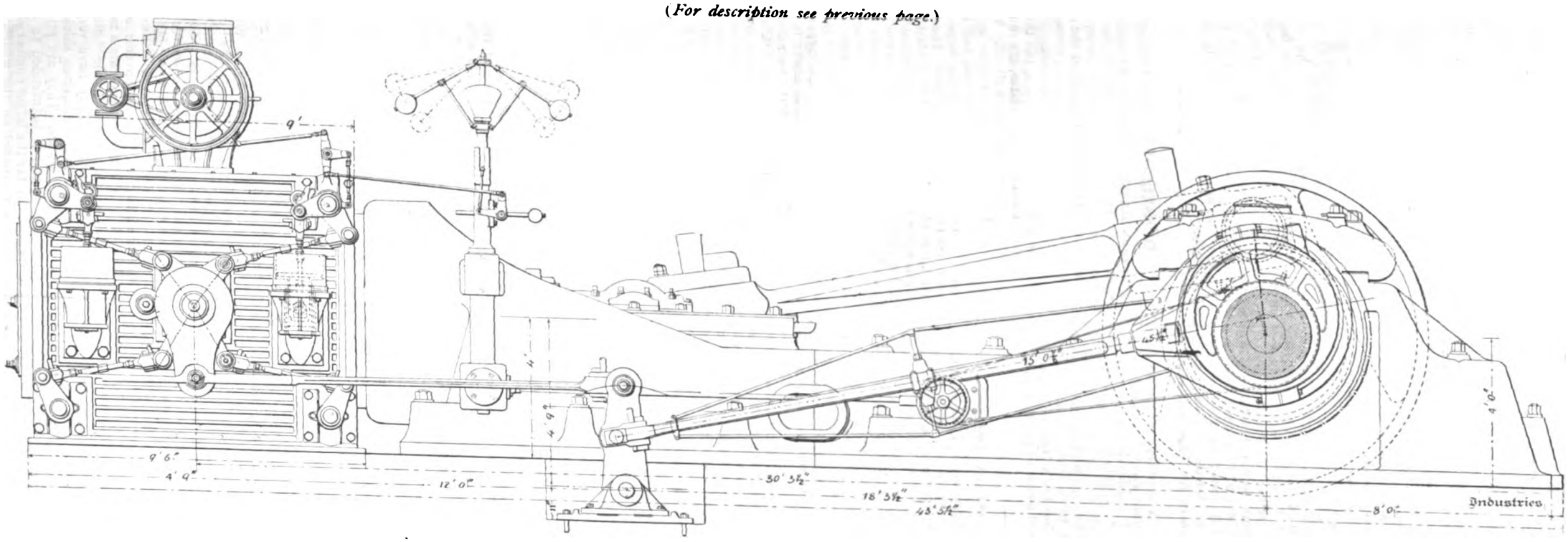


FIG. 1.—SIDE ELEVATION.

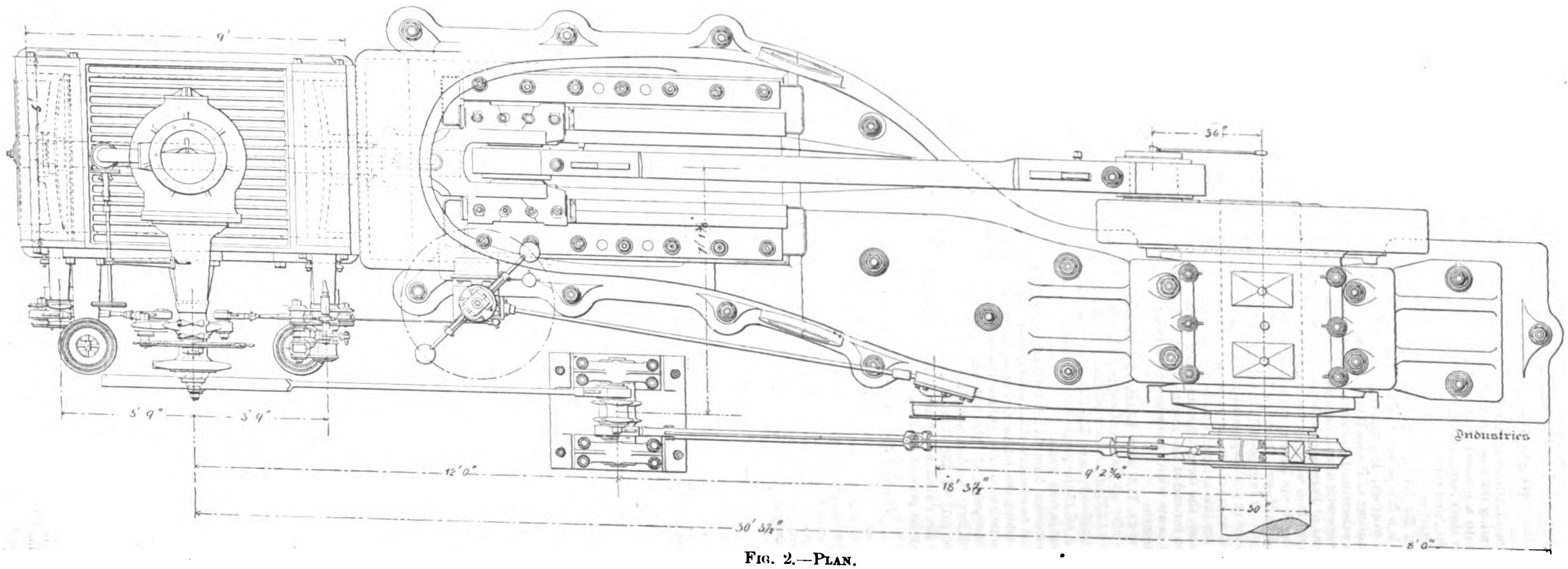


FIG. 2.—PLAN.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 20th January, 1891.

Iron.—Little or nothing has been done in the iron trade here during the past week, and reports from the provinces testify to a general state of lethargy. The Paris Syndicate at their last meeting established the price for bars at 132s. 6d., and for joists at 140s. 6d., but business has been transacted as low as 128s. 6d. per ton for bars, and 136s. per ton for joists. Old iron rails are quoted at 72s. 4d. There is a fair prospect of business on the cessation of the severe weather. In a recent interview that Mr. Yves Guyot, the Minister of Public Works, had with the representatives of the suburban districts, he assured them that the lines of tramways which have for a long time been projected for the environs of Paris should be shortly put in hand. The supplying of iron work, to the amount of over 700,000fr., for a building in the Jardin d'Acclimatation here, has been entrusted to Messrs. Dubois & Nicolle, of Paris.

Coal.—It is expected that there will be large advances in the price of coal next week; retail dealers are commencing to ask as much as 50 per cent. increase on the current price for this article. Fuel is for the most part sent to Paris by water, the freight by rail being high, and an estimate can be formed of the situation here in looking at the empty canal boats which have now been lying ice-bound for the last month.

Copper, Tin, and Lead.—Prices have gone down 20s. per ton for all classes of copper without exception. First quality Chilian bars are officially quoted at £57, and ordinary Chilian bars at £55 the ton. There is also a general falling off in the prices for all kinds of tin, and the lead market is very weak.

Proposed New Customs Tariff.—The Customs Commission (*commission des douanes*) have finally adopted a list, from which the following duties on metals are an extract, and which now only awaits the decision of the Chambers. The discussion of this Bill will doubtless fill up a great part of next Session, and give rise to strenuous opposition on the part of the limited Free Trade party, as in most cases the duties are considerably higher than those existing under present treaties.

Proposed Entrance Duty per 100 *kil.* (220*lb.*).

	General Tariff. Francs.		Minimum Tariff. Francs.
Paper-making machinery	12	...	9
Printing machines	10	...	6
Agricultural machines (motor not included)	12	...	9
Sewing machine tables	20	...	12
Sewing machine heads	60	...	40
Dynamos of 1 ton weight and upwards	30	...	20
,, 110lb. to 1 ton	50	...	30
,, 22lb. to 110lb.	90	...	80
Machine tools weighing more than 1 ton	20	...	10
,, ,, of from 660lb. to 1 ton	40	...	20
,, ,, below 660lb.	80	...	50
Stationary engines with fly-wheel	9	...	7
Marine and pumping engines	16	...	12
Locomotives and portable engines	20	...	15
Gas, petroleum, hot, and compressed air engines, over 660lb. weight	16	...	12
Gas, petroleum, hot, and compressed air engines, under 660lb. weight	25	...	20
Hydraulic machines, turbines, &c.	16	...	10
Locomotive tenders	15	...	10
Boilers, not including castings for fire-grate	20	...	9
,, tubular	25	...	14
All apparatus for refining sugar, distilling alcohol and perfumes, and refrigerating apparatus in the construction of which brass or copper is the principal metal, weighing 660lb. and upwards	35	...	20
Below 660lb.	60	...	40
Detached castings, finished or adjusted, weighing 1 ton and upwards	18	...	12
Below 1 ton in weight	25	...	15
Finished detached wrought iron or steel pieces (including axles, springs, and wheel tyres), weighing 660lb. and upwards	18	...	15
From 220lb. to 660lb.	25	...	20
Below 220lb.	50	...	30
Parts of electric machines in brass or copper weighing less than 2½lb.	100	...	75
All iron work for railway carriages and waggons, domestic furniture, doors, windows, locks, &c., in iron or bent sheet iron	20	...	15

French Submarine Cables.—The statistics of the Postes et Télégraphes, which have just appeared, give 1,000 as the number of submarine cables in use all over the world. The cost of these cables is about twenty million pounds. Of those which belong to Governments, Denmark owns 36, England 104, Germany 35, France 46, Greece 45, Italy 22, Spain 3, Brazil 19, India 72, and Norway no less than 236.

BERLIN, 19th January, 1891.

Iron.—The firmness of the iron markets continues, but the demand revives very slowly. The increase of business done is not sufficient to account for this firmness in prices, which has developed into a distinctly marked upward tendency for some classes of iron and steel. One of the causes which have operated to bring about a more stable state of things is the strong situation of the coal trade. With dear fuel and a prospect of still higher rates for coal, iron manufacturers were compelled to make a stand against the "bearing" influences of speculators. Another cause of no small importance is the prospect of large purchases of iron on the part of the Government. It is reported that the Landtag is to be asked to grant a credit of about 100,000,000 marks, 50,000,000 of which are to be spent in railway extension and in augmenting the rolling stock of the existing lines. Portions of the permanent way, too, are to be relaid with heavier rails. Though no great increase has taken place in the demand since the beginning of the year, inquiries are more numerous. There is manifestly a disposition on the part of consumers to buy more largely, which is held in check only by the exceptionally severe weather which has brought so many out-door works to a stand. The export trade remains in a languid state. The following statistics are instructive—the figures relate to the export trade of the years 1889, 1886, and 1883 respectively, in iron and steel:—To Russia, 67,190 (49,486, 66,890) tons; to Austria-Hungary, 24,363 (23,225, 60,537) tons; to Switzerland, 61,405 (50,477, 44,623) tons; to France, 13,844 (19,938, 48,483) tons; to Belgium, 40,268 (124,724, 53,111) tons; to Holland, 79,842 (108,569, 97,177) tons; to Great Britain, 72,020 (48,754, 66,816) tons; to Italy, 66,415 (73,786, 68,009) tons; and to North America, 53,024 (94,887, 71,887) tons. The figures for 1890 will show a serious shrinkage.

Soapmakers' Syndicate.—A meeting of the several associations of soap manufacturers was held the other day at Frankfort for the purpose of considering a scheme for uniting them into one "union." If this scheme be carried into effect, and, judging from the feeling of the meeting, it will be carried into effect, the soapmaking industry of Germany will be controlled by a "ring," whose first efforts will be directed to raising the selling prices, which are now very low relatively to the cost of production.

VIENNA, 19th January, 1891.

The Iron Market.—The enlargement of the boundaries of Vienna by the inclusion of its suburbs is likely to cause increased activity in the building trade, and hence also in the iron market, during next spring. Some important orders for rolling stock have lately been placed, the Southern Railway Company having ordered 10 locomotives, 80 goods waggons, and 50 passenger carriages, which are to be constructed by home manufactories. The Vienna Waggons Loan Company is about to increase its rolling stock by 500 waggons. As the result of long negotiations the Austro-Hungarian Iron Syndicate has been renewed for the next three years.

The Coal Market.—The coal market continues active. During the temporary stagnation of the traffic, owing to the snowstorms, the demand increased, and the traffic has resumed its former activity. The traffic returns of the various railways show the extraordinary amount of business done during the past year. The State Railways of Saxony forwarded 300,000 tons of Bohemian coals last year more than in the previous year. The Aussig-Teplitz line carried 1,660,000 tons to the Elbe last year, against 1,330,000 in the year 1889. The Dux-Bodenbach line shows an increase of 450,000 tons in the quantity of coal carried, and the Prague-Dux line an increase of 140,000 tons. These amounts show the increased production of Bohemian coals, and this increase may be expected to continue during the present year. The Northern Railway Company have not yet sold their coal mines, though the Credit Bank, Count Larisch, and Count Wolezek each offered ten million florins for them.

Electrical Engineering.—The Government has just granted to the Anglo-Austrian Bank a concession for the formation of the General Austrian Electricity Company.—Messrs. Ganz & Co., of Budapest, announce that the electrical central station constructed by them for the Roman Gas Company at Tivoli, near Rome, will be opened on the 1st May next.

The Customs Treaty with Germany and the Iron Industry.—Six years ago the Government, which has since that time been in power, saw the necessity of reducing the imports from Germany, in order that a chance might be given to native manufacturers of producing goods which up to that time had been imported. On this understanding capital was invested in new and already existing industries. Now that these industries are beginning to come into full operation, the treaty, which it is now proposed to conclude with Germany, will allow such goods as a short time were produced by our manufacturers under great disadvantages to be imported into Austria from Germany. It seems that we are thus departing from the principle that Austria should produce its own iron, and under such circumstances the apprehension which is felt by the iron industry concerning the new Customs Treaty is justifiable.

BRUSSELS, 20th January, 1891.

Iron.—There is but little that is encouraging in the near prospects of the iron trade. During the last week there has been a little buying on English account, and there are other orders of somewhat greater importance in sight in the same direction. Beyond this there is no improvement, and the depression is very great. Manufacturers are losing heart, and have begun to reduce the number of hands in their employ. Already a considerable number have been discharged, and much larger numbers are under notice to cease work at the end of the month. Production is now barely more than half what it was this time last year, but the requirements of consumers are insufficient to absorb even this restricted output. The amount of business done does not, however, represent the whole of the difficulties of the situation. Prices have dropped to an unremunerative level, so that on the few transactions which take place there is no profit; often a loss is incurred in executing an order. Every account received of the blast furnace industry speaks of fresh furnaces being blown out. No improvement is to be looked for till coal has become cheaper, and of that there is no immediate prospect. Several of the blast furnace owners have contracted for a six months' supply of coke from Germany. Shares in iron concerns are at a discount.

Coal.—The demand for house coal has increased so much of late in consequence of the exceptionally cold weather, which still prevails, that the falling off in other sorts, notably those suitable for metallurgical purposes, is not felt. Never were the coal markets, as a whole, more active than they are now. In the first week of the year the quantity despatched by railway from the pits amounted to 234,890 tons, against 190,110 tons in the corresponding week of 1890.

DÜSSELDORF, 20th January, 1891.

The Iron Market.—Trade looks more promising than a week ago. The pig iron stores at the Westphalian and Rhenish blast furnaces declined during the months of November and December, in spite of the many holidays in the latter month. The prices are generally the same, but best forge pig has risen to 54–56 marks. The finished iron trade is in a fairly good condition, but the makers of wire, and recently those of boiler plates, are suffering. The Saar and Lorraine district is very well off. The production of pig iron in 1890 was 1,012,030 tons, against 899,924 in 1889, the production of Thomas pig (all kinds of pig iron fitted for the basic process) having increased from 294,401 tons in 1889 to 331,003 tons in 1890. The Burbacher Works have lately blown down two of their blast furnaces, but they will be again blown in next spring when the new Bessemer steel works, which are now under construction, will be ready. These famous works have hitherto made only wrought-iron girders, and the new department will consist of two basic converters of 10 tons capacity each. The Völklinger Hütte, which is situated close to the Burbacher Hütte, is erecting a plant of the same capacity, and both will begin operations next spring. These works, in conjunction with those of Gebr. Stumm, make the Saar district a formidable competitor of the Westphalian district.

The Coal Market.—The market continues to be very firm. The Westphalian collieries are sold out for the first quarter of this year, and prices are rising. As the greater portion of the production passes through the hands of three syndicates at Dortmund, Bochum, and Essen, present prices seem likely to remain steady. The want of coal waggons on the railways continues, which is shown by the fact that the Erin pit, near Castrop, recently got only 15 waggons, while the administration had ordered 130, and the Hugo pit, near Carnap, only 35 out of an order for 110. The management of the railways is made more difficult by the disorder prevailing on all Dutch railways, which in the past weeks received 4,000 more waggons from Germany than they delivered. The coke market is in a very good condition. The current prices for smelting coke vary from 130 to 150 marks.

The Verein Deutscher Eisenhüttenleute.—At meetings held on the 21st ult. and the 11th inst., which were attended by some 500 members, papers were read on the American trip of last October. Mr. Thielen, Mr. Brauns, and Mr. Schrödter gave general *résumés* of the Southern, the Northern, and the Canadian trips, while Mr. Schlink and Mr. Schilling discussed the American blast furnace practice. Mr. Spannagel read a paper on "Rolling Mills," Mr. R. M. Daelen on "Steel Making," Mr. E. Klein on "Engineering Appliances," and Mr. Macco on "American Railway Practice." There was a very good discussion, in which Dr. Wedding took part.

Shipbuilding.—In German naval circles the most important event of the past year is, without doubt, the beginning of the four men-of-war of 10,000 tons each. Two of these big ships will be constructed at the Vulcan Works in Stettin, the third by the Germania at Kiel, and the fourth in the Imperial Wharf in Wilhelmshaven. The cost of each of them is estimated at 10,000,00 marks, excluding the cost of the armament, which amounts to 4,000,000 marks. Besides these ships, the building of a large yacht for the personal service of the Emperor is projected. In 1890 there were launched the "Aviso Meteor," in Kiel; the cruiser "Bussard," in Dantzig; the "Pelikan," in Wilhelmshaven; and the man-of-war "Beowulf." The latter represents a new type of this kind of ship, the first of which, the "Siegfried," was put in service in the spring. They have very powerful engines, the plates are 240 millimetres thick, and the guns are placed in two towers. They are primarily intended for coast defence, and it is intended to build eight more of this kind. By far the larger number of the German torpedo boats are constructed on the wharfs of Mr. Schichau, in Elbing, who is now proceeding to complete the number up to sixty vessels.

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TRANSATLANTIC SERVICE.—The Norddeutsche Lloyd, whose fleet now consists of more than eighty steamers, has announced its intention to begin in March next to make three trips every week from Bremen to New York, and *vice versâ*, by fast-going vessels. The steamers will leave these harbours on every Tuesday, Wednesday, and Saturday. The latest steamer, the "Spree," of 9,500 tonnage, has made a very quick voyage. As these steamers call at Southampton, and also carry mails to England, all English firms having connections with the United States will be glad to hear of these new postal arrangements.

AMSTERDAM, 19TH JANUARY, 1891.

THE WEATHER AND NAVIGATION.—The difficulties of navigators in various parts of Holland, in consequence of the exceptionally severe weather, still continue. Amsterdam is not yet accessible, although a large staff is kept working night and day sawing through the ice in the North Sea Canal, assisted by the torpedo staff of the Royal Navy, which uses gun-cotton and dynamite to destroy the ice floes and ice blocks as soon as cut. The impression made is, however, not considerable. At Rotterdam an ice dyke is at last forming in the new waterway which seems likely to prove troublesome if the frost should continue. At Flushing the crowd of vessels—steam and sailing—unable to reach Antwerp still continues, and as many as 100 are now lying in the harbour or in the roads. Unfortunately the carrying power of the State Railways has nearly broken down under this sudden weight of cargoes, and the latest intelligence shows that only a proportion of the goods discharged by the incoming vessels can be moved to their destination. The other goods are either left in the ships or upon the quays waiting for despatch. Flushing has as yet no bonded warehouses, and this want is severely felt now, especially in the case of perishable merchandise, which is liable to damage by lying exposed upon the quays.

THE RAILWAYS.—The unprecedented block upon the main lines of the Dutch railways is still unabated, and if a general strike of workers were in full swing the state of things could not well be worse. It has been confirmed that goods from Germany are not at present accepted for transmission through Holland, and the goods traffic from Belgium has likewise been brought to a standstill. The annoyance and the losses falling upon traders and manufacturers, both home and foreign, are very considerable.

THE TRADE OF ROTTERDAM IN 1890.—From January 1st to December 27th, 1890, 4,437 vessels were cleared inward at Rotterdam, against 4,380 in 1888, and 4,432 in 1889. These totals do not include fishing craft. The tonnage entered was 3,784,500 in 1888, 3.973,200 in 1889, and 4,224,275 in 1890. This would tend to show that ships of a larger size are now availing themselves of the facilities that Rotterdam offers.

NEW COMPANY.—The articles of association have been approved in the case of the "Dutch and German Transport Company," with a capital of 250,000 guilders, formed for the purpose of organising transports between Holland and Germany, and trading upon the Rhine and other rivers and canals, either with owned or chartered steamers and sailing vessels.

STOCKHOLM, 17TH JANUARY, 1891.

PROJECTED IMPORTANT RAILWAYS.—As the natural resources of the country become more and more developed, the need of improved means of transport and communication naturally increases. The plan of connecting Ornsköldsvik with the North Tunnel Railway by means of a junction railway has long been under consideration, and is now likely to be realised, as it is hoped that the Government will introduce a Bill providing for its construction in this year's Parliament. Although the new railway, when completed, will no doubt prove an important one, it is neither a long nor an expensive line. The cost is calculated at 1,548,000kr., and the length is only 29 kilometres. Even if the cost should reach 1,800,000kr., as the officials of the State Railways have estimated, it is thought the contemplated line should be able to pay its own way. Of other new railways likely to be soon taken in hand are the lines between Trelleborg and Oxie, or some other point on the Malmö-Ystod line, and the Herniösand-Salleftea Railway.

SWEDISH WOODEN HOUSES.—This industry seems to be constantly increasing its market, the Swedish wooden houses being of a pretty construction, and also cheap. From Brazil an order has just been received for thirty of these houses.

REDUCTION IN THE OUTPUT OF TIMBER.—The efforts which have been made to lower the output of timber in Sweden have led to satisfactory results. The reduction agreed upon affects both Sweden and Finland, and amounts to about 30 per cent. of the production, which represents more than 11,000,000 pieces of timber, or, reduced into goods ready for export, some 350,000 "standards." It is stated, in a circular issued by the Export Society, that the proposal to reduce the present winter's output has been accepted by eighty-five of the timber exporters in the North, whose floatings last year amounted to 20,897,245 pieces of timber, and who have undertaken, subject to others following suit, to reduce their floatings during the present winter to an aggregate of 13,851,987 pieces of timber. There is to be a decrease in the output of timber from Norrland, for the present winter, of 7,045,258 pieces of timber, which is a reduction of about 34 per cent. as compared with last year's output. The society, in its circular, confirms the agreement entered upon. The reduction agreed upon in Finland reached about 4,000,000 timbers up to the end of 1890. Such agreements are sometimes regarded sceptically, but as the undertaking is given in the most binding manner, and as the society intends to control the output, there can be no reasonable doubt about its being faithfully carried out.

CHRISTIANIA, 17TH JANUARY, 1891.

THE PAPER INDUSTRY.—This industry is continuously increasing in Norway, which is a natural consequenee of the advanced wood pulp manufacture. The less favourable state of the wood pulp market has for the last few years caused manufacturers to search for some remedy, and the paper manufacture has thereby obtained a great impetus, which has brought about several important installations, with improved machinery. The Gjethus paper mills have been rebuilt, after the fire, in a very satisfactory style. The manufacture of paper will commence with two machines, to which two more will probably be added, and the manufacture of half-cellulose has also been decided upon. At the Bentse mills paper for newspaper is the main feature, and three of the machines are used for production, the raw material being wood pulp, both mechanical and chemical. At the Alvöen paper mills the make of packing paper has been at least partly abandoned for better kinds. The Bohnsdale, the Kleofos, the Strois, the Tinfos, the Graufos, and one or two other paper mills either have already started or are about to start new and extensive machinery. The Union Company paper mills, which are not yet completed, will probably be the largest establishment of this kind in Norway, and one or two other large works are projected. The number of paper machines has been nearly doubled during last year. With the great amount of available water power, and the production within the country of the most important raw material, Norway certainly possesses very fair chances of making the paper manufacture an important industry.

MADRID, 19TH JANUARY, 1891.

SHIPMENTS OF IRON ORE AT BILBAO.—The fall of snow has caused much inconvenience in the working of the mines, and many ships have been detained. Shipments of hematite pig iron have been chiefly for the Glasgow market. The market at present looks weak, and lower prices are expected, though the cost of production will probably remain the same. The expenditure on fuel will be lessened when Spanish coke is used in the Bilbao blast furnaces, but two years will probably elapse before coke is chiefly used in the furnaces.

THE COAL BASIN OF THE SOUTH.—The coal companies in the neighbourhood of Belmez, Espiel, and Peñarroya are now making large profits. The output for the year 1890 was 260,000 tons, whilst the amount sold was 330,000 tons, so that orders are in excess of the supply. Prices, therefore, continues to rise, large coal being sold at 24s., and small at 11s. The average cost of production is from 7s. to 8s., and mine owners are trying to increase the output in consequence of the large profit. An English company is supposed to be about to work some new mines, and if the prices are maintained in England, and the working expenses are kept low, the business is likely to be very profitable. The Gibraltar market may possibly receive its supply from this coal region if a line of railway should be made to a shipping port on the Guadalquiver.

COMMERCIAL RELATIONS BETWEEN CUBA AND SPAIN.—Since the revolution of 1869 there has been a tendency to use the term "ultramarine provinces" in place of "colonies," and progress has been made towards a total assimilation of Spain with her colonies. An important step in this direction was made when goods produced in the colonies were regarded as national goods and admitted into Spain free of duty, and in the same way Spanish goods were to enter free into Cuba, Porto Rico, and the Phillipine Islands. This measure was favourable to Spanish industries generally, and to the cotton mills in particular. Matters were going on satisfactorily until the passing of the McKinley Act. It seems almost impossible to reconcile the conflicting interests which have arisen with regard to the mother country and the colonies through the passing of that Act.

NEW YORK, 10TH JANUARY, 1891.

PIG IRON.—The past year breaks all records of pig iron production in the United States. As estimated by the *American Manufacturer* the total production for the year amounts to 9,091,979 gross tons, or 10,183,016 net tons, which is 1,666,937 tons in excess of 1889. Low prices and stocks accumulated caused the production in the second half of the year to be considerably below that of the first. In the Pittsburgh district production is much in excess of the demand, buying still being poor on account of the stringency in the money market. Bessemer pig, which a year ago was selling at $24, and is now about $16 per ton, must have nearly reached its lowest limit, as coke is 35c. dearer and ore $1 dearer than a year ago. The decision of twenty-three firms in the Shenango and Mahoning Valleys to shut down their blast furnaces to-day because of high coke and freight rates will result in making prices firmer. As these furnaces have 80,000 to 90,000 tons in stock, they can better afford to shut down than to continue in operation.

GOVERNMENT CONTROL FOR RAILROADS.—The Attorney-General of Nebraska, in his report to the Governor, deals with the railroad question in severe terms, and advocates the Governmental control of railroads. In speaking of the Board of Transportation composed of five State officers, of which he is one, he says that the system is a complete failure, as the railroads, by their influence, prevent adequate relief for the people. The report refers to the recent consolidation of interests in Western railroads, and declares that it is a menace to public rights requiring immediate attention. Government control is urged as the only remedy, as such consolidation furnishes an effective army for political work, and it is said that the political influence of railroads is already too strong. The report urges the Governor to bring the matter before the Legislature, so that it may send a memorial to Congress, and bring the question to an issue by foreclosing the lien of the Government on the Union Pacific Railroad Company.

REPORTS OF RAILROADS.—The report of the Lake Shore and Michigan Southern road for the year shows that the gross earnings were $20,874,200; the expenses, $14,189,200; net earnings, $6,685,000. After deducting declared dividends, a balance of $342,010 is left. The annual report of the Michigan Central Railroad shows—gross earnings, $14,340,000; expenses, $10,514,000; net earnings, $3,826,000; and surplus earnings, $1,372,000. After deducting the share of the Canada Southern, and the amount of the declared dividend, there remains a balance of $102,091.

WOOL.—In its annual review of the wool trade of the United States the *American Wool Reporter* estimates that the total supply now on hand amounts to 92,820,000lb., as against 99,285,000lb. a year ago. The figures for the first ten months of 1890 show a total importation of 87,944,194lb., in comparison with 110,721,455lb. for the corresponding time last year, and in consequence of the lessened amount of foreign wool on the market there is a marked improvement in the wool goods business. The supplies of wool in the United States cannot be considered burdensome, the only weak spot in the outlook being the probability of increased importation of foreign wools after the beginning of the year.

PHILADELPHIA, 9TH JANUARY, 1891.

CHICAGO CANAL TO THE SOUTH.—The report of the chief engineer of the Chicago Drainage Commission favours a deep-water channel from Chicago to the Gulf of Mexico, as well as to the Atlantic Ocean. He estimates that a channel 20ft. in depth by 600ft. wide would actually cost less than the 8ft. depth and narrow width proposed by the Federal Government, because of the difference in location. The report recommends the abandonment of the lake front for other than refuge purposes, and in place of the lake front he puts the Chicago and Desplaines River and the proposed ship canal, with additional outlets through the heart of the city. The filling in of the lake front would give a large quantity of immensely valuable land, the income of which would in the end relieve Chicago of all taxation for the great waterway.

RAILWAY EXTENSION.—Details published in the *Engineering News*, show that the total addition to the railway mileage during the year 1890 was nearly 5,800 miles, or about 700 miles more than were laid in 1889. The total amount of railway completed on January 1, 1891, is 167,172 miles, and of this amount over 36,000 miles, or 22 per cent., have been constructed during the last five years. The greater part of the mileage for the year has been laid in the Southern States, where the rate has been increasing for a number of years, although it has been stationary or decreasing in nearly every other section.

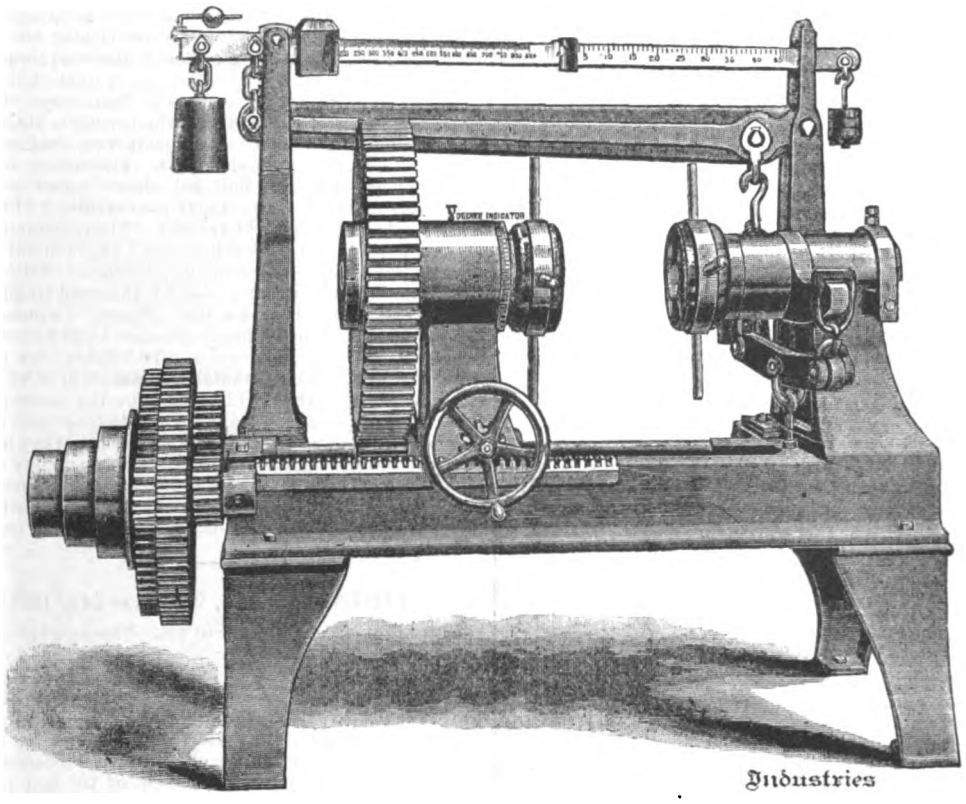
MAKING A RIVER FREE OF TOLL.—The United States District Court has recently delivered an opinion fixing $209,000 as the sum to be paid by the United States to the Monongahela Navigation Company for lock and dam No. 7 in the Monongahela River. This is an important step in the contest being made by shippers, consumers, and owners of river craft for free navigation of the waters of the United States. Nearly fifty years ago the Navigation Company constructed a chain of seven slack water dams in the Monongahela River extending from Pittsburgh to a point near the West Virginia State line. This was done to enable navigation of the stream at all seasons, and has resulted in raising the river from one of comparatively no importance commercially to one of great use. At that time the general Government had little money to spare for such improvements. Toll is charged upon all shipments. There has long been a demand that the general Government should make the river free, and two years ago $162,000 was appropriated to buy one of the dams and make it free. The company refused to sell at that price, and valuers fixed the price at $209,390. The company appealed to the Courts, which have just decided that $209,000 is the amount to be paid. The company is likely to again appeal, as the Court held that the river belongs to the general Government, and nothing could be allowed for the company's franchise, the cost and earning capacity of the dam only being taken into account.

A LARGE IRRIGATION SCHEME.—The Bear Valley Irrigation Company has been incorporated in California, with a capital of $4,000,000, one-fourth preferred and the balance common stock. This company buys out the Bear Valley Reservoir property and the Alessandre tract of 216,000 acres of fruit lands, which is to be irrigated by the Bear Valley Reservoir water. Two million four hundred thousand dollars of the common stock is to be paid for these two properties, and the balance is to be sold to raise funds to build a new Bear Valley dam at a cost of $150,000 and also to convey the water to two irrigation districts comprising 510,000 acres of fruit lands.

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AN IMPROVED TORSIONAL TESTING MACHINE.

CONSTRUCTED BY MESSRS. RIEHLE BROS., PHILADELPHIA, U.S.A.



AN IMPROVED TORSIONAL TESTING MACHINE.

THE above illustration represents a general view of an improved power torsional testing machine as built by Messrs. Riehle Brothers, of Philadelphia, U.S.A., for the Union Pacific Railroad, Omaha, Nebraska, the Russian Government, and the Thomson-Houston Electric Company. The machine was originally constructed for working by hand, but has since been altered for power working. The fixed head, shown on the right hand side of our illustration, carries self-centreing grips, and has arms projecting from either side of the grip head, the whole being supported on a knife edge. To prevent the grip head lifting from its normal position, the arms are attached to an equalising lever underneath; the latter is in turn connected to the weighing beams, on which the torsional stress on the body under test is recorded in foot-pounds, thus obviating calculation on the part of the operator. The cone pulley, shown on the left, has four diameters, and is driven from a counter-shaft. The levers and weighing beams are adjusted to the United States standard. The whole is made of the best material, and has been carefully designed. We are indebted to our American contemporary, *The Iron Age*, for our illustration.

FORMAL INQUIRY INTO THE BOILER EXPLOSION AT JARROW.

THE Board of Trade inquiry into the circumstances attending the explosion of a boiler at Messrs. Palmer & Co.'s works, Jarrow, on November 17th last, was opened on the 15th inst. The Commissioners were Mr. Howard Smith and Mr. Matthew McIntyre. Mr. K. E. K. Gough conducted the inquiry on behalf of the Board of Trade. The parties in the inquiry were Mr. John Price, as representing Messrs. Palmer's Shipbuilding Company; Mr. Joseph William Reed, manager of their engine works; Mr. J. F. L. Crosland, as representing the Boiler Insurance and Steam Power Company, with whom the boiler was formerly insured; and Mr. Neil McDougall, as representing the British Steam Users' Society, with whom the boiler was insured at the time it exploded. The explosion was caused by the collapse of the boiler flue. Robert Scanlon, forgeman, was struck by a piece of flying material and killed; two men named Porthouse and Johnson were severely scalded, and a man named Evans was slightly hurt.

Mr. Smith, in giving judgment, said the boilers in the forge were under the charge of Mr. Reed, with Mr. Alex. McDougall, foreman boilermaker, acting under his instructions. On the 25th of June, 1890, Robert Ritchie, on behalf of the British Steam Users' Society, examined the boiler in question, and he said he complained to the engineer in charge as to the defective condition of the boiler. The British Steam Users' Society, in their report to the Messrs. Palmer, said:—"The flue tube of this boiler is evidently in a somewhat serious condition, and should be replaced at an early opportunity." Mr. Price never saw the report of the British Steam Users' Society, having been obliged to leave on the morning when it came; but he had told them that if he had seen it he would still have continued to work the boiler. They desired to give Mr. Price every credit for the way in which he had given his evidence, but they could not help thinking that he had made that statement because of his desire to screen Mr. Reed, who had been in the employment of the firm for a very long time. Then there was a working examination made of the boiler on November 10th, 1890, and the British Steam Users' Society then, although they had previously said that the flue was in a somewhat serious condition, and they would like to see it replaced, made no allusion to it in their November report. The explosion was caused by overheating, acting on a plate which had become dangerously thin by corrosion. The thickness of the plate that exploded was from ⅛th to 5-32nds of an inch. They did not suggest that the attendant in charge of the boiler was negligent. They had been asked certain questions by the Solicitor to the Board of Trade with regard to the conduct of the different parties concerned. With regard to Mr. Crosland, they were of opinion that there was no need for his company to order a further hydraulic test after the test of 1885, or drilling of the plates. With regard to Mr. McDougall, of the British Steam Users' Society, they did not think that he, looking at the interests of human life and the dangerous properties of boilers, was justified in accepting the insurance of this boiler on January 31st, as he did, without making a proper inspection of the boiler, of which only a working examination was made. They believed that he was alarmed about the condition of the boiler after Ritchie's report, and that he believed it was not safe to work the boiler till Christmas. They did not think that Ritchie made a proper examination, and he ought to have drilled the plates. It must be remembered that Mr. McDougall's Society had insured a very large number of Messrs. Palmer's boilers, and he might not wish to find fault with a boiler unless it was really in a seriou condition. He sent a notice, and heard nothing; and, although he had another opportunity of communicating with them when the external examination was made, again he did not do so. He said now that it was safe to work the boiler till Christmas. The Commissioners' impression was that he might think so after the explosion, but that at the time he wrote the letter referred to he was of opinion that the boiler was unsafe, and they were of opinion that it was unsafe. They thought he was to blame for not putting his inspector's report into definite form, and also for not calling Palmer & Company's attention to it later. They came to the conclusion that no blame attached to Mr. John Price personally, but technically, as representing the company, he was to blame. They thought that Mr. Reed was to blame for allowing the boiler to be worked after receiving the report in July, but they thought he had rather drifted into error than gone into it wilfully. What he ought to have done on receiving that report was to have stopped the boiler at once. He should not have allowed his desire to work the boiler to have weighed against possible danger to human life.

Mr. Gough asked that an order for a portion of the costs of the inquiry should be made against Mr. Price and Mr. Neil McDougall. Mr. Smith did not make any order against Mr. N. McDougall, but against Mr. Price, not in his personal capacity, but as representing the Palmer's Company, he made an order for £40 costs.

THE CLEVELAND INSTITUTION OF ENGINEERS.

A MEETING of this Institution was held at Middlesbrough on the 19th inst., and proved one of the most important held for some years. The principal item was to discuss a paper by Mr. James Davis, of Park Gate Works, Rotherham, on "The Manufacture of Basic Open-Hearth Steel." The President, Mr. C. J. Bagley, in opening the discussion, said that, in his opinion, basic steel must come to the front for plates, as it had already done for rails. This was a matter which was of the greatest importance to Cleveland, with its phosphoric ores.

Mr. P. C. Gilchrist, of London, pointed out that if they made steel which would contain ·05 per cent. of phosphorus, and would contain carbon up to about ½ per cent., it was a matter of perfect indifference to a skilful steelmaker whether he started with a mixture in the bath containing 2 per cent. or $\frac{1}{10}$th per cent. of phosphorus. The official attitude regarding basic steel abroad was very satisfactory. The German, French, and Russian Admiralties all accepted basic steel for their boiler plates. In England the Admiralty were examining into the matter. The question was of immense importance to England, as last year we imported four million tons of hematite iron from foreign sources. He had no hesitation in saying that basic steel, made from any phosphoric ore, was fully equal to any made from English or foreign hematite, and would meet all the requirements of Lloyd's, the Board of Trade, and the Admiralty.

Mr. W. H. White, Chief Naval Constructor to the Admiralty, said that the position in which basic steel stood in regard to the Admiralty was that corresponding to that occupied by Bessemer acid steel, which was largely used, but which was not used for certain specific portions of ships. The Admiralty had been experimenting for the past three or four years to determine how basic steel behaved under the rough treatment of the shipyard. They had learned a great deal, and that these experiments were not finished was not their fault. Meantime they were using basic steel rivets with excellent results, and the engineering department of the Admiralty were using basic steel tubes of low tensile resistance as the material they preferred.

Mr. Milton, chief engineer and surveyor of Lloyd's, claimed that Lloyd's Committee had not "thrown cold water" on the process. All the trouble with basic steel for shipbuilding had been with basic steel of high tensile strength. Lloyd's had always taken the position of accepting steel by any process which fulfilled their tests, and at present works were manufacturing basic steel for shipbuilding purposes under Lloyd's tests, and had been doing so for three years.

"SERVE" RIBBED BOILER TUBES.

WE recently gave an account (see *Industries*, Vol. IX., page 435) of this latest departure in boilermaking, and we are pleased to learn that the satisfactory results therein recorded continue to be borne out by actual experience. The steamer "Phra Nang," in which the boilers were fitted with "Serve" ribbed tubes, has made a successful passage out to China, and the Fairfield Ship-

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building Company has received a report from the chief engineer of the vessel, stating that the "Serve" tubes behaved quite satisfactorily throughout the voyage, and have caused an appreciable saving in the coal consumption. As there have been various circumstances which render it impossible to institute an exact comparison between the outward voyages of the "Phra Nang" to China and of the sister vessel in which the boilers are fitted with ordinary "plain" tubes, the steamship owners have expressed the desire that the two vessels shall complete three months' regular trading in the China Seas before a detailed report of the exact economy derived from the "Serve" tubes is made. Meanwhile the report just referred to must be satisfactory to the makers, Messrs. John Brown & Co., Limited.

Constant working of the boiler fitted with "Serve" tubes, with which the comparative trials were conducted at Sheffield, also confirms these experiences. At a recent comparative test of boilers Nos. 1 and 2, on the 15th inst., both under high "induced" draught, the former gave 15 per cent. greater evaporative efficiency and with slightly less fuel consumption. It is intended to continue the experiments with the view of demonstrating that with high accelerated draught, as commonly required in war vessels, the diameter of the boiler tubes can with advantage be largely increased, and thereby the choking of the tube ends—a common source of trouble when "plain" tubes of small diameter are adopted—can be obviated without any loss in evaporative efficiency.

THE INSTITUTE OF MARINE ENGINEERS.

A MEETING of this Institute was held on the 13th inst., when a paper was read by Mr. F. W. Shorey, on "Capital and Labour." The paper dwelt first with the origin of wealth, the source of the latter being set down as the material held by mother earth, until won from her hand by the skill and labour of man. Granting the materials to be at hand, labour is necessary for moulding them into shape for the purpose of commerce. The value of the products of work differs according to the facilities at command in the various countries for disposing of such products, while the climatic and national differences in respect to food, clothing, and other neccessaries of life tend to regulate the cost of production, and it may be added that the mental and physical culture of the working also affect the cost, and more especially the true value of the product. Reference was made to the recent strikes in London, and it was questioned whether any gain had accrued either to the country or to those particularly concerned in the strike except in a few isolated cases. The words of Sir H. Parkes were quoted, in which he said that the strike in Australia was almost as disastrous as a bombardment, and added that the country would suffer less at the hands of an enemy.

In the course of the discussion which followed the paper, it was urged that far too much had been made of the "labourer and his hire" in very many cases by agitators whose capital was the discontent they could ferment amongst classes of workers of all kinds. It was further urged that the wealth of a nation consists in the wisdom, skill, and brains of its rulers, that the brain of Nasmyth, which planned the steam hammer and gave it to the nation, had been more powerful for good than the brains of many scores of labourers, therefore it was meet that the brain, skill, and energy which direct capital and invest it in works which give employment to the labourer should be left as free and unfettered as possible. The proceedings were brought to a close by a vote of thanks to the author. The discussion will be continued on the 27th inst.

It has been proposed that premises should be purchased at Stratford for the better accommodation of the Institute, for the purchase of which £269 has been voluntarily subscribed. Further donations are promised.

SHIPBUILDING NOTES.

MESSRS. FLEMING & FERGUSON, shipbuilders and engineers, Paisley, have received notice of the arrival at her destination of the steam paddle tug "Mana," which they lately built and engined for the Timaru Harbour Board, New Zealand.

ON the 8th inst. there was launched from the yard of the Blyth Shipbuilding Company, Limited, Blyth, a screw-steamer, built to the order of Mr. W. Todd Moffatt, of Aberdeen. The steamer is to carry about 260 tons, and is intended for the coasting trade. She will be towed from Blyth to Aberdeen to receive her engines and boilers, which are being constructed by Messrs. Blaikie Brothers, of Aberdeen. The Blyth Shipbuilding Company have also several new vessels on the stocks in various stages of progress, and their graving dock is at present filled by a Hartlepool steamer. In addition to these the company are engaged with the extensive repairing of several steamers at their quay and in the river.

ON the 8th inst. there was launched, on the Tyne, from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay, a steel screw steamer, the "Cragg," built to the order of Messrs. Fisher, Renwick, & Co., of Newcastle, and of the following dimensions, viz. :—Length, 180ft.; breadth, 28ft.; depth, 14½ft., and to class 100 A1 at Lloyd's. This vessel has water-ballast, and is also fitted with all modern improvements for the rapid loading and discharging of cargo, including three double-cylindered steam winches, windlass, large donkey boiler, steering gear amidships by Messrs. Davis & Co., Limited, and Hastie's screw gear aft. The engines, which are to be supplied by the North Eastern Marine Engineering Company, Limited, are of the triple-expansion type, having cylinders 13½in., 22½in., and 36in. in diameter, by 27in. stroke, and working at a pressure of 160lb.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, January 23rd, at 9 p.m. Lecture on "Some Applications of Photography," by the Right Hon. Lord Rayleigh, F.R.S.

MANCHESTER ASSOCIATION OF ENGINEERS.—Saturday, January 24th, at 7 p.m. Paper to be read: "Dynamos: the Consideration of the Chief Features which Regulate their Application," by Mr. A. B. Blackburne.

NEXT WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, January 27th, at 8 p.m. Ordinary meeting. Paper to be read: "Machine Stoking," by Mr. J. F. Spencer, M.Inst.C.E.

SOCIETY OF ARCHITECTS.—Tuesday, January 27th, at 7.30 p.m. Ordinary meeting.

SOCIETY OF ARTS.—Tuesday, January 27th, at 8 p.m. Paper to be read: "Lithography: a Finished Chapter of Illustrative Art," by Mr. William Simpson.

INSTITUTION OF MECHANICAL ENGINEERS.—Thursday, January 29th, at 7.30 p.m. Annual general meeting. Papers to be read: "On Some Different Forms of Gas Furnaces," by Mr. B. Dawson; "On the Mechanical Treatment of Moulding Sand," by Mr. W. Bagshaw; "Fourth Report of the Research Committee on Friction: Experiments on the Friction of a Pivot Bearing."

PRICES CURRENT, 21ST JANUARY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 0 0	.....	6 10 0	f.o.t. wks.
„ Angles	5 17 6	.....	6 7 6	„
„ Plates	6 0 0	.....	6 10 0	„
Staffordshire Bars	7 0 0	.....	7 10 0	London.
„ Angles	7 5 0	.....	7 15 0	„
Crown Sheets	7 7 6	.....	7 17 6	„
„ Hoops	7 7 6	.....	7 17 6	„
"Siemens-Martin" Steel Boiler Plates			8 0 0	„
„ Ship and Girder			7 2 6	„

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.B. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3.	42/- Cash.	
Scotch Warrants, m/n	47/4½ „	
Hematite Warrants, m/n	53/- „	
Stocks in Stores. Scotch	572,834	Tons.
Middlesbro'	122,334	„
Hematite	212,281	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.	
Coltness	... .	...	f.o.b. Glasgow.
Gartsherrie	... .	...	„ „
Langloan	... .	59/6	„ Ardrossan.
Summerlee	69/-	58/6	„ „
Glengarnock	... .	...	„ „
G.M.B. ex Store	47/9	47/6	f.o.t. Works.

METALS.

		£ s. d.		£ s. d.
Spelter:	Ordinary	£24 5 0	to	24 10 0
Copper:	British Cakes and Ingots	58 10 0	„	59 0 0
„	Chili Bars, G.O.B.'s	53 2 6	„	53 7 6
„	Other sorts, G.M.B.'s (equal to Chili Bars)	53 2 6	„	53 7 6
„	Manufactured (strong)	65 0 0	„	66 0 0
Lead:	Common Pig	13 10 0	„	13 15 0
„	English Sheet	14 5 0	„	14 10 0
Tin:	Straits	91 7 6	„	91 15 0
„	Australian	91 12 6	„	92 2 6
„	English Ingots	94 15 0		.....

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: A better tone has been observable in copper during the past week. More business has taken place, with an improved demand generally. Stocks of copper decreased about 860 tons during the first fortnight of the present month, and Chili bars are 7s. 6d. to 10s. higher since our last report, being quoted to-day £53 2s. 6d. to £53 7s. 6d. cash, with moderate business. The revolution in Chili has tended to strengthen prices. Manufactured £65 to £66, "strong," with more inquiry.

TIN: Steady, at about last week's rates, the fluctuations during the week having been within narrow limits.

LEAD: Unchanged, with small demand.

SPELTER has advanced considerably, owing to short supplies, the Baltic ports having been closed by ice.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 4½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 3	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	10 12 6	—	10 15 0
„ Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	18 10 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 8	—	.....
„ (50/90 %)	„	0 3 7	—	.....
Copper Sulphate	ton	18 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 0 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 9¾	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 9	—	.....
„ White	„	0 3 9	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	5 0 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	11 5 0	—	11 7 6
„ „ „ 60%)	„	10 5 0	—	10 7 6
„ „ (Cream 60%)	„	9 5 0	—	9 5 6
„ Crystals	„	3 0 0	—	.....
„ Bicarbonate	„	7 10 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 1 10	—	.....
Tartar, Cream of	cwt.	4 13 0	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Rather more business is passing in chemicals. Sulphate of ammonia has a better inquiry, and prices are firmer. Benzoles are steady at late rates. Carbolic acids very slow of sale. The foreign demand for sulphate of iron continues very strong, and there is more inquiry for sulphate of copper for forward delivery. Muriate of ammonia and sal ammoniac are selling freely, but carbonate of ammonia moves off slowly. Chlorate of potash is firm, and chlorate of soda scarce; bichromates dull. Prussiate of potash has a fair trade, and higher prices are asked in some quarters.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	38 10 0
„ Ceylon	„	28 10 0
Cottonseed	„	18 0 0
Cod	„	23 0 0
Lard	„	34 0 0
Linseed	„	21 10 0
Olive, Spanish	„	40 0 0
Palm, Lagos	„	25 10 0
Rapeseed: English	„	29 5 0
Seal: Pale	„	25 0 0
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	22 0 0
Turpentine	per cwt.	1 9 9
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 6
Spirit	„	0 0 8

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HOME INDUSTRIES.

LONDON, 22nd January, 1891.

The Money Market.—The money market remains fairly easy, though there has been a slight hardening of rates from the lowest points touched. For some time there was no demand for loans for short periods, though no more than 1 per cent. was charged, and, in the absence of any supply of bills, discounts were done as low as 1⅛ per cent. The springing up of a fairly persistent demand for gold for the Continent stiffened rates a little from these points. The stock markets have been rather idle, and the movements have been variable and uncertain. Silver securities have not been very active, owing to anxiety as to the course of the new American legislation, and have simply followed the changes in the price of the metal from day to day. The cloud of labour troubles hangs over home railways, and, as the dividends so far declared have not been reassuring, this has been a drooping market. The frequent fluctuations in New York have prevented London from taking any hold of Americans, and prices in general are disposed to fall away. South American stocks, after being subjected to the influence of a fresh semi-panic, are inclined to recover. In mining shares there has been a fair degree of activity. In miscellaneous and industrial securities most attention has been given to American brewery shares, in which there has been quite a little boom.

Institution of Electrical Engineers.—On and after the 25th inst. the address of this Institution will be—Victoria Mansions, 28, Victoria Street, Westminster, S.W.

The Junior Engineering Society.—At a meeting of this Society, held on the 16th inst., a paper was read by Mr. P. J. Waldram on "Modern Hydraulic Lifts." The author first dealt with ordinary warehouse and passenger lifts. The difference between direct-acting and suspended lifts was explained, and the question of the balancing of direct-acting rams was entered into, Ellington's, Richmond's, and other balances being described. After briefly referring to telescopic and variable power lifts, and to the Eiffel Tower elevators, the author proceeded to the consideration of canal and ship lifts, illustrating the former class by the large canal lifts at Les Fontinnetes and La Louvière, designed by Messrs. Clark & Stanfield, and the latter by the lift at Bombay Harbour by the same engineers.

Detection of Flaws.—A trial of an instrument called the sciséophone, invented by Captain de Place, for detecting flaws in metal castings, was recently made in the presence of Sir Frederick Bramwell, Sir Benjamin Baker, and other eminent engineers and members of the Ordnance Committee. The pneumatic tapper is placed in connection with a telephone, a microphone being placed in the circuit. Many flaws were detected by the instrument, and the trial, though not entirely successful, showed that the apparatus is capable of being made thoroughly efficient for its purpose.

Association for the Improvement of Geometrical Teaching.—At a meeting of the Association, which was held at University College, Gower Street, on the 17th inst., Mr. R. B. Hayward, F.R.S., being in the chair, a paper on "The Use of the Term 'Abstract' in Arithmetic" was read by Miss Wood. A paper on "The Foundations of Geometry" was then read by Mr. E. T. Dixon. The author stated that he had worked out a subjective theory of geometry deduced from the two fundamental concepts, "position" and "direction." His paper consisted of a statement of his definitions, and showed how some of the propositions of elementary geometry were deducible from them. A paper on "Some Notes on 'Statics and Geometry'" was read by Mr. E. M. Langley, in which the author brought forward a new proof of Brianchon's theorem founded on statical considerations. A paper on "Another Voyage to Laputa," which was to have been read by Professor Minchin, the President of the Association, will be published in the annual report.

Business Announcements.—Messrs. Appleton, Burbey, & Williamson have just issued a full and well-illustrated catalogue of their electric light fittings, electric bells, and switches. Owing to an increase of business the firm has removed to more commodious premises, the Tower Bridge Electrical Works, Bermondsey, where they have erected new machinery for the manufacture of electric light fittings and patent switches and switch-boards.—Messrs. Thomas Barraclough & Co., Limited, who are engaged in the manufacture of wire rope machines, telegraph and electric cable making machinery and torpedo cable machinery, have taken offices at 20, Bucklersbury, London, E.C.

Report on Wool for the Past Year.—Messrs. Helmuth, Schwartze, & Co., in their annual report on wool state that, the state of trade during the past year has completely belied the favourable anticipations which were formed of it, and presents a striking contrast to the unbounded prosperity of the preceding twelve months. The downward course of prices may be attributable to a reaction from an undue expansion of trade in 1889. The activity of that year absorbed the largely increased supplies, and left the market absolutely bare of stocks of wool. The industrial activity of last year has been on a more restricted scale, partly in consequence of the 1889 legacy of stocks of goods, partly of the necessity imposed by the supply. Less goods to the extent of 100,000 bales River Plate wool have been manufactured, and there are short receipts from Russia and a heavy falling off in the imports of foreign and Mediterranean low wools. It is not too much to say that the decrease in the quantity worked up by the European industry is equivalent to 300,000 bales colonial wool; and not only has there been this enormous reduction in manufacturing, but the lessened quantity has passed into consumption at lower prices. Unquestionably a more normal state of things has thereby been brought about, and, though the situation looks nothing like so hopeful as a year ago, the probability is that it is in reality much sounder.

MANCHESTER, 22nd January, 1891.

The Linen and Jute Trades.—There has been a fair amount of business transacted during the week amongst houses catering chiefly for the home trade, and preparations are now in active progress for the holding of special sales. In the export business the market is slow, and the orders booked during the past few days have not been important. The Chilian troubles have a disturbing influence, especially upon firms interested in the "West Coast." Shipments are, of course, checked by these events. The Chilian market, though not amongst our largest, is one which merchants would be very sorry to lose. There is very little demand for United States' account, and Canada is not buying freely. The financial condition of many houses in the Dominion is unsatisfactory, and it will be some time before business recovers from the effects of recent shocks. The prices both of yarns and cloth continue firm, and there is continued strength in the low Irish end.

The Eight Hours Bill.—The Bury Trades Council, representing twenty-four trade societies, at a recent meeting unanimously passed a resolution to the effect that such a concession should be obtained rather by the organisations at present existing than by legislative action. This fairly represents the view of the general body of operatives in Lancashire.

An Improved Castor.—A neatly contrived castor for chairs, &c., has been devised by Mr. G. L. Scott, of Manchester. It is intended to obviate the difficulties arising from the ordinary construction of castor, where the roller is carried on a cranked swivel arm, which is easily broken off. The centre pin of the roller bearing is fixed in a small plate rotating freely round a centre pin secured in the body of the castor. The plate named, when pushed round into any position, rests on the base of the cup or disc of the castor, and is thus, while quite free to move in any direction, thoroughly supported in every position. It is, in fact, a well-supported universal joint. The castor is a great improvement on the older types.

An Improved Water Tap.—Messrs. John Horrocks & Sons are introducing an improvement in taps such as are used for water pipes in which a clack valve with leather washer below is forced on to a seat. When from wear the tap begins to leak, it is ordinarily difficult to renew the leather washer, but in the new tap a subsidiary clack is used by which the supply can be immediately closed to enable the renewal of the washer or repair of the disc valve.

A High-pressure Lancashire Boiler.—Messrs. Robert Taylor & Sons, of Marsden, have recently completed a Lancashire boiler for India, which is designed to work at the high pressure of 180lb. It is intended to supply steam for a triple-expansion engine driving a cotton mill in Bombay. The boiler is 20ft. long by 7ft. diameter, and is constructed entirely of steel plates ⅞in. thick in the shell. The end plates are ⅞in. thick, the front end being flanged and the back end attached by an angle ring 5in. by 5in. by ⅞in. The circular seams are double riveted with inch rivets and the longitudinal seams are treble riveted. The boiler has been hydrostatically tested to 325lb. in the presence of representatives of most of the boiler insurance companies in the district, with satisfactory results.

Proposed Quadruple Expansion Mill Engines.—It is stated that another attempt is to be made in the Oldham district to use quadruple-expansion engines. The late Mr. Daniel Adamson, about twenty years ago, fitted a set of engines on this principle in a mill near his works, but they did not work well and were finally abandoned. The pressures of those days were not sufficient, but as it has been shown that boilers can be easily constructed to bear 200lb. pressure, the problem is much simplified. The latter is the pressure to be adopted, and Messrs. Musgrave & Sons, Limited, are the engineers whose names are given in connection with the enterprise.

GLASGOW, 22nd January, 1891.

The Railway Strike.—The crisis on the Scottish railway system is as acute as ever. The struggle is now in its fifth week, having begun on the 21st ult. The mineral traffic is still extremely disorganised, and the large exporters are doing no business. The coal shipments from the two principal loading berths, the General Terminus and the Queen's Dock, show a decrease for the past four weeks, as compared with the corresponding four weeks last year, of 69,958 tons. The passenger service of the North British Underground Railway was suspended during Tuesday, the 20th inst., owing to there being no signalmen in the boxes in the tunnel. Passengers from the East had to alight at Bellgrove Station, about two miles from Queen Street terminus. The whole of the industries in the Glasgow district are suffering more or less acutely. The loss to the public is much greater than the loss either to the companies or to the men on strike, and unless a speedy end is put to the crisis the indignation of the long-suffering public will have become quite uncontrollable. The fact that there are faults on both sides does not tend to reconcile the public to suffer the loss consequent upon the dislocation of the railway service.

Pig Iron.—The annual statistical statement issued by Messrs. James Watson & Co. shows that the consumption of pig iron in Scotland during 1890 was greater than in any previous year, while the shipments were higher than in any year since 1884, and the stocks lower than in any year since 1878. The figures are—

	Tons.
Stocks, December, 1889	1,035,840
Production, 1890	798 333
Total	1,834,173
Shipments	442,377
Per rail to England	12,956
Consumed in Scotland—	
Foundries	346,782
Malleable iron works	419,613
Stock, December, 1890—	
Connal's stores	587,652
Makers' yards	25,793
Total	1,835,173

The furnaces in blast on 31st December numbered only 6, 134 being out of blast; but in the early part of the year 66 furnaces were in blast, 140 being in existence. Miners' wages are stated at 5s. 6d. per day, being 6d. in advance of wages in 1889. The average price for the year was 49s. 6d., against 47s. 9d. for 1889. The maximum monthly average price of the year was 61s. 1d., in January, and the minimum was 44s. 7d., in June, 1890.

Explosion of Two Gasometers. — An explosion, happily unattended by loss of life, but resulting in the destruction of two gasometers, took place on the 15th inst. at the gasworks of the Corporation of Glasgow, at Dawsholm, Maryhill. The occurrence will form the subject of an official inquiry, and in the meantime no authoritative explanation is possible. It is supposed, however, that some leakage had occurred, and that an amount of air was thus admitted into one or both of the holders sufficient to produce an explosive mixture. The gasometers had each a capacity of 1,600,000 cubic feet, and measured 90ft. by 160ft. Both the holders had been recently enlarged. One of them was made by a Scottish and the other by an English firm. The report of the explosion was heard at the West End of Glasgow, and a huge flame shot up from one of the gasometers. The roofs were blown off both, although fortunately the plates were not carried far. A third gasometer near the other two escaped injury. Indeed, it is remarkable that so little damage was done, the pits and the supporting columns being comparatively uninjured. If the third gasometer had shared the fate of the other two, a large part of Glasgow would have been left in darkness. The gasometers were about two-thirds filled with gas. The cost of the two together was about £22,000, but the wreck by no means represents a total loss.

The "James Watt" Dinner.—The annual dinner given alternately by the Philosophical Society and the Institution of Engineers and Shipbuilders was held this year under the auspices of the former. On the 19th inst., Professor MacKendrick, President of the Philosophical Society, occupied the chair, and among those who proposed or replied to the usual toasts were Sir William Thomson, President of the Royal Society, Professor Max Müller, Mr. George Herriott, of the Board of Trade, and others. The President, in pronouncing the usual eulogy upon Watt, made an interesting comparison between the human body considered as a machine for the transformation of energy and a steam engine.

(From our own Correspondents.)

LIVERPOOL, 21st January, 1891.

Visit of the Mechanical Engineers to Liverpool.—As the Council of the Institution of Mechanical Engineers proposed to hold their summer meeting this year in Liverpool, the Mayor called a meeting of the members of the Liverpool Engineering Society, local members of the Institution, and other representative men, to discuss the advisability of sending them a formal invitation. The meeting on Tuesday, the 20th inst., was largely attended, and it was unanimously resolved to send the invitation to the President. A strong executive committee was also formed to carry out the necessary arrangements.

Marine Engineers' Institute.—At a meeting of the Institute, on the 16th inst., a paper on "The Proposed Museum of Naval Architecture and Marine Engineering," was read by Mr. B. H. Thwaite. The author pointed out that most of the offices of the great shipping companies had a considerable number of models, which were, however, so placed as to be practically useless to the naval profession, and in many instances were neglected and dust-covered. Such a museum as that proposed would be of immense advantage to the owners of the models, as each owner could have his own model classified and kept distinct and apart from those of other firms. The proposed collection of models and naval engineering appliances would mark more conspicuously the stages of progress. The committee

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of such a museum might institute rewards for seamanship, for inventions and systems designed for the amelioration and safety and conditions of the sailors, and for the progress of the science of maritime travelling and international commercial intercourse.

BUSINESS ANNOUNCEMENT.—The engineering business previously carried on under the style of Messrs. Simpson, Bruce, & Co., at 7, Rumford Street, Liverpool, will be transferred to the firm of Messrs. Simpson, Mackirdy, & Co., the services of Mr. Nesfield being retained under the new arrangement. The latter firm, which also had its offices at 7, Rumford Street, has now removed to new offices at 29, South Castle Street, Liverpool.

LEEDS, 21st January, 1891.

THE HULL AND DISTRICT INSTITUTION OF ENGINEERS AND NAVAL ARCHITECTS.—At a meeting of the Hull and District Institution of Engineers and Naval Architects on the 13th inst. a paper on "Art in Relation to Shipbuilding," was read by Mr. F. Somerscales (Earle's Shipbuilding and Engineering Company). The author said that the external form and structural details of ships, like all other constructive work, afforded ample opportunities for displaying an appreciation of art. Examples were given of different parts of a ship where the opportunity was afforded for manifesting an interest in art, amongst which the author mentioned the lower portion of the stern frame, the stem, the break of the poop, the "run" of the forward plating where it meets the stem, the position and relative proportions of the masts and rigging, and of the funnel.

PIG IRON STATISTICS.—The ninth issue is announced of Mr. E. W. Crawley's "Pig Iron Statistics," which gives the daily prices for 1889 and 1890 of Scotch, Cleveland, and hematite irons, together with 34 years' statistics of Scotch pig iron, showing the foreign shipment and consumption in Great Britain. The preface gives some useful information on the purchase and sale of warrants.

SHEFFIELD, 21st January, 1891

IRON AND STEEL.—The recent financial crisis at home, and the unsettled state of our best customers in South America, have stopped all new schemes and curtailed many of the old ones. There was a falling off in exports to the Argentine Republic of 17,000 tons during December, 1890, as compared with the last month of 1889. Pig iron of all grades is lower in price than has been the case for some time. Ordinary forge pig is from 42s. to 45s., and hematite, of which a large quantity is used here, may be bought for 62s. Merchant iron of all classes maintains a fairly steady value, and the best brands are firm at recent quotations. The Yorkshire makers of best brands are working to their full capacity on general orders for blooms, billets, and plates. The construction of ordnance and material for naval armament continues to steadily progress. Messrs. Thomas Firth & Sons have received another order for projectiles made on the "Firminy" plan, those previously made having given every satisfaction during the recent trials under severe tests.

COAL.—Fuel of all grades is in great demand. The railway companies appear to have been successful in obtaining their coal for 10s. per ton, instead of 10s. 6d. The increased consumption of gas is causing a large output of gas coal from the soft coal mines. London merchants are buying the best qualities of house coal heavily, so that, with the railway and gas contracts together, miners are fully employed. In the Barnsley district nuts are making from 8s. to 10s. per ton; slack, 4s. to 7s.; and common smudge, which a few years ago could not be disposed of at any price, is now selling at 3s. to 5s. per ton.

NORTH STAFFORDSHIRE, 21st January, 1891.

THE IRON TRADE.—There is a downward tendency in connection both with demand and prices, and the immediate outlook is distinctly unfavourable. Severe competition for orders for crude metal and finished material prevails, and buyers are able to get their own terms. Unless an improvement shortly occurs, there can be no no doubt that some general action will have to be taken with a view to reduce the cost of the raw material. A condition of things in which miners are receiving 50 per cent. advance in wages, and manufacturers are working without remuneration, cannot last.

SWANSEA, 21st January, 1891.

TYDEMAN'S DREDGING APPARATUS.—The executive committee of the Swansea Harbour Trust reported to the last monthly meeting, on the 12th inst., that after the extended trial given to Mr. B. Tydeman's patent apparatus for removing silt, &c., which is now fitted on the steamship "Princess," hired for the purpose, they are satisfied that it will be of advantage to the trustees to continue this system of maintaining the entrance channel. The trustees, therefore, adopted the recommendation of the committee to avail themselves of the option of purchasing the "Princess" at the agreed price of £2,950, less £1,040, being two-thirds of the amount paid for her six months' hire.

TINPLATES AND THE HARBOUR TRUST.—The consolidated rate on tinplates shipped from the port of Swansea has been increased from 1s. 3½d. to 1s. 4½d. per ton. Owing to the increasing trade, the Trust have found it absolutely necessary to provide additional warehouse room and lay down an extra line of railway. £2,500 are therefore to be expended on these improvements at the Prince of Wales Dock.

CARDIFF, 21st January, 1891.

IRON AND STEEL.—The steel rail trade is in an unsatisfactory condition, as the report of the Rhymney Iron Company's directors shows. Prices have fallen from £7 per ton at this time last year to £5 per ton, although the prices of raw material and labour are nearly as high. The principal ironmasters have large collieries, however, and the present high prices for coal enable them to reap an advantage in this direction. Still, the condition of the pig iron and steel trades is anything but healthy, and unless the demand expands additional furnaces will certainly have to be put out. Steel tinplate bars are quoted from £5 15s. to £6. Iron ore is steady. Rubio has realised 14s. 3d. per ton c.i.f. Cardiff for 50 per cent. iron. Freights from the Spanish ports are firmer, in consequence of a number of steamers being laid up.

COAL AND COKE.—The steam coal trade is active, and shipments have been maintained above the average. Business transactions have been limited on account of the inability of colliery proprietors to accept any new orders. Prices, naturally, are firm, with an upward tendency. No. 1 quality, 15s. 3d. to 16s.; No. 2 quality, 14s. 9d. to 15s.; No. 3 quality, 14s. to 14s. 6d.; No. 4 quality, 13s. to 13s. 9d. f.o.b. Cardiff. For house coal the demand is very brisk, and consumers experience considerable difficulty in procuring regular supplies Prices have advanced, No. 3 Rhondda being sold at 16s. to 16s. 6d. per ton, and No. 2, 15s. to 15s. 3d. Small steam coal is steady at 7s. to 7s. 6d. In the coke trade there is no change, the inquiry being limited. Foundry coke (best) realises 24s. to 25s.; ordinary, 23s.; furnace, 19s. 6d. to 21s.

BARROW-IN-FURNESS, 21st January, 1891.

HEMATITE.—A depression has set in in the hematite trade. Orders are not offering freely, and makers are not entering into many new contracts. The demand for Bessemer iron is restricted in consequence of the stoppage of the Moss Bay Steel Works in Cumberland, but confidence in the future is shown by the fact that steel makers are in some cases accumulating stocks for future use. Prices are easier at 53s. 2d. for warrants net cash, and 54s. for parcels of Bessemer iron net f.o.b. The output is shown to be greater than the consumption, and during the past week stocks have increased 1,562 tons, which represents the output of nearly three furnaces. Two furnaces have been blown out during the week, one at Moss Bay and one at the Solway Works, and now there are in blast 48 furnaces, and 28 out of blast.

STEEL.—The steel trade is fairly steady. Rails are in fair demand at £4 17s. for heavy sections, £6 for light rails, and £7 for colliery rails net f.o.b. The business doing in steel shipbuilding material is only small, and that is chiefly on local account, from which source prospects of new trade are most apparent. Prices are steady at £6 7s. 6d. for plates, £5 12s. 6d. for angles, and £7 2s. 6d. for boiler plates. Hoops are strong at £6 10s., and there is a good prospect in the casting and forge branches of the steel industry, but the other branches of the trade are indifferently supplied with orders.

SHIPPING.—The shipping returns are discouraging. The exports of pig iron and steel during the week were 11,337 tons, compared with 16,094 tons in the corresponding week of last year, a decrease of 4,667 tons. The shipments for the year, so far, amount to 39,905 tons, compared with 51,238 tons in the corresponding period of last year, a decrease of 11,333 tons.

MIDDLESBROUGH, 21st January, 1891.

PIG IRON.—The market is dull and there is scarcely any business doing. Buyers offer from 42s. 3d. to 42s. 6d. per ton for No. 3 G.M.B., but there are few or no sellers at these prices, as every day brings them nearer to the usual revival of trade with the opening season. The keeping back of iron for Scotland, through the railway strike, contributes to the dulness. Middlesbrough warrants are as low as 42s. cash buyers, 42s. 6d. sellers. Connal & Co.'s stock on the 19th inst. stood at 122,045 tons, being an increase since the beginning of the month of 6,159 tons. In hematite mixed numbers are 55s. 6d. per ton f.o.b. sellers.

MANUFACTURED IRON AND STEEL.—Finished iron is brisk enough on going orders, but new orders are not so plentiful as could be wished, so that some firms are open to easier terms than those quoted in the open market. Iron ship plates, £5 15s.; iron boiler plates, £6 15s.; common iron bars, £5 15s.; best bars, £6 5s.; best best bars, £7 5s.; iron ship angles, £5 10s. per ton, all less 2½ per cent. f.o.t. at manufacturers' works. Steel is duller, with a very quiet outlook. Some works are just resuming after the holidays. Prices remain much the same as they were. Rails (heavy), £4 17s. 6d. to £5 2s. 6d.; railway sleepers, £5 17s. 6d. to £6 10s.; ship plates, £6 5s. to £6 7s. 6d.; boiler plates, £7 5s. to £7 7s. 6d.; ship angles, £6 5s. to £6 7s. 6d. per ton f.o.t. at works.

SUNDERLAND, 21st January 1891.

THE SHIPPING AND COAL TRADE.—The freight market has shown some improvement, but this is far from being general, as is evident from the steady increase in the number of vessels laid up. One of the Sunderland shipowners has eleven vessels, of 24,000 tons deadweight carrying capability, idle on the River Tyne, but this is only a fractional part of the tonnage now withdrawn from working. The outputs of shipbuilders during the last two or three years have been so heavy that the laying up of less than one million tons of shipping cannot materially affect the general tone of the freight market, unless there is a continuation in the expansion of the world's transport requirements.

SHIPBUILDING.—The prospects for the present year are not so favourable as those of 1890. There are at present forty steamers, of 90,575 tons, and six sailing vessels, of 10,910 tons, in course of construction—*i.e.*, a total of forty-six vessels, of 101,485 tons, as against sixty-four vessels, of 142,789 tons, a year ago, only one of which was a sailing vessel. No new contracts are being entered into, and there is little reason to anticipate any improvement unless there is a substantial reduction in the cost of labour and material. Little progress is being made with work in hand, owing to the delayed delivery of steel angles and plates ordered from Scotland.

MARINE ENGINEERING.—There appears to be some uncertainty as to the refusal of the engineering employés to work overtime, but in the present state of trade an open rupture is scarcely to be feared. In addition to the construction of machinery and boilers for several new vessels, one of the local firms—Messrs. William Allan & Co., Scotia Engine Works—is fitting a complete set of new triple-expansion engines and boilers to the foreign steamer "Bergen."

THE PETROLEUM INDUSTRY.—Progress is being made by the Anglo-American Oil Company for the opening up of the oil-in-bulk trade at this port. Permission has been obtained for laying the necessary piping from the South Dock to the site of the proposed storage tanks. Two acres of land have been obtained, on which the works of the company, including three or four tanks, are to be erected.

ELECTRIC LIGHTING.—A special meeting of the County Council of the borough of Sunderland has been summoned for the 16th prox., to consider the question of the electric lighting of the town, and, if it be so decided, to take the necessary steps for obtaining the sanction of the Board of Trade.

NEWCASTLE, 21st January, 1891.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock during the week ending the 10th inst. amounted to 93,022 tons, being a decrease, as compared with the corresponding week last year, of 15,439 tons.

SHIPBUILDING.—The severe weather tends greatly to impede shipyard work, and during the past few days very little progress has been made with contracts. An additional hindrance is found in the difficulty of procuring adequate supplies of material from the steel manufacturers, this cause of stoppage being more generally felt since the commencement of the Scotch railway strike. The present aspect of affairs is consequently very depressing, and in spite of the long spell of prosperity that has fallen to the lot of those connected with the trade, some sections of the workmen are now feeling the pinch of poverty. The only prospect of improvement lies in the advent of milder weather, and the settlement of the unfortunate dispute which prevents the conveyance of supplies from the steel making centres of Scotland, and it is to be hoped that these conditions will soon be brought about. The work now in the hands of builders is sufficient to keep the mass of the workmen employed for two or three months to come, if there were no exceptional impediments in the way of its progress, but no new orders are being received, and it seems probable that by midsummer more than half the building berths on the river will be empty.

ENGINEERING.—Marine engine works continue to be briskly employed, and for some time to come it is not likely that any very distinct indications of a falling off will be presented. The substitution of triple-expansion for compound engines in old steamers very materially assists in keeping the industry active, and will no doubt be the means of maintaining full work in the engine shops for some months after the shipyards have become slack. In the locomotive establishments business is also fairly good, and it is understood that some orders of importance are now being tendered for by local firms. Manufacturers of ships' pumps are well supplied with orders, and one or two firms that are concerned in the production of certain well-known engineering specialties are exceedingly busy.

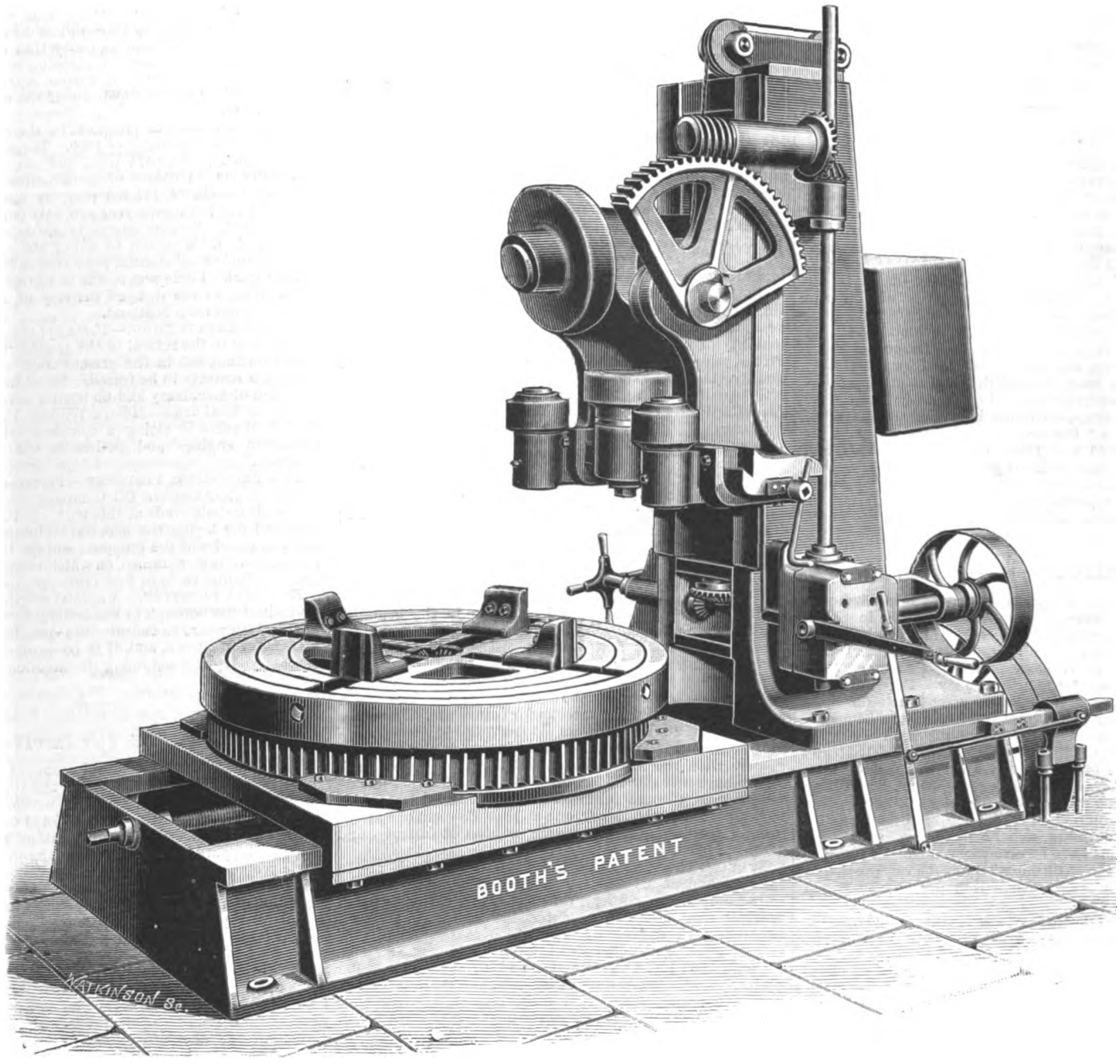
MESSRS. GEO. ANGUS & CO.—At the annual meeting of shareholders, which was held on the 19th inst., the announcement was made that the business prospects of the company were excellent, and that the profits on the past year's working were sufficient to permit of a dividend of 10 per cent. being declared, after adding £7,000 to the reserve fund.

ELECTRIC LIGHTING.—Messrs. J. H. Holmes & Co. have obtained some further important contracts for both marine and land installations, and the great briskness which has existed at their establishment for many months past is likely to be maintained throughout the whole of the present year.

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BOILER FLUE FLANGING MACHINE.

CONSTRUCTED BY MESSRS. GEORGE BOOTH & CO., ENGINEERS, CENTRAL IRON WORKS, HALIFAX.



GENERAL VIEW.

BOILER FLUE FLANGING MACHINE.

WE illustrate above a powerful machine, designed and constructed by Messrs. George Booth & Co., Central Iron Works, Halifax (for Messrs. Denny & Co., engineers and boilermakers, Dumbarton), for flanging marine boiler flues. It is capable of flanging flues of various sizes, from 1ft. 10in. to 4ft. 6in. diameter, by 1ft. 6in. to 4ft. 6in. deep, of mild steel plate ⅝in. thick. The flue to be flanged is placed upon the chuck plate and held secure by four gripping jaws, the top end of the flue being supported by two guide rollers, which are adjusted simultaneously to suit various diameters of flues. The chuck plate is rotated by powerful gearing, and the flanging roller is brought into contact with the flue by suitable power, which can be easily regulated by the hand lever shown on the front of the machine. This lever is in close connection with the belt fork lever, and is consequently under full control of the attendant. The machine is constructed in a substantial manner in order to withstand the rough usage of a boiler shop. It can bend a 4½in. flange on an "Adamson" pattern of flue at the rate of a flange per minute, each flange being formed at one heat. The material is not injured in any way, and the work done is superior to work found in hand-formed flanges. The object of the machine is to flange flues in short lengths in order to obtain the advantages of radial stiffness with the necessary longitudinal elasticity.

COMMERCIAL FORTUNES AND LAND PURCHASE.

THE steady decline in land values does not seem to have checked the desire of successful business men to become landowners. Each year the leading sales are to men who have themselves made fortunes or have inherited fortunes made in business. Last year was no exception to the rule. The largest single sale was that of the estate of Durris, in Aberdeenshire, to Mr. Baird, of Gartsherrie. The property, which extends to 17,000 acres, and has a rent roll of £9,700, had been withdrawn previously at £270,000. Among other Scotch sales were those of the Forest of Glentana, in Aberdeenshire, 29,000 acres, to Sir W. Cunliffe Brooks, for £120,000, and Kildermorie, in Ross-shire, to Mr. Walter Shoolbred, who has now acquired a deer forest of 45,000 acres. Mr. Frederick Colman last year bought Lord Egmont's place near Epsom, Nork Park, extending to 1,600 acres. This is not far distant from Gatton Park, which Mr. J. J. Colman had acquired from Lord Oxenbridge for £82,000 two years previously. Close at hand Mr. Boord, M.P., has settled down at Wakehurst, the historic home of the Dowager Marchioness of Downshire, which has been sold to him with an estate of 1,200 acres. Norbury Park, near Epsom, was transferred to Mr. Leopold Salomon for £75,000. Mr. Eckroyd was already a large owner of land in Cumberland before he added the 1,800 acres of Ormathwaite Hall to his possessions. He has now a stretch of nine miles' of fishing in the River Eden. The old estate of the Honeywoods, Chilton Park, near Hungerford, is the property of Sir William Pearce, who paid £80,000 for its 2,300 acres. The price paid by Mr. L. W. Adamson, of Park Works, Gateshead, for the 1,370 acres of Eglingham, in Northumberland, has not transpired, but the estate was bought in at the sale for £29,000. Mr. W. J. Joicey secured Sir James Mackenzie's place at Sunningdale, Ascot, for £40,000, just before the baronet's death. Mr. W. H. Smith continues his purchase of Lord Devon's lands that fringe Dartmoor. The chief feature of the Duke of Newcastle's important sale of his Worksop Manor estate in Nottinghamshire and Derbyshire was the purchase by Mr. John Robinson of the house and 1,644 acres for £35,000, with nearly as much again for the timber. The Thurgarton Priory estate, of almost equal value, had been acquired by Mr. Robinson two years previously. The Yorkshire territory owned by Mr. Samuel Cunliffe Lister, of Manningham Mills, now exceeds a million sterling in value. Recently he added to it the mineral estate of Ackton Hall, near Pontefract, the price paid for the 1,200 acres being £192,000. Selsdon Park, in Surrey, 563 acres, has become the property of Mr. Wm. Stevens. Finally, Mr. J. Spiller, of Westwood House, Droitwich, has bought Compton House, and 1,696 acres, near Stockbridge, in Hants. There were also many minor sales absorbing the estates of the old nobility and squirearchy.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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Industries:

FRIDAY, 23RD JANUARY, 1891.

OUR NAVAL POLICY.

THE Naval Estimates will soon come before Parliament, and no doubt the whole subject of our naval policy will again be brought up for discussion. Last year the debate degenerated into a conversation on a few details, but in the interval the Report of the Commissioners on the Civil and Professional Administration of the Naval and Military Departments, and the relations of those Departments to each other and to the Treasury, has been presented to Parliament, and, moreover, many important discussions relating to our naval policy have taken place. At the time the Report appeared we made (see *Industries*, Vol. VIII., page 422) some reference to its most important points and mentioned its chief recommendations, but so far as we are aware nothing has been done to carry them into practice. The Report will necessarily receive attention in the next debate on the Navy Estimates. As we mentioned in our previous notice, the questions which are discussed in the Report are grouped under two principal heads, namely—(*a*) measures required to ensure closer administrative harmony between the naval and military services; (*b*) the internal administration of each of the two Departments and their respective relations to the Treasury. The first of these is the one which will receive most attention, not only because the second is less important, but also because during the past few years, as every one will admit, very great improvements have taken place in the administration of the various departments of the navy. The Commissioners stated that the first point which struck them in the consideration of the organisation of the army and navy was that though in action they must be to a large extent dependent on each other, and though in some of the arrangements necessary as a preparation for war they are absolutely dependent on the assistance of each other, little or no attempt has ever been made to establish settled and regular intercommunication or relations between them, or to secure that the establishments of one service should be determined with any reference to the requirements of the other. The Commissioners further report that no combined plan of operations for the defence of the Empire in any given contingency has ever been worked out or decided upon by the two Departments; that some of the questions connected with the defence of military ports abroad, and even of those at home, are still, after much departmental correspondence, in an unsettled condition; and that the best mode of garrisoning some of the distant coaling stations is also undecided. The Commissioners described this as an unsatisfactory and dangerous condition of affairs and one obviously requiring immediate remedy. Their proposals, however, did not excite much enthusiasm, the chief one being that there might be some advantages in the formation of a Naval and Military Council, which should probably be presided over by the Prime Minister, and consist of the Parliamentary heads of the two services with their professional advisers.

This is certainly a weak proposal after such an elaborate indictment of our present system, and has been severely criticised by naval and military authorities. It is, however, easier to criticise than to amend, and comparatively few definite proposals have been made for improving the present state of things. In a recent number of the *Nineteenth Century*, however, Lieutenant-General Sir W. F. D. Jervois makes some suggestions which are well worthy of careful consideration. He is of opinion that the failure of the Hartington Commission in its attempt to grapple with this difficult question is due mainly to one principal cause—namely, want of appreciation of the fact that Great Britain is primarily a naval power. According to Sir W. Jervois, the Hartington Commission placed the army and navy on the same pedestal, and, starting from this false assumption, failed, as might have been expected, to arrive at any conclusion which would square with actual facts. His view of the problem is this: Given, as they are at present, two mutually dependent services, so to organise them that they may efficiently perform each its proper function in the defence of the British Empire. The solution he puts forward amounts to this, that the navy must not be dependent on the army for the defence of its ports and coaling stations, nor must there be laid upon the Army Department the burden of finding garrisons for places which are held purely as foci for naval action. He thinks that the forces for the defence of naval stations, both at home and abroad, should be under the orders and control of the Navy Department. His aim is, in short, to have what he calls "Home Rule for the Navy," by making it self-sufficing and self-contained, and independent of the army for all its own requirements. He maintains that the navy should be absolutely responsible for its own efficiency in respect, not only of seagoing vessels, but of the various stations to which those vessels must resort for coal, refit, and repair. It would thus secure what it chiefly needs—unity of purpose and direction. This would involve the placing of the field artillery, the royal engineers employed on harbour defence, the submarine mining engineers—in fact, all engaged in harbour defence—under naval control. He even suggests that some portion, at least, of the militia and volunteers, in all places where they can take part in naval operations, should be comprehended within the same organisation. He strengthens his position by showing that in Germany the defence of the coast is entirely in the hands of the navy, and that in France, and the French colonies generally, the garrisons of sea fortresses consist of marine troops, under the orders of the Minister of Marine, and the defence of the coast is entrusted, not to military, but to naval officers. He further quotes the opinion of Lieutenant Colwell, of the Intelligence Department of the United States Navy, to the effect that "the coast defence of Great Britain is notably the most inefficient of any of the great European Powers." No doubt Sir William Jervois' proposals will come up for discussion in connection with the debates on the Naval Estimates, and we think them worthy of study.

The Commissioners considered not only the defence of the United Kingdom, its colonies, and dependencies, but also the protection of its commerce, supplies of food, and other necessaries. This part of the subject will, no doubt, be referred to in the Parliamentary discussion on the results of the autumn manœuvres last year. The present Board of Admiralty had been engaged in carrying on an extensive shipbuilding programme, but some of the Commissioners expressed an opinion that all those

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causes which had made a strong navy necessary had operated, and were operating, at a greater rate than the programme of the last three years allowed for, and they were in favour of a still more extensive programme being undertaken.

A matter on which Sir George Tryon has strong opinions, and which is directly connected with naval policy, is that of the national insurance of our mercantile marine during a period of war. He thinks that, as the existence of the nation depends on free mercantile marine communication between the various ports, it is hard to call upon private individuals to provide, out of their own resources, what is necessary for the existence of the nation, and he contends that the nation ought to assist in meeting the expense. Stated shortly, Sir George's proposal is that the State, subject to certain conditions and regulations, should undertake to pay the cost of vessels and cargoes destroyed by the enemy. He urges that, on the outbreak of war, the premiums for marine insurance would rise to a great height—far, indeed, in excess of the real risk incurred—with the result that shipowners would become discouraged and feel inclined to lay up their vessels in port. This policy would not only diminish commerce, but place the supply of food and raw materials in the hands of neutrals, who, having to pay no large premium for war risks, would be placed in a position of great advantage. Such a scheme as this—although no doubt there are difficulties connected with it—would, in times of trouble, help us to maintain our industries, our commercial supremacy, and, above all, our food supplies, and is worthy of careful thought.

AMERICA AND THE SILVER QUESTION.

The current reports from the United States on the probable action of Congress with regard to silver are so contradictory, that it is impossible to form from them a trustworthy estimate of the probable future of silver. Although recent attempts of Congress to control the price of silver in the markets of the world cannot be said to have resulted successfully, and, therefore, indicate a certain want of foresight on the part of American financial politicians, it is impossible to lend credence to the report that it is likely that Congress will sanction the free coinage of silver in the United States while restricting the coinage to United States silver only. It is clear that such a proceeding, so far from lending support to silver, would not improbably result in further depression of the price, through a portion of the production apart from America being deprived of a market now existing there—at least partially. Meanwhile, the tendency seems to be in the direction of an advance in silver, although this may be checked by rumours, true or false, of United States legislation on the subject. While there is much to be said for a single Act of the Legislature having the effect of restoring the *status quo ante* demonetisation of silver, the frequent legislative pottering at the currency is unquestionably a mistake. We have been favoured with the following carefully prepared and, we believe, thoroughly reliable statistics bearing upon the present position of silver, with relative comments:—

TABLE I.

STATISTICAL POSITION OF SILVER AND PROBABLE EFFECT OF PROPOSED UNITED STATES LEGISLATION.

Production of Silver (in Ounces).

		United States.	Rest of World.	Total.
	1887	41,260,000	54,917,375	96,177,375
	1888	45,780,000	64,292,140	110,072,140
	1889	50,000,000	75,988,671	125,988,671
Estimates.	1890	53,000,000	83,000,000	136,000,000
Estimates.	1891	57,000,000	88,000,000	145,000,000

The estimates for 1890 and 1891 are, of course, to some extent, guesswork, but it will be seen that the ratio of increase has been put very considerably below that of the preceding years, though the stimulus to production afforded by the higher prices would seem to justify very much larger estimates.

The figures given in Table II. at the top of the next column show the disposition of silver, and are (approximately) summarised from the Report of Treasury to Congress in December, 1889, and refer to the previous year (1888):—

TABLE II.

	Ozs.
United States coinage and certificates	26,000,000
Arts and manufactures (for all the world—Soetbeer's estimates)	16,000,000
Subsidiary coinage, Europe and South America	17,000,000
China, India, and the East	45,000,000
Unaccounted for	6,000,000
Total for 1888 (as per Table I.)	110,000,000

If Congress enacts free coinage, restricted to home production, the United States will, of course, use up the whole of the silver they produce, and the balance of the world's production may be expected, on the above basis of distribution, to be disposed of as shown in

TABLE III.

		Ozs.
Arts and manufactures (as before) Subsidiary coinage Unaccounted for	As in Table II.	39,000,000
Leaving for India and the East		49,000,000
Total production for 1891 outside United States, as per Table I.		88,000,000

Therefore, India and the East will have to absorb, even on the extremely moderate estimate of production given in Table I., 49,000,000oz. in 1891, against 45,000,000oz. in 1888, although silver and the Eastern exchanges now are 10 to 12 per cent. higher than they were then. This seems to indicate that silver and the exchange must come down considerably in order to admit of the additional absorption. If, however, Congress passes an Act increasing Treasury purchases to (say) 6,000,000oz. monthly, the effect on silver generally would probably be more favourable, because then the Treasury purchases would not only absorb the whole of the home production, but also some 15 million ounces more (on the basis of Table I.). It must, however, be remembered that there is a heavy accumulation of stock in the United States, computed at 12 to 15 million ounces (visible and invisible), so that any rise in price which might be occasioned by the passing of such a measure would probably not last long.

It was announced last October that Austria had decided to convert into gold at the earliest favourable opportunity 60 million florins out of the 190 millions she holds. If this were done, it would add 20 million ounces to the world's supply of silver. On the other hand, as regards silver securities, such as rupee paper, the extreme cheapness of money and scarcity of first-class securities is one favourable feature, and another is that the value of silver will probably be to some extent sustained speculatively by the expectation that the next Congress will enact unlimited free coinage.

These conclusions appear sound. There is, however, the not very remote probability that Congress, disappointed at the result of its past legislation on the silver question, will leave the matter alone for a year, and trust to the chapter of accidents to bring about a change in the market price of silver which would relieve the United States of the necessity of independent silver legislation. The probability, on the other hand, of France taking some step in the near future is certainly to be reckoned with in any comprehensive view of the situation.

THE SCOTTISH RAILWAY STRIKE.

Although the goods and mineral traffic is being partially grappled with by the railway companies, this is only being done at the expense of the passenger traffic. The number of men still on strike, in spite of deflections from their ranks, is still sufficient to prevent due performance of the public service. The shipbuilding yards are now all working, though at some of them the stock of steel is being so rapidly exhausted that they cannot go on much longer without supplies from the works. These are all stopped excepting the Clydesdale, which has succeeded in maintaining its supplies of fuel and iron. The difficulty of getting material conveyed is so great that some of the boiler makers are at a complete standstill for want of plates.

To all attempts at conciliation by the men the directors have given the unvarying reply, "Return, and we will consider your grievances." The men regard this as too vague. The deadlock thus remains in the fifth week of the strike, to the almost intolerable embarrassment of the public, and specially of the industrial community. It is necessary to explain that the Glasgow and South-Western Company's men returned to their work some time ago, that a considerable proportion of the Caledonian men have returned, and that now, as at the beginning of the struggle, the chief brunt of it falls upon the North British Railway. The returns of these companies show that the proportion of rolling stock to mileage is largest in the first case, smaller in the second, and smallest in the third. It is fairly clear, therefore, that the real cause of the crisis and of the prolongation of it, is the insufficiency of the rolling stock of the North British Company. The directors are apparently attempting to work their business with insufficient plant and with too small a capital. If the company gave orders for a hundred additional engines, and raised the capital necessary to pay for them, the service would be vastly improved, and the chronic state of discontent, both of the servants and of the public, be ended.

THE SKILLED LABOUR MARKET.

According to the Board of Trade Journal, the state of the skilled labour market during the past month affords little indication of the general labour interest of the kingdom. Several weeks of severe weather have seriously affected the indoor industries by interfering with the means of transport of the raw material. Building and other outdoor trades have suffered most severely from the severity of the weather. The number of strikes during the past month was sixty, which is one less than in the previous month, and of these fifteen were in the cotton trade. The railway strikes in Scotland have affected a large number of workmen. Of the twenty-two trade unions of skilled operatives which have sent in returns as to the state of their respective industries, a few show a slight improvement, but the majority show a marked falling off consequent on the causes already referred to. The total membership of these societies is stated at 239,960, and of these 7,302 are returned as unemployed. This is a proportion of 3·05 per cent., as against 2·4 in the month preceding. As compared with the corresponding period of previous years, it may be said that in January, 1890, the percentage of men out of work in these trades was 1·7; in January, 1889, 3·3; January, 1888, 6·9; and in January, 1887, 8·7. The trades showing most improvement are the cotton-spinning and shipbuilding trades, the percentage of those out of work in the last-named industry having improved during the month from 5·76 to 4·27. Most of the other trades show worse results, but in no case can the change be pronounced serious when all things are considered.

TREATY REVISION IN JAPAN.

The question of treaty revision in Japan, to which we have frequently referred, has become complicated by considerations of party politics and sectional opinions, and these will add immensely to the difficulty of settlement. As we have on a previous occasion pointed out, the question might have been settled some years ago with comparative ease, in a manner which would have prevented it being raised for a considerable time, for then the foreign Powers had only to deal with a comparatively despotic Government. Now it has to deal with a representative Government which is criticised by a public press, and which is thus doubly bound to respect public opinion. It is stated by the foreign press in Japan that the recent proposals of the Government are for the purpose of conciliating the patriotic party in the country, and evoking the opinion of the foreign residents, which, in the open ports at least, is unanimously and decidedly against the proposals. It is not within our province to enter into the consideration of either the personal or political questions involved, but we have no hesitation in saying, after considerable personal knowledge of the country and the people, that the present state of affairs is a grave injustice to Japan and an injury to the foreign trade of the country. During the past twenty years the Japanese have made so much progress in every way that it is only right that they should expect a considerable relaxation of arrangements which were made under a totally different state of affairs. We trust that some method will soon be found to bring a change about.

EFFECTS OF THE McKINLEY ACT.

According to a statement made by a correspondent of the *Times* with reference to the working of the McKinley Act during the past three months, the working people of the United States are worse off than before the change in the duties. In many cases there has been a decrease in wages, whilst there has been a rise in the price of nearly all the necessaries of life. In some manufactures there has been an increase in the price of the product without any increase in the workers' wages. The Furnacemen's Union, the Journeymen Plumbers' Union, and the Typefounders' Union all report that there has been a reduction of wages, whilst, in other instances, such as that of the Manhattan Brass Works

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and lace and mantle manufactures, the reduction of wages has resulted in strikes, which have been generally unsuccessful. The workpeople of several firms engaged in the cigar trade struck work on their wages being reduced, and in other trades, where the men have struck, their places have been filled by foreigners. The workers in the silk, upholstery, woollen, and cotton trades have also suffered a reduction of wages, and the restriction of production by some manufacturers has still further injured the workers. The goldbeaters alone have secured an advance of wages through the passing of the Act.

THE LATE MR. COSMO INNES BURTON.

A recent China mail has brought news of the death of Mr. Cosmo Innes Burton, who was appointed last year to the Professorship of Chemistry at the new Technical Institute of Shanghai. His death at the age of twenty-eight has excited feelings of regret among fellow workers in this country, who regarded him as one of the most original of the younger generation of chemists.

Mr. Burton's father was Mr. John Hill Burton, the well-known Scottish historian. That his intellectual inheritance, however, was scientific, not literary, was early apparent, for as a boy he worked in the chemical laboratory which he and his elder brother—now Professor of Sanitary Engineering in the University of Tokio—fitted up for themselves. After graduating in Edinburgh Mr. Burton became assistant to Dr. Japp, now Professor of Chemistry at Aberdeen, and, in conjunction with him, contributed four memoirs to the Journal of the Chemical Society, embodying the results of extensive researches in the department of organic chemistry. His interests in chemistry, however, were essentially of a practical nature. He was interested in social reforms of every kind, and eagerly embraced the opportunity offered to him by the Town Council of Edinburgh of examining the air of public buildings in that city. He made a careful chemical and biological investigation of the air of the chief schools and theatres of the city, and drew up an exhaustive report on the subject.

He was profoundly interested in both the technical and philosophic aspects of chemical science. One of his investigations, the subject of which was the heat produced by the compression of pure solid and liquid substances, was pretty far advanced before he left for China. His friend, Mr. W. Marshall, in conjunction with whom a large part of the work was carried out, will shortly publish the results of the research.

Mr. Burton received last spring his appointment in China, and proceeded to Shanghai, where he arrived in the end of July. A letter written by him in the beginning of October was full of hope and enthusiasm about his work. Within a month of the date of the letter he was cut down by an attack of malignant small-pox after two or three days' illness.

THE LATE BARON HAUSSMANN.

The death of Baron Haussmann, in his eighty-second year, which we briefly announced last week, removes from French society a well-known figure, who, as Prefect of the Seine under the Empire, did so much to transform Paris from a mediæval to a modern city. Beginning life in the office of a notary, he worked his way to the Bar, and from that, through various grades of office, to the Prefecture of the Seine in the year 1853, and it was in this position that he did the most important part of his life's work. The chief feature in the domestic policy of Napoleon the Third was the transformation of the capital. A glance at the map of Paris shows that in its general plan it differs from most modern cities chiefly in the fact that, instead of being laid out in rectangles, its main thoroughfares radiate from a few central points, an arrangement which is admirably adapted for the treatment of insurgent masses, for a few cannon placed at each point could sweep the streets with ease. One of the chief industries of Paris has for a long time been the entertainment of visitors, and it has met the want of a city of pleasure for those who have superfluous wealth—a want which was beginning to be more widely felt about the time of Haussmann's appointment. Every franc invested in improvements brought a certain return to the city, and helped to increase its trade. During the seventeen years of Haussmann's reign as Prefect of the Seine, he opened 200 new thoroughfares, built 14 bridges and 400 kilometres of sewers, and laid down 1,200 kilometres of main piping for the water supply. He built 241 new public buildings of different kinds, and covered 80 hectares with markets and slaughter-houses. He made in some of the worst parts of the city many new thoroughfares, and in other places he erected splendid rows of palaces ornamented by public gardens. The woods of Vincennes and of Boulogne were transformed into splendid parks, and Montceau was made a perfect gem of landscape gardening.

The cost of all this was, of course, enormous—more than two milliards of francs, or close upon £85,000,000, of which about one-half was raised by loan, and the rest defrayed out of ordinary municipal revenues. The interest to be paid per annum was about 67,000,000fr., reducible to 57,000,000fr. as the annuities fell in. On the other hand, the revenue rose by leaps and bounds, and in the last year of his tenure of office not only met all charges, but left about a million and a half sterling for new undertakings. All this was done without fresh taxation, and the present high rates on the citizens of Paris arise, not from Haussmann's operations, but from the expenses of the war and of the Commune.

Letters to the Editor.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—I have read with much interest your recent articles by Mr. Thwaite on the above subject, and, whilst congratulating him in suggesting a possible solution for the remedy of London's great plague, should like to point out a few of the difficulties which his scheme would have to surmount.

In all radical changes—unfortunately, perhaps—the main question to be decided is one of cost, and I think that it is mainly in the estimate of the economic value of the scheme that criticism on Mr. Thwaite's suggestion will be directed. Even if we admit with him that gaseous fuel has economic advantages which render it superior to all other forms of heat, the large amount of capital required to convert existing plant adapted for burning coal and coke into suitable gas stoves is sufficient to cause many people to restrain from making any change in their present forms of heating. Not only is this the case, but we have, I believe, yet to discover what form of domestic gas stove is best adapted to the heating of rooms, and Mr. Thwaite gives us no information in this direction.

It is true that the gas companies for many years past have been endeavouring, by lectures and demonstrations, to educate their customers to the advantages which may be derived from cooking by gas, but there are few stoves which can be said to fulfil all the requirements of home use.

Mr. Thwaite should, in fairness to his scheme, add the cost of converting in each house the existing hearths into the best form of gaseous stove, and add thereto the loss of capital which would be necessarily entailed by a universal adoption of the new system of heating. I think that his alternative scheme will commend itself to most of your readers, as such a system would admit of gradual development, and make it possible for builders to design and construct new houses with a dual system of pipes for both lighting and heating purposes. Although the recent trials of incandescent gas lighting at Harrogate and elsewhere have not been so satisfactory as advocates of this system would like, yet it by no means follows that we may not have a perfected system of rendering a heat-giving gas available for lighting purposes as well, and, if such a system be devised, a supply of heating gas would be still more desirable for the poorer districts, where electric lighting is not likely to be sufficiently economical for general use for many years.

The discussion which Mr. Thwaite's articles deserve should certainly lead to some immediate steps being taken to induce the authorities who are appointed to discharge the duties of carrying out the development of our big city to give an earnest consideration to the suggestions which Mr. Thwaite has put forward in his able articles.

Yours, &c.,
Cockney.

London, 19th January, 1891.

To the Editor of "Industries."

Sir,—The article by Mr. Thwaite in your last week's issue suggests such a complete revolution in our present system of heating that it seems necessary to consider whether we cannot effect such a desirable change in some simpler way.

Mr. Thwaite, whilst striking out an original line for dealing with this evil, seems to ignore the steps which are being taken by others towards achieving the same object, and, although we may admire him for his originality in proposing so bold a scheme, it would have been better if he had given reasons for assuming that the present efforts will not be fruitful of any permanent results. The committee which is at present at work in Manchester is doing good work in testing smoke-preventing appliances, and their report, which is to include not only "a comparison of the different methods of burning coal smokelessly," but is to be extended to those methods of consuming coal where the fuel is first converted into gas, and the gas so produced burned in the furnaces, will give a basis from which future operations may satisfactorily spring.

Mr. Thwaite, by assuming that gaseous fuel is the only way out of the difficulty, has forgotten that improvements are gradually evolved out of existing systems, and that radical changes are seldom adopted on a large scale without a long period of trial on a small scale.

The Alkali Inspector, in his last annual report, referred to the satisfactory nature of the gas-producing arrangements of Messrs. Brunner, Mond, & Co., in Cheshire, where not only is a smokeless gas economically employed in the place of the ordinary system of coal burning, but an important bye-product in the form of ammonia—equal to 66lb. of sulphate for every ton of coal—is obtained. This experiment, together with the employment of natural gas in Pittsburgh, does certainly tend to support Mr. Thwaite's views. The conditions of success for domestic heating are, however, entirely different, as gaseous fuel seems to be only adopted for local heating, and the gas stoves and other appliances at present in use have not been very acceptable to the public. If Mr. Thwaite had been able to demonstrate the advantages in a changeable climate such as London of a system of hot water or hot air heating and ventilation, in which his gaseous fuel could be consumed in the basement of a dwelling-house, and thus be a source of heat for the whole building, then his scheme would have been more complete, but until he tells us how he intends to use his gaseous fuel as a source of domestic heating I must regard his solution as impracticable and Utopian.

Yours, &c.,
R. S.

London, 20th January, 1891.

IMPROVEMENTS IN THE MANUFACTURE OF NITRIC ACID.

To the Editor of "Industries."

Sir,—I am sorry that I cannot give your correspondent, Mr. Blount, such definite information as he wants, as to the cost of erection of a nitric acid factory, both on the old system and on my new one, since I cannot control the figures given at random by others. I have built several factories, both on the old and on my system, and my statements as to relative cost were based on this experience, and from the personal knowledge of the arrangement of over a score of factories.

It will, of course, be patent to every expert that factories may be built in very different ways, and that their actual cost must, in consequence, vary considerably. Thus, in the case of a factory where perfect working is considered of secondary importance to cost of plant, a wooden shed, and imperfect means of condensing the last traces of fumes (providing there is no Alkali Act to interfere with such practice), may be erected at a considerably less cost than a properly arranged and equipped factory, although the difference can never be so great as to reduce the cost to £1,500 for a daily output of 35 cwt. of strong acid. But it was not such a woodshed makeshift that I had in my mind. I compared a high-class factory on the old system with a high-class one on my system, and then the saving must be at least 60 per cent., since my system requires two-thirds less building and one-half the number of retorts and batteries required for the best old system.

To give Mr. Blount an exact idea, I may mention that an estimate that I have recently given for a factory to produce 1,500 tons of strong acid yearly, solidly built in brick and filled with the best appliances, to comply with regulations quite as strict as the English Alkali Act, amounts to about £3,200, including a brick chimney shaft 80ft. high.

Yours, &c.,
Oscar Guttmann.

Dunster House, Mark Lane, E.C.,
17th January, 1891.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

To the Editor of "Industries."

Sir,—I have read with much interest "Student's" letter, under the above heading, in your issue of the 9th inst. That such a question as that under discussion should be answered in the negative, can, in my opinion, only be due to a thorough misconception of the true relations in which theory and practice stand to one another. Generally speaking, in a certain sense, practice—whether it be the practice of nature or of man—must precede theory. Every theory, however complete and far-reaching may be its applications, must, in order to have any value at all, be based, in the first instance, on observed phenomena, of which there can be no ultimate explanation. A good instance of this is the law of gravity, the fundamental expression of which is the result of observation, and in so far empirical. I need scarcely remark that I should apply the term "result of observation" to a theory which had been in the first instance conjectural, but was confirmed subsequently by experiment.

Theory is simply the systematic expression, in the first instance, of the laws which experience has shown to apply to phenomena. If true and general in its character, it will always be found capable of extension beyond the original limits of observation, and in this way is often prophetic.

Descending from the general to the special, and confining our attention to the theory of thermodynamics, what do we find? The theory of heat, even as formulated twenty years ago, contained the germs necessary for the development of a complete theory of the steam engine; that it was not practically applied appears to me to be, not the fault of the theory or its originators, but of the engineers who were incapable of appreciating it and seeing whither it tended! A reproach frequently hurled at the ordinary text-books on the steam engine is that they assume, for theoretical purposes, a condition of things in the cylinder of a steam engine which has no existence in reality—namely, that the walls are non-conducting. On the strength of this it is asserted that their teachings have no value whatever, and are even misleading. This is simply absurd. In elementary applied mechanics problems are generally studied, in the first instance, on the assumption that there is no friction, yet I venture to think that no one would assert, on this account, that the study of such problems was useless, and only to the least intelligent of students could it possibly be misleading.

At the present day the study of thermodynamics in its broadest sense is as essential to an engineer, who has to do with steam or other heat engines, as is a knowledge of geometry and trigonometry to a surveyor. If the interest taken in the subject by the leading men in the engineering profession is any evidence of its utility, then let your correspondent "Student" attend a meeting of either the Institution of Civil Engineers or the Institution of Mechanical Engineers, when any paper on steam engine performance or a kindred subject is under discussion, and I think he will be amply convinced. For the man ignorant of thermodynamics, a great part of such a discussion would be mere unmeaning gibberish. It is not merely or mainly the professors, for whom your contemporary, *The Engineer*, has such unbounded contempt, whose voices are to be heard at these meetings discoursing of adiabatic, isothermal, and saturation curves, standards of

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efficiency, initial condensation, and the like, but those engaged in the manufacture of steam engines, locomotive superintendents, and marine engineers.

Speaking from my own experience, I have no hesitation in saying that every man occupied with the design of steam, gas, hot air engines, or air-compressers should have a thorough knowledge of thermodynamics. Such a knowledge, even if it did nothing further, would, for example, at least save him from the not uncommon mistake of imagining that there is a margin of about 90 per cent. for economising in the best steam engines and boilers and from wasting time on impossible schemes for this object. Half an hour's calculation will often prevent the expenditure of days, or even weeks, of fruitless labour, which, in the absence of the necessary theoretical knowledge, would have been certainly undertaken through ignorance of its futility.

On no subject, I believe, is there a greater confusion of ideas than on the purpose and scope of technical education. It is very usual to hear so-called practical engineers speak disparagingly of the capacity of youths trained in technical colleges. They seem to imagine that such institutions, if their existence is to be justified, ought to turn out ready-made engineers, and because they find that is not the case sneer at "theory." The fact of the matter is that nowadays, in order to qualify for his profession, the young engineer requires theoretical training *in addition to* and *not as a substitute for* the practical discipline of former days.

Yours, &c.,
G. R. Bodmer.

London, 20th January, 1891.

Legal Proceedings.

BRITISH TANNING COMPANY *v.* GROTH.

This was an action tried before Mr. Justice Romer and was brought by the assignees of Messrs. Worms and Babé's patent, No. 9515 of 1887, to restrain an alleged infringement, and to recover damages in respect thereof. For the plaintiff the Attorney-General appeared, with Mr. Farwell and Mr. Gregson; for the defendant, Mr. J. Fletcher Moulton, Q.C., and Mr. Oswald.

The patent covers a new process of tanning, which has proved to be extraordinarily successful, and has effected a reduction in the time consumed in the process from six or eight months to no more than as many days. The process consists essentially in causing a current of electricity to pass through the tanning liquid and the hides immersed in it, and at the same time in maintaining the contents of the vat in a state of mechanical agitation. The agitation prevents the formation of a film of exhausted liquid upon the surface of the partly treated hides, and secures uniformity of composition throughout the tanning medium. The passage of the electric current facilitates the process of osmose, by which the tanning agents are conveyed into the interior of the hides.

The Attorney-General, in opening the case for the plaintiff, argued that the patentee had been the first to disclose the process of treating hides simultaneously by mechanical agitation and the electric current. The particular method of embodying this principle which he had described consisted in enclosing the hides and tanning liquor in a rotary drum mounted upon a horizontal axis. The drum would be about one half full of liquor, and the liquor would contain the hides. The current was introduced by means of electrodes mounted on the interior of the drum in contact with the liquid, and the circuit completed through the liquid. He contended that this was to be regarded as a type of the class of tanning appliances in which the treatment of the hides by the combination of mechanical rotation and the electrical current simultaneously applied was to be found, and that a proper construction of the patent would enable the patentee to assert rights in respect of all such appliances. Upon this view of the patent he showed that the apparatus used by the defendant would be an infringement. In the defendant's process the hides are stretched upon a frame which turns upon a vertical axis within a tanning vat, which may be, but is not necessarily, a circular stationary drum. The electric current is introduced by means of metallic electrodes disposed somewhat differently from the plaintiff's, but substantially equivalent to them. There is here, then, a rotation of the hides in the tanning liquor for the purpose of keeping that portion of the liquor which is in contact with the skins constantly refreshed, and an electric current employed to promote osmose. The differences introduced by employing a rotating frame turning on a vertical axis within the vat, instead of a drum rotating on a horizontal axis and containing the whole charge of liquor and hides, were, he contended, merely colourable differences, and did not take the process out of the category of infringements.

The validity of the patent sued upon had been called in question on one ground only—namely, that of the publication of the invention within the realm through the medium of an abstract of the patentees' American patent, which was received at the Patent Office before the date of the English application. The Attorney-General admitted that this prior publication would be sufficient to destroy the patent if it were not protected by the Patent Act, but he contended that in the circumstances of this case the publication could not operate to injure the patent. He relied upon section 103, which provides that in the case of an application for a patent made by the patentee in a foreign State of the invention sought to be protected, if that State be one with which the Government of this country has entered into any arrangement for the mutual protection of inventions, the applicant shall be entitled to a patent for his invention in priority to other applicants, and that such patent shall have the same date as the date of the protection obtained in such foreign State, provided that the application be made within seven months from the application in the foreign State. The section further provides that the publication or use of the invention within the realm during such seven months shall not invalidate the patent. The original patent in this case was taken out in France, and with the French Government such a convention as is contemplated by the statute had been concluded on the 17th March, 1884. A French patentee coming for an English patent in 1887 was entitled to his original French date if he applied within seven months, a period which would cover the actual date of the present application. The Attorney-General was constrained to admit that this patent had not in fact got the French date, but he argued that the claim in the statute was only directory, and that it was the duty of the Patent Office to give to every grant its proper date. That if the office had failed of its duty in this instance, the effect could only be to abridge the term of the patent, not to render the grant invalid, and he met the point that it was for the patentee to see that he got the right date, by explaining that at the time when this application was made no form had been devised which was strictly applicable to the case of a foreign patentee. On the contrary, every application was required to be made in the common form scheduled to the Act, and this form made no reference to foreign patents.

He called in support of his case Mr. Wm. Crookes, F.R.S., Professor Sylvanus Thompson, Professor George Forbes, Mr. James Swinburne, and Mr. John Thomas Blackmore, the last named being a practical tanner. The evidence which they gave was directed to support the Attorney-General's opening statement, but Mr. Moulton, in cross-examination, elicited admissions that the mechanical treatment of hides during tanning in a revolving drum quite apart from electricity was a well-known process at the date of the patentee's application, and that this treatment had for some purposes distinct advantages over other methods of mechanical treatment. In particular it was admitted that, as compared with the defendant's process of stretching the hides upon a frame, the method of causing them to roll upon the interior face of a rotating drum produced a bending of the hides upon themselves and a rubbing upon one another, which were important items in the treatment. They greatly increase the suppleness of the resulting leather, and they also occasion a rise of temperature.

Mr. Moulton, for the defence, called Mr. A. Wilson, a practical tanner, Dr. S. Rideal, and Mr. A. P. Trotter. Their evidence was directed to emphasise the effect of the admissions already obtained from the plaintiff's witnesses, that the method of tanning in a rotating drum was a known method of treating hides at the date of the patent, and that it possessed distinct advantages over other methods of mechanical treatment, which led to its preferential adoption in the preparation of certain leathers; that in these respects it was distinct from the defendant's process, and that this particular process would be understood to be indicated by the language used in the specification. Upon these materials Mr. Moulton submitted his case. He argued that the process "substantially as described," which the patentee had claimed, was not the broad method of applying mechanical agitation and an electric current simultaneously, but the more narrowly defined mechanical process, of which the rotating drum forms an essential feature, and in support of this contention he relied, not only on the terms of the English specification, but also on the still more explicit language of the French specifications, which he was able to use for this reason: it was essential to the plaintiff's success that he should assert that the French patent and the English patent were for the same invention, as otherwise the Convention would not get rid of the prior publication of the American abstract. But, if so, either the one or the other might be read to ascertain wherein the invention consists. Upon the point of law he argued that, as it is certain that under existing rules the foreign patentee has the option of taking an ante-dated patent under the Convention, or an ordinary patent without regard to the Convention, whichever he might consider more advantageous, it must have been so from the first, otherwise it would follow that the rights of the foreign patentee had been abridged by the statute and limited to the conventional patent, and only restored by the new rules when made. Therefore the patentees must be taken to have exercised a choice when they obtained their British grant, and the date is conclusive evidence against them as to what their choice was.

Mr. Farwell replied for the plaintiff, and Mr. Justice Romer gave judgment in favour of the defendant on both points. In so doing, he remarked that Subsection 2 of Section 103 of the Patent Act must be read as a part of the whole section. It was not intended to extend the rights of a patentee taking an ordinary patent. Although no special form of application had been devised at the date of this patent, the date is, nevertheless, conclusive. If there had been a mistake it was the patentee's fault, or, if not his fault, then his misfortune. Upon the point of infringement his decision turned entirely upon the construction of the specification, and he thought that the true construction was the narrower one for which the defendant had contended—not the broader for which the plaintiff had argued. Upon this view there was no infringement, and his judgment went accordingly.

The practical questions agitated in this case are of the greatest interest and importance, since extraordinary results, as above mentioned, have been obtained by applying electricity to the tanning process in the way now disclosed. The technical questions also are of no slight importance. The point so much discussed about the effect of the Convention is not likely to affect many patents, since the difficulty can hardly arise, now that a special form of application has been provided for the use of a foreign patentee. But the case illustrates afresh the capital importance of properly drawn claims. So far as the evidence tendered shows, there was no reason at all why Messrs. Worms and Babé should not, in 1887, have obtained protection for the broad principle of applying an electric current to hides undergoing the tanning process in any form of apparatus which kept them in a state of mechanical agitation. They elected to patent one form of such apparatus, that which they considered best for their purpose, with the consequence that the idea which they were undoubtedly the first to embody in an invention became thereupon common property, and at the service of every inventor ingenious enough to devise a novel mode of applying it.

ELECTRICITY IN TRANSITU: FROM PLENUM TO VACUUM.*

Kinetic Theory of Gases.—Matter at its ultimate degree of extension is conjectured to be not continuous, but granular. With speculations as to the constitution of liquid and solid matter I need not trouble you, but will proceed at once to the third or gaseous state of matter.

The kinetic theory of gases teaches that the constituent molecules dart in every possible direction with great but continually varying velocities, coming almost ceaselessly in mutual collision with each other. The distance each molecule traverses without hitting another molecule is known as its *free path*; the average distance traversed without collision by the whole number of molecules of a gas at any given pressure and temperature is called the *mean free path*. The molecules exert pressure in all directions, and are only restrained by gravitation from dissipating themselves into space. In ordinary gases the length of the mean free path of the molecules is exceedingly small compared with the dimensions of the vessel, and the properties we then observe are such as constitute the ordinary gaseous state of matter, which depend upon constant collisions. But if we greatly reduce the number of molecules in a given extent of space the free path of the molecules under electric impulse is so long that the number of their mutual collisions in any given time in comparison with the number of times they fail to collide may be disregarded. Hence, the average molecule can carry out its own motions without interference. When the mean free path becomes comparable to the dimensions of the containing vessel, the attributes which constitute gaseity shrink to a minimum, the matter attains the ultra-gaseous or "radiant" state, and we arrive at a condition where molecular motions under electrical impulse can easily be studied.

The mean free path of the molecules of a gas increases so rapidly with progressive exhaustion, that whilst that of the molecules of air at the ordinary pressure is only $\frac{1}{10000}$th of a millimetre, at an exhaustion of a hundred-millionth of an atmosphere, the mean free path will be about 30ft.

In discussing the motions of molecules we have to distinguish the *free* path from the *mean free path*. Nothing is yet known of the *absolute* length of the free path nor of the *absolute* velocity of a molecule. For anything we can prove to the contrary, these values may vary almost from zero to infinity. We can deal only with the *mean* free path and the *mean* velocity.

The Passage of Electricity through Rarefied Gas.—The various phenomena presented when an induction spark is made to pass through a gas at different degrees of exhaustion point to a modified condition of the matter at the highest exhaustions. Here is a slightly exhausted tube (Fig. 1), like the first in the series just exhibited (75 mm.), the induction spark passes from one end to the other, A B, and the luminous discharge is seen as a line of light, acting as a flexible conductor. Under the tube I have an electromagnet C, and on making contact the line of light dips in the centre down to the poles of the magnet, and then rising again proceeds in a straight line. On reversing the current the line of light curves upwards. Notice that the action of the magnet in this case is only local.

* Abstract of Presidential Address given by Mr. William Crookes, F.R.S., before the Institution of Electrical Engineers on the 15th inst.

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In a highly exhausted tube the action is quite otherwise. Such a tube is before you (Fig. 2), and in it I have carried the exhaustion to a high point (0·1 mm.). I pass the induction current and you perceive the electrified molecules, like the line of light in the first tube, also move in straight lines, and make their path apparent by impinging on a phosphorescent screen D E. If, however, I submit them to the action of a magnet C, their behaviour is different. The line dips down to F, but does *not* recover itself.



FIG. 1.—P = 75 MM.

It seems that in the tube first shown we have to do with the average behaviour of the molecules of gas in its totality. In the second case, where the gas has been greatly attenuated, we are merely concerned with the behaviour of the individual molecules of which it was originally composed.

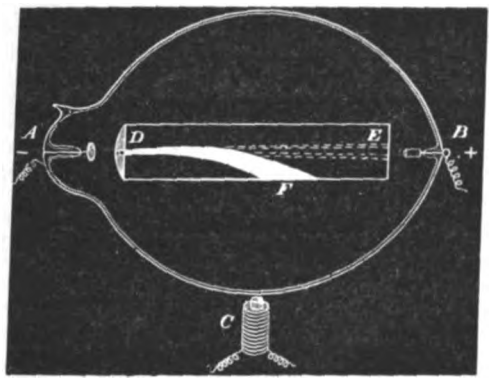


FIG. 2.—P = 0·1 MM.

The Stratified Discharge.—When the gas is rarer than is necessary to give the flexible line of light, as shown in the first experiment, the luminosity is plainly discontinuous, or, as it is termed, stratified.

A very good illustration of this fact may be taken from the moving crowd in any much frequented street, say, Fleet Street. If at some time, when the stream of traffic runs almost equally in both directions, we take our stand at a window from which we can overlook the passing crowd, we shall notice that the throng on the footway is not uniformly distributed, but is made up of knots, we might almost say blocks, interrupted by spaces which are comparatively open. We may easily conceive in what manner these knots or groups are formed. Some few persons walking rather more slowly than the average rate slightly retard the movements of others whether travelling in the same or in an opposite direction. Thus a temporary obstruction is created. The passengers behind catch up to the block and increase it, and those in front, passing on unchecked at their former rate, leave a comparatively vacant space. If a crowd is moving all in the same direction the formation of these groups becomes more distinct. With vehicles in crowded streets, the result, as everyone may have remarked, will be the same. Hence mere differences in speed suffice to resolve a multitude of passengers into alternating gaps and knots.

Instead of observing moving men and women, suppose we experiment on little particles of some substance, such as sand, approximately equal in size. If we mix the particles with water in a horizontal tube and set them in rhythmical agitation, we shall see very similar results, the powder sorting itself with regularity into alternate heaps and blank spaces.

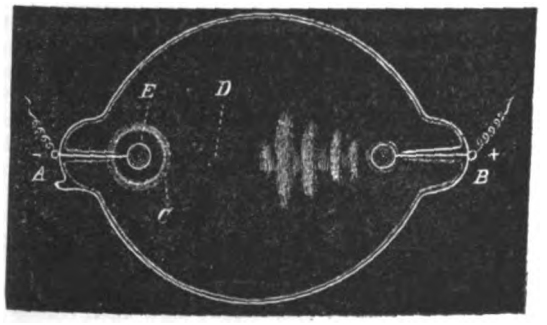


FIG. 3.—P = 3 MM.

If we pass to yet more minute substances we observe the behaviour of the molecules of a rarefied gas, when submitted to an induction current. The molecules here are free, of course, from any caprice, and simply follow the law I seek to illustrate, and though originally in a state of rampant disorder, yet under the influence of the electric rhythm they arrange themselves into well-defined groups or stratifications; the luminosities show where arrested motion with concomitant friction occurs, and the dark intervals indicate where the molecules travel with comparatively few collisions.

The Dark Space.—After the stratification stage is passed we come to a very curious phenomenon, the so-called "dark space." Separating the negative glow from its electrode is the dark space. In this tube it is so small that the glow appears to be in actual contact with the electrode, but on exhausting a little further it rapidly separates; and in the next tube (Fig. 3), containing air at a pressure of 3 mm., this dark space E has extended so as to remove the negative glow about 4 mm. from the electrode A. It is with this dark space that I particularly wish to deal to-night. Therefore I shall refer to it as the "dark space," meaning always that in the negative glow.

With hydrogen stratifications the contents of the tube under the electric discharge still obey the laws following from the average properties of an immense number of molecules moving in every direction with velocities of all conceivable magnitudes. But if I continue exhausting, the dark space E round the negative pole A becomes visible, grows larger and larger, and at last fills up the entire tube. The molecules at this stage are in a condition different from those in a less highly exhausted tube. At low exhaustions they behave as gas in the ordinary sense of the term, but at these high exhaustions, under electric stress, they have become exalted to an *ultra gaseous* state, in which very decided properties, hitherto masked, come into play.

The radius of the dark space varies with the degree of exhaustion, with the kind of gas in which it has been produced, with the temperature of the negative pole, and to a less extent with the intensity of the spark.

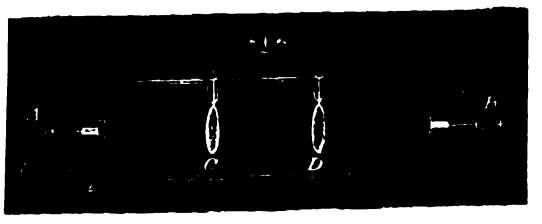


FIG. 4.

Exploration with Idle Poles.—Wishing to learn something of the electrical condition of the matter within and without the dark space, I made a tube (Fig. 4), having besides the positive and negative terminals A B two extra intermediate poles C and D. The tube showed that when the exhaustion was such that both the idle poles were outside the dark space, on passing the current through the tube, there was a considerable difference of potential between them when measured on the galvanometer. If the exhaustion was carried so high that one of the extra poles was just on the border of the dark space, then no current passed between them. When the exhaustion was still further increased so as to enclose one of the extra poles fully in the dark space, again there was a great difference of potential between them, but the direction was reversed, the pole at highest potential now being the one formerly at lowest potential.

When the dark space has been further explored by means of a movable negative pole, I found that the effects did not depend essentially on the exhaustion, and were really due to the position occupied by the extra poles with regard to the dark space.

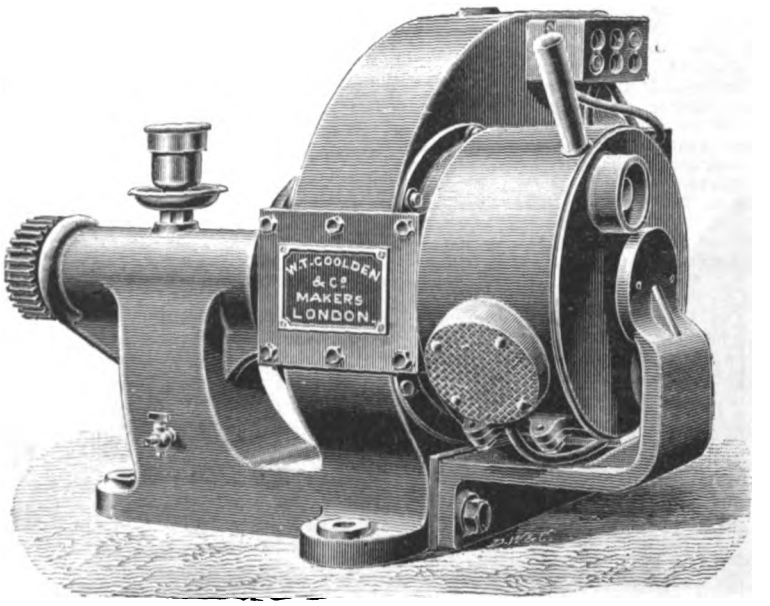
When a substance that will phosphoresce under electrical excitement is introduced into the tube, the position of greatest luminosity is found to be at the border of the dark space, just where the two opposing armies of negative and positive atoms meet in battle array and recombine.

(To be continued.)

THE "GOOLDEN" MINING MOTOR.

CONSTRUCTED BY MESSRS. W. T. GOOLDEN & CO., ELECTRICAL ENGINEERS,

WOODFIELD WORKS, HARROW ROAD, LONDON, W.



THE "GOOLDEN" MINING MOTOR.

ONE of the principal difficulties with electric mining motors arises out of the rough conditions and dirty situations in which the motors have to be used, and a further difficulty in coal mines is the danger that occasionally arises from the presence of explosive gases. For ordinary purposes, even in coal mines, it may be safely assumed that the motor will not be working normally in an explosive atmosphere, and it is therefore sufficient to enclose the whole armature and brushes in air-tight and dirt-tight coverings. Such coverings would be sufficient to exclude an explosive mixture for many hours, and before such mixture found its way into the neighbourhood of the armature or brushes, the condition of the atmosphere would be noted by the attendant, and the current cut off. The above engraving shows one form of the "Goolden" mining motor as made by Messrs. Goolden & Co., London, which embodies, besides the complete enclosing of the armature, various other important features. The construction of the armature is unusually strong, the wires being keyed in every position, and insulated from the core and from one another by means of mica. These methods enable the machines to be used for driving hauling machinery subject to great vibration and shocks by the use of gearing, thus doing away with belts, chains, and other forms of connection, all of which have been proved in practice to be unsuitable for working or not portable.

For cases where it is desired to make a machine absolutely safe in an explosive mixture, Messrs. Goolden's patents cover an arrangement in which the volume of gas enclosed in the cover of the brushes in contact with the commutator is as small or less than that enclosed in an ordinary safety lamp, and therefore, should ignition result, the volume of gas, compared with the length and cooling surface of the outlet, is such that no flame will appear externally. These motors are now being widely adapted for use in electric coal-cutting machinery, electric pumps, electric haulage, and rock-drilling plants, and on a future occasion we hope to illustrate and describe some of these applications to practical mining.

THE PHYSICAL SOCIETY.

AT a meeting of this Society, held on the 16th inst., Professor W. E. Ayrton, F.R.S., President, being in the chair, Professor C. M. Minchin read a paper on "Photo-Electricity." His experiments on the subject were commenced in 1877, in attempting to produce a photographic image of a distant object. The result sought for has not, hitherto, been obtained, but the experiments have led to the discovery of many interesting phenomena. Some of these were shown to the meeting. Electric cur-

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THE PREPARATION OF BORAX.

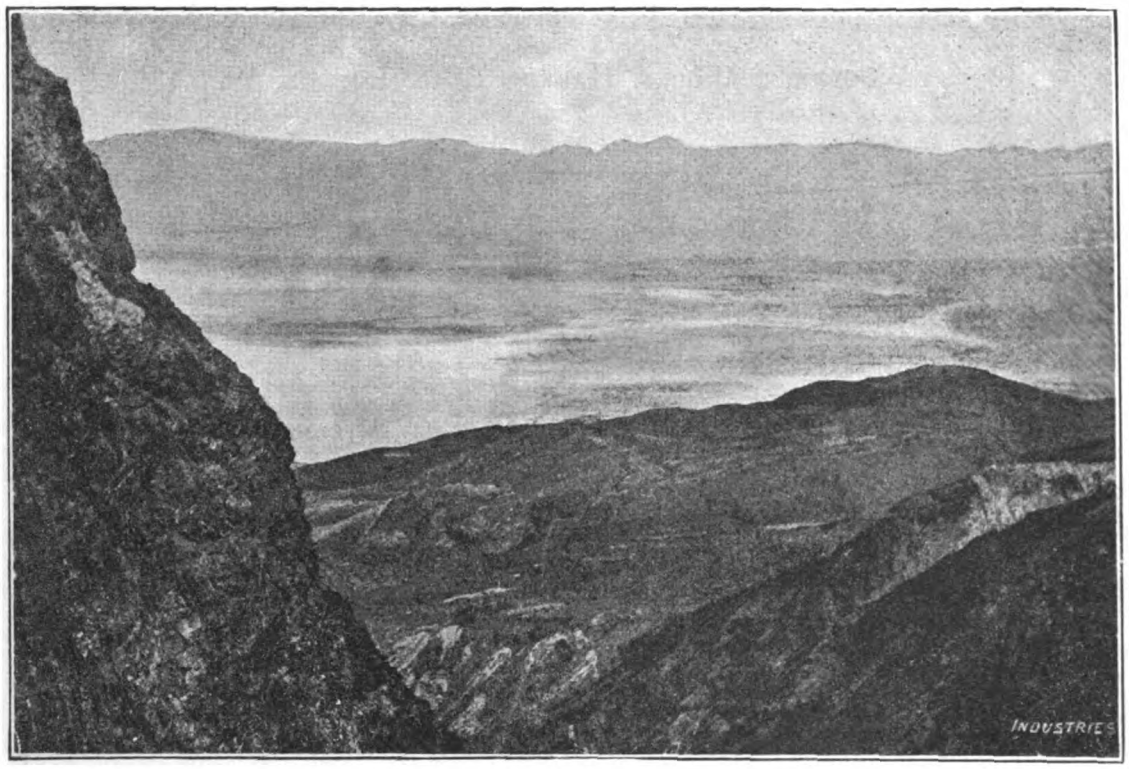


Fig. 1.—Saline Valley.

rents are produced by the action of light on silver plates coated with collodion or gelatine emulsions of bromide, chloride, iodide, and other silver salts, or with cosine, fluorescine, and other aniline dyes, when the plates are immersed in a suitable liquid and one plate illuminated whilst the other is screened. The directions of the currents depend on the materials employed, and the blue end of the spectrum is most effective. Currents have a photographic effect on the plates, and this action is strictly confined to the parts through which the current has passed. Comparatively strong currents were obtained from plates coated with cosine and gelatine. A curious reversal was observed with some cells, the exposed plate first being positive to the screened one, and almost immediately afterwards negative. On shutting off the light a transient increase of current resulted, and afterwards disappeared gradually. M. Becquerel, who has studied the action of silver plates coated with bromine, &c., concludes that the nature of the exposed plate (whether positive or negative) depends on the thickness of the surface layer. The electromotive force of such cells rarely exceeds $\frac{1}{20}$th of a volt.

Uncleaned tinfoil plates in common tap water give a current when one is exposed to light and the other screened. Cleaning the plates destroys the effect. In nearly every case the exposed plate was first positive, and, after a time, became negative; and by exposing various parts of a plate (some portions of which had been previously exposed) the currents could be varied in direction at will. These peculiarities may explain the known divergence of tin from Volta's law. The phenomena have also been studied by aid of the electrometer. Tinfoil obtained from tobacco packages was found to be very sensitive to light. One side of such foil is dull and the other bright. By pasting slips of it on opposite sides of a glass plate, so that dissimilar sides were outermost, and immersing them in alcohol, a cell giving an e.m.f. of $\frac{1}{10}$ volt when the dull side was exposed to light was obtained. The addition of any salt to the liquid, with a view to diminishing the resistance, invariably reduced the e.m.f. Experiment showed that the alcohols were by far the best liquids to use with tinplates. A process for producing very sensitive tinplates was described, which apparently results in the formation of white oxide of tin on the surface of the foil. With one such plate and another unsensitised plate the best results have been obtained by immersing them in methyl alcohol prepared from oil of wintergreen. From experiments on the variation of e.m.f. with the intensity of light, it was found that the square of the e.m.f. is proportional to the intensity.

Some tin cells behave in a very peculiar manner, for it often happens that a good cell will exhibit no e.m.f. after being kept a few days. A slight impulse or tap given to the cell or its support restores the sensitiveness; another impulse makes the cell unsensitive, and these effects can be repeated indefinitely. Such cells the author calls "impulsion cells," and some were exhibited at the meeting. The sensitised plate of one of these cells had different properties at its two ends, for impulses had no effect on the nature of the lower end, but changed the upper end from positive to negative, and *vice versâ*. Electromagnetic impulses, such as are produced by sparks, are capable of altering cells from the unsensitive to the sensitive state, but fail to produce the reverse effect; a Hertz oscillator restored the sensitive state in a cell placed at a distance of 81ft. away. The "impulsion effects" can be got rid of by renewing the alcohol on several successive days.

During last year the author made some selenium cells by spreading the melted substance on metal plates and immersing them in liquids together with an uncoated plate. Of the various metals and liquids tried, aluminium and acetone gave the best effects. The process of forming these "seleno-aluminium cells" was described. One of their peculiarities is that they are nearly equally sensitive to rays of all colours, and when exposed to strong light may give an e.m.f. of $\frac{1}{2}$ to $\frac{3}{4}$ of a volt, the sensitised plate being negative. An arrangement of 50 cells in series with an electrometer was exhibited, whereby the e.m.f. generated by light falling on the cells could be caused to ring a bell and light or extinguish electric lamps.

In conclusion the author pointed out the possible applications of photo-electricity to photometry, telephotography, and the utilisation of solar energy. At the request of the President, Professor Minchin promised to show the experiments on February 13th, on which date the discussion on the paper is to take place.

Professor F. R. Barrell then exhibited and described a lecture-room apparatus for determining the acceleration due to gravity. A number of iron balls are allowed to fall through a certain height in such a way that one starts off when its predecessor arrives at its destination. From the time occupied by all the balls, the time for one can be found, and, knowing the distance traversed, "g" can be determined. The apparatus consists of two electromagnets joined in series with a battery and key, together with a ball-feeding device. One of the magnets is vertically over the key, and serves to catch the balls as they emerge from the feeding tube, whilst the other magnet actuates a kind of slide for supplying successive balls. When one ball falls on the key it breaks circuit, and thus causes the first-mentioned magnet to let go its ball. The key then springs up again, thus making circuit; the feeding magnet then supplies another ball, which is caught by the holding magnet until the falling ball reaches the key, and the operations are repeated. Fairly accurate results can be obtained by the apparatus.

Sir John Conroy's paper, on "The Change in the Absorption Spectrum of Cobalt Glass by Heat," was postponed.

THE PREPARATION AND INDUSTRIAL APPLICATION OF BORAX.

Although very little information on the subject of borax, is afforded in books of chemical technology, chemistry, and other scientific works, it is nevertheless an article used more or less extensively in a number of industries.

When the supply was limited to the "tincal" obtained from deposits found in the Himalayan Mountains of Southern Thibet and Northern India, and brought from thence upon the backs of sheep to the highways of commerce, the demand was confined simply to the working of precious metals. Then came the utilisation of the boracic acid, found in the vapours of the suffioni, at Monte Rotondo and the surrounding neighbourhood, in Tuscany, by Count Lardarel.

But notwithstanding the most strenuous efforts to increase this supply, not more than 3,000 tons could be obtained per annum, and this, by a simple process, was converted into borax. The demand by china and earthenware manufacturers for borax as an ingredient for their glazes soon caused this source to be entirely inadequate to the demand. In the year 1869 the borate of lime mines, of Suzurlu, in Asia Minor, were opened, and from this source from 7,000 to 8,000 tons of borax are annually obtained. Prior to that, in the year 1856, borax was discovered in California by Dr. John A. Veatch, since which time no less than ten deposits have been discovered and operated in North America. Five of these are situated in California, and five in the neighbouring State of Nevada. The Californian marshes are situated at Saline Valley, Furnace Creek, and Armagosa, all in the county of Inyo; Slate range in San Bernardino County, and Lower lake in Lake County. The Nevada marshes are at Rhodes, Teels Marsh, Fish Lake, and Columbus, in the county of Esmeralda, and Salt Wells, in Churchill County. By far the richest marsh is Saline Valley The crude borax there covers the plain, which is 18 miles long by 12 miles wide, for an area of over 1,000 acres, with a depth of from 6in. to 18in.

The borax is mixed with sand, sulphate of soda, carbonate of soda, and salt. The colour of the crude material as it lays upon the plain is of a peculiar greyish yellow, giving the surface the appearance of snow somewhat tinged by age. The material varies in richness from 10 to 90 per cent. of pure borax.

Surrounding the plain are a complete circle of mountainous hills, with here and there a copse of mesquit, manzanita, or shellac wood, and, looking over the dry and arid marsh towards the mountains, small streams of pure fresh water may be observed, affording not only a pleasant relief to the eye, but a great boon to those employed in the industry. Saline Valley is on the eastern slope of the Sierra Nevada Mountains, 11 miles from the line of the Carson and Colorado Railroad Company, and its topographical aspect is best described by comparing it to an immense saucer.

As regards the various uses of borax, manufacturers of china, earthenware, white glazed bricks and tiles use borax in making "fret" for glazing the different descriptions of goods. Cement, likewise, compounded with borax, possesses the quality when set with water of taking a polish like marble. In the hardware trade it is used for enamelling copper and iron. In this capacity borax reduced to a glass forms a vitreous coating. Gold and silversmiths use it in soldering and reducing the precious metals; coppersmiths apply it to brazing, and ironsmiths to welding. In connection with the textile trade, silk weavers employ a solution for dissolving the glutinous matter adhering to raw silk; hat makers as a solvent for shellac to form a stiffening; dyers and calico printers as a mordant; laundrymen, in conjunction with starch, for putting a beautiful gloss or finish upon linen after being ironed; and paper makers, in the fabrication of highly glazed paper. Colour manufacturers use it in the preparation of Guignet's green and borate of manganese, which acts as a drier. Photographers use it in print varnishing, and the formation of toning baths for silver prints. As a fireproof material it is used as a lining between the inner and outer shells of safes. The candlewick maker, on the other hand, uses it for steeping the wick, so that when the candle is lighted the wick curves over and is completely burnt away. The property borax possesses of softening hard water renders it useful to the soap manufacturer.

The success which has attended the introduction of borax as a food preservative may be judged from the fact that, in 1883, 2,000lb. weight was used for the purpose of preserving hams and bacon by the pork packers of Chicago, Kansas City, and St. Louis, whilst in 1888, or five years afterwards, over 2,000,000lb. weight was used for the same purpose. The great advantage of borax as an antiseptic lies in its purity and agreeable properties. It is odourless, easily soluble in water, of a pleasant sweetish taste, and resembles in appearance

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the finest sugar or refined table salt. It is harmless, in fact, it is considered to benefit the human system, as its employment in over a dozen pharmaceutical preparations would denote. It enters into the composition of the following medical preparations:—Boroglyceride, borax lozenges, ung-acidi-borici, borax lint, glycerinum boracis, borax pastilles, boro-tartrate of potash, mel boracis, glacialin, and tartarus boraxatus.

Our illustrations, which are from photographs, represent in Fig. 1 the borax marsh at Saline Valley, where the crude borax is seen lying on the plain, and in Figs. 2 and 3 views of the reduction works and dwellings. The method employed of refining the crude borax consists in, first of all, collecting the material from the plain. This is done by simply shovelling layers of the surface to a depth of 18in., and loading it into waggons provided with wide tyres to the wheels to prevent them sinking into the loose friable mass. Below the surface of the marsh at a depth of 4ft. liquor is found highly impregnated with borax. The material is hauled to the refining works, which are conveniently situated upon firm ground at the edge of the marsh.

The next process consists in dissolving all the soluble matter in the crude material. For this purpose wrought-iron pans are used, about 35ft. long by 7ft. wide, semi-circular in shape, set on arches of stone, beneath which are furnaces and flues for heating the contents of the pans. They are supplied with water from the neighbouring mountain streams by means of iron pipes, and the fuel necessary for boiling the water is obtained from the timber growing in the immediate vicinity, of which there is an immense quantity. The crude borax is thrown into the pans, and with the aid of long poles is vigorously stirred until all that is soluble is dissolved; the liquor is then allowed to settle for some hours, and when perfectly clear is drawn off into round tanks made of light galvanised iron, where the borax crystallises on cooling. When the crystallisation is complete, the "mother liquor" is drawn off, leaving only the crystalline borax, which is removed and packed into sacks for commerce.

The operation is conducted inexpensively as far as the production of the borax is concerned, the principal item of expense in connection with its cost for commercial purposes being the railway carriage from the point of consignment to New York, which amounts to £7 10s. 8d. per ton. All the other outlay is said not to exceed £5 per ton. As the price of borax in Great Britain is about £28 per ton, it will be seen there is considerable profit attached to its manufacture, which is due to the fact that all the borax deposits throughout the world are in a few hands and consumers are largely under the control of the producers.

THE ANALYSIS OF THE AIR OF LARGE CITIES.

The question of air pollution is being taken up in earnest in Manchester. Certainly the smoky condition of the atmosphere of our large cities has, in conjunction with fogs, been brought prominently forward during the long frost, and any movement which has for its object the minimising of the evil has our hearty support. The late Dr. Angus Smith, in his book on "Air and Rain," gave a *résumé* of the large amount of work he had done in connection with air analysis, but not much attention seems to have been given to the subject in recent years. Much remains to be cleared up as to the origin of fogs, although a good deal of attention has been paid to the matter by Aitken, whose papers have appeared in the *Philosophical Magazine*. It was thought, therefore, that a systematic series of analyses, carried out at different points of a large city at the same time, would give valuable information as to the chief causes of pollution, and to this end a chemical sub-committee has been appointed by the Town Gardening Section of the Manchester Field Naturalists' Society. The committee consists of Dr. Bailey, Dr. Cohen, and Mr. P. J. Hartog, B.Sc., of the Owens College Chemical Staff, and Dr. Tatham, Medical Officer of Health for Manchester. A subscription list was opened to defray the cost of apparatus, &c., and about £200, the sum required, has been raised.

The analytical scheme is a very comprehensive one. The observations, which are to be made at seven different stations in Manchester and Salford, are intended to afford definite information on the following points:—

1. The composition of the air in densely populated as compared with thinly populated districts.
2. The relation between atmospheric impurities and prevalent sickness and mortality.
3. Amount and distribution of noxious ingredients specially injurious to plant life—*e.g.*, sulphurous acid.
4. The extent to which smoke and noxious gases are due to (*a*) dwellings; (*b*) factories.
5. Nature of fog, and the chemical character of the air during the prevalence of fogs.

At a meeting of the Society on the 7th inst. Dr. Bailey reported that their investigations had been commenced. They had found, he said, that the snow carried to the ground large quantities of sulphuric and hydrochloric acids, and also some of the elements of sewage. The depositions on leaves collected at the various observing stations were in amount directly as the population, and the greatest injury to plant life was found to be due to the emanations from dwelling-houses. They estimated that, in one day, two tons of "blacks" and 3 cwt. of sulphuric acid were deposited per square mile of the city area. The above figures are sufficient to show that much interesting and valuable information may be looked for when the final report of the committee is issued. On similar lines, a committee, with which the names of Professor Oliver and Mr. Scott, the botanists, are associated, has been appointed in London, the initiative being due to the Royal Horticultural Society.

THE PREPARATION OF BORAX.

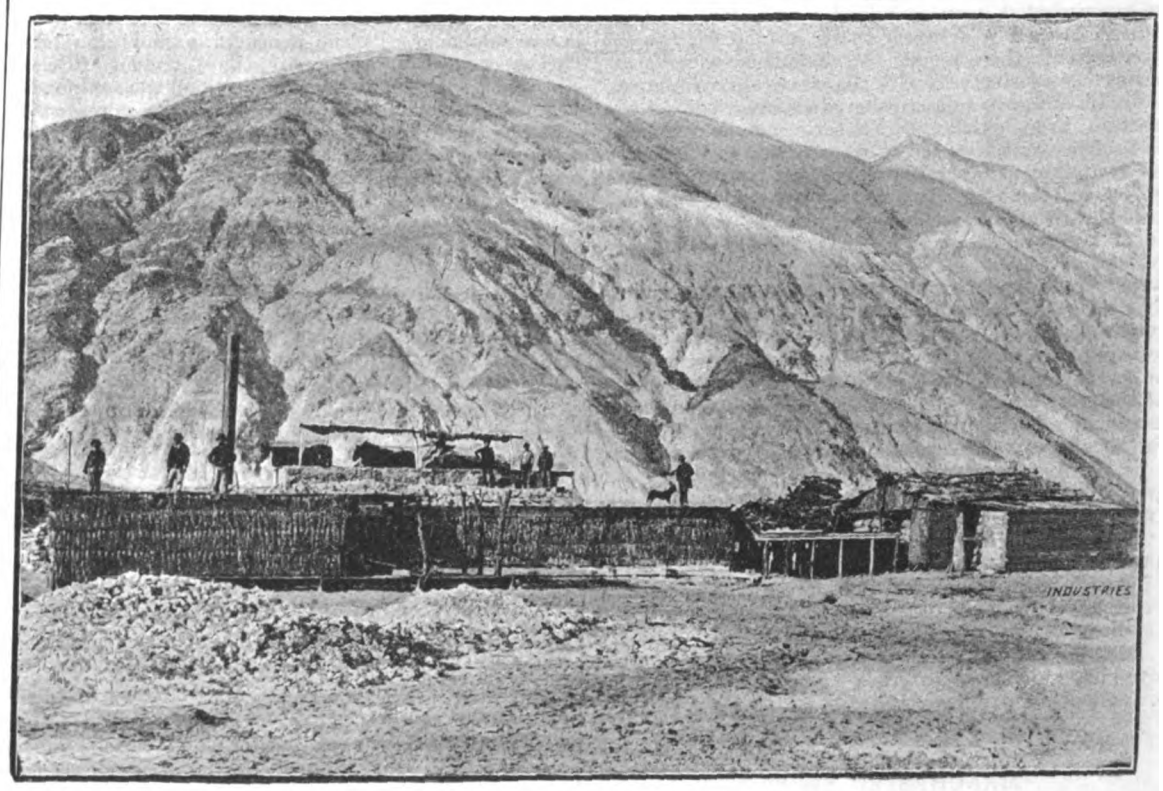


Fig. 2.—Reduction Works.

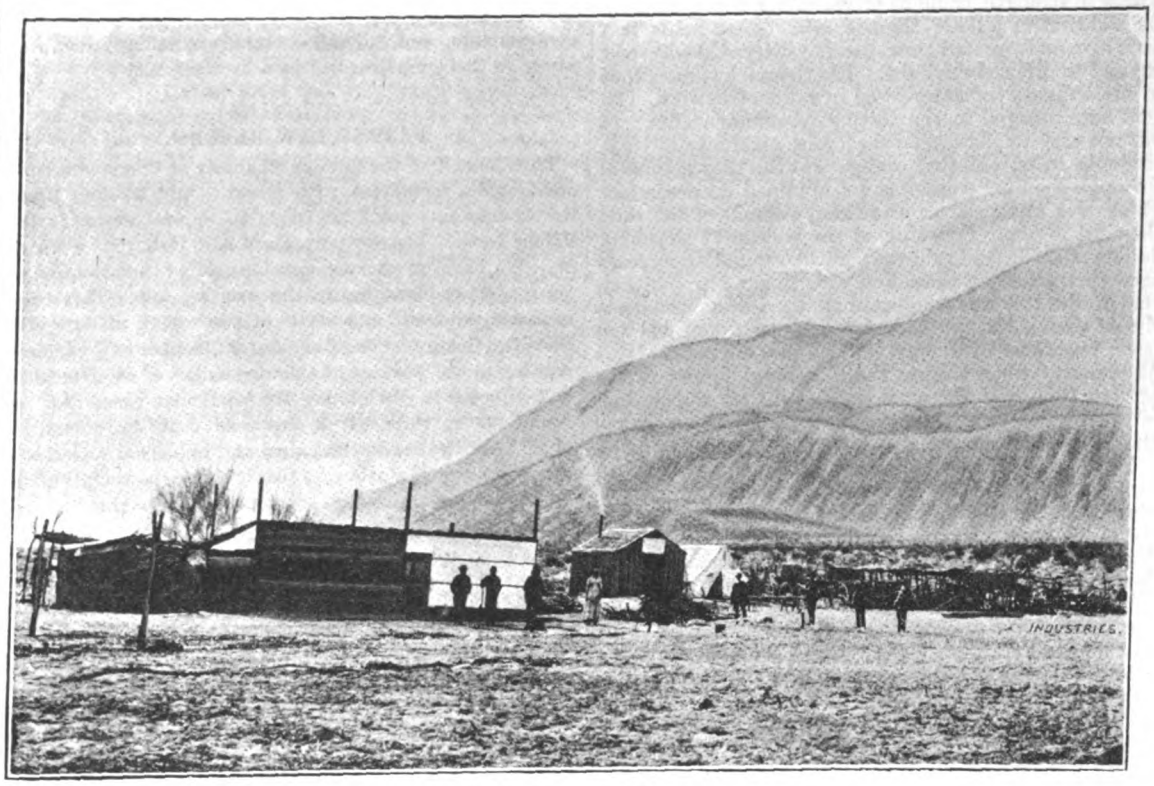


Fig. 3.—Dwellings of Workpeople.

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

An extra meeting of this Society was held on the 19th inst., when a paper was communicated by Mr. J. A. Wanklyn, on "The Constitution of Butter." The evidence which the author put forward in favour of the novel views which he held on this subject was severely criticised by Dr. C. R. A. Wright and Messrs. O. Helmer and Allen, of Sheffield.

Subsequently a paper was read by Mr. Watson Smith, on the McArthur Forrest "Cyanide Process for the Treatment of Gold Ores," in which the author gave a short account of laboratory experiments made with a view of ascertaining the efficacy of the process with poor grade ores. Our readers will be aware that this process consists in agitating the crushed ore with a

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solution of potassium cyanide, and then passing the solution of gold cyanide so obtained over zinc turnings, and finally recovering the gold from its zinc alloy by distillation. Three experiments were given in detail by the author, showing the variation of yield with strength of cyanide solution and length of agitating time. The ore experimented upon contained both gold and silver, and the process was shown to be suitable for the recovery of both these metals, the amount recovered comparing very satisfactorily with the assay values of the ore.

Mr. Blount gave a description of his experience of the process. From his laboratory experiments, he concluded that a 1 per cent. solution of cyanide was as efficient as one containing 2·5 per cent., and that the process was applicable to certain Australian ores which had not yielded satisfactory results when treated with chlorine under pressure. Several speakers followed, who gave evidence of the satisfactory working of the process on a large scale in South Africa, and Mr. Vautin pointed out that in gold-bearing rocks in which there was much pyrites, the cyanide process was far more economical in working than any of the chlorine processes with which he was acquainted. He threw some doubt on the validity of the patent, and stated that he believed anyone could use cyanide for the recovery of gold from these ores. He further suggested the use of an alloy of 99 parts zinc and 1 part sodium as a better material for precipitating the gold from the cyanide solution than the zinc foil and turnings at present employed.

Dr. Rideal regretted that those interested in the rival processes had not joined together to carry out a series of experiments on the same kinds of ore in order that the relative values of the different gold extracting processes might be placed on some scientific basis.

Mr. Watson Smith showed specimens of the crude cyanide, zinc, and materials at present used by the owners of the patent.

MANCHESTER SECTION.

At a meeting, held on the 9th inst., Mr. Hart being in the chair, Dr. Gerland contributed some laboratory notes. He had found that standard oxalic acid, which was liable to alter in strength, could be preserved for a long time by the addition of a little thymol acid. Some made two years ago, and, treated thus, had not altered at all when exposed to diffused daylight. The thymol had no action on the ordinary indicators used in volumetric work. The next note referred to the testing of alumina salts. It was not easy to determine the exact alkalinity of basic luminous salts. Methyl orange was the best indicator, although the final point was not obtained at once, a fact which was instanced as a striking example of retarded chemical action. Speaking of the testing of bleaching liquors, Dr. Gerland said that he had found some years ago, when titrating these liquors with arsenite solution, that if the test was conducted slowly less chlorine was shown than if the test occupied a longer time. He had never been able to account for this, and did not find this discrepancy when testing the bleaching liquors of the present time, and therefore suggested that the product of the Weldon process differed in some way from that of the old Deacon process.

In the ensuing discussion, Dr. Grossman said that the strength of bleaching liquors always deteriorated on standing. By testing in different ways, different results were obtained. If the bleaching powder was sent out from the works warm it frequently happened that the free oxygen present caused the conversion of hypochlorite into chlorate, and this not only meant a loss of chlorine, but he had also known it to lead to explosions. If Dr. Gerland had not made his tests in alkaline solution, of course chlorine would be generated by the decomposition of chlorates.

Dr. Gerland said that he had tested in alkaline solution.

Mr. Carter Bell said that he saw no advantage in using standard oxalic acid; he used standard hydrochloric in all cases, and always weighed it out instead of measuring it for accurate work.

Mr. J. A. Wilson then read a paper on "Turkey Red Oil." This oil, he said, owed its name to the fact of its being used in turkey-red dyeing. It was first introduced in 1876, and results from the interaction of sulphuric acid on olive or castor oil. The manufacture consists—first, of the hydrolysis of the fatty oil, and, secondly, of the purification of the product and partial neutralisation with alkalies. The acid used, which varies from 15 to as much as 40 per cent. of the weight of oil, is added gradually, so as not to cause a great rise of temperature. The purification is effected by washing with brine and dilute alkali, the resulting product having approximately the following composition—1·3 per cent. Na_2O, 20 per cent. free fatty acid, and 25 per cent. glycerides—and is usually sold on the basis of 45 per cent. fatty matters.

Mr. Wilson proceeded to deal with the applications of the oil in dyeing and calico printing, and then gave a *résumé* of the theories held as to its constitution. The study of this involved a knowledge of the reaction of sulphuric on both oleic acid (olive oil) and ricinoleic acid (castor oil), and here chemists differed. The fatty matters are partly soluble and partly insoluble in water. The soluble part is believed by Liechti and Suida to consist of glycerol sulphates, while Müller Jacobs considers them as free sulphonic acids, and Benedikt as sulphuric esters. This experiment did not confirm the statement of Benedikt that by boiling castor turkey red oil with sulphuric acid ricinoleic acid was produced. It was noteworthy that the more castor and olive oil were acted on by sulphuric acid the less iodine was absorbed in Hübl's test. In conclusion, the following analytical scheme was given as being the most satisfactory to use. The specific gravity is taken by a Westphal balance, and varies from 1·135 to 1·017. The total alkali is determined by H_2SO_4. The free fatty acids are dissolved out with alcohol and ether at a low temperature and titrated with alcoholic potash. The total fatty matter is determined by shaking up the oil in a separator with brine and strong HCl, and subsequently extracting with ether.

An animated discussion on the chemical constitution of the oil followed the reading of the paper.

Notes.

SMALL ELECTROMOTORS.

It is often said that there should be an enormous demand for small direct or alternate current motors for driving hoists, printing machinery, small workshops, sewing machines, amateurs' lathes, knife-cleaning machines, hairdressers' brushes, and so on. Before central stations were established the good time for motors seemed to be in the far future. Now, however, we have central stations, yet not a motor is to be seen. When gas engines were new, grocers liked to have nickel-plated specimens on show in their windows driving coffee-grinding machines, and the enterprising printer advertised that he printed by gas power. Why do not similarly enterprising people use electromotors, and advertise that everything requiring power on their premises is driven by electricity?

PATENT LAW REFORM.

The Council of the London Chamber of Commerce have nominated a committee, with power to add to their number, to take any steps advisable to secure reform in the Patent Laws. The committee will find plenty of work to do. We have on various occasions called the attention of our readers to blemishes in the existing law. This committee is, no doubt, one result of the report made by the Chemical Section of the Manchester Chamber of Commerce, relating to the practice of claiming a class of combinations, and afterwards disclaiming the particular cases that are found not to work. It is proposed that the committee should ask the various technical and industrial societies to nominate representatives, so that it may be powerful enough to hope to see their suggestions carried through.

THE NEWSPAPERS OF THE WORLD.

The printing industry is not only important in itself, but also because of its immense general influence. The department in which this influence is greatest is that of newspapers, the number of which published in all countries is estimated at 41,000. Of these 24,000 appear in Europe. Germany heads the list with 5,500; then comes France with 4,100, Britain with 4,000, Austria-Hungary with 3,500, Italy with 1,400, Spain with 850, Russia with 800, Switzerland with 450, Belgium and Holland with 300 each, and the remainder in the smaller countries. The United States have 12,500 newspapers, Canada has 700, and Australia also 700. Out of the 300 journals published in Asia, Japan alone has 200. If this is any measure of progress, the latter country has progressed immensely, for twenty years ago it had no newspapers.

EDIBLE EARTH.

The villagers of Penacova, in Portugal, have for generations eaten a variety of earth obtained in the neighbourhood. All ages and both sexes chew it as if it were tobacco. Unfortunately any one of them leaving home is afflicted with "a singular *maladie du pays*, with gastric symptoms," unless he be provided with a supply of the earth. It is a tale like that told by Bret Harte of "The Wonderful Spring of San Joaquin" over again, and the reason is very probably the same—namely, the presence of arsenic in the earth, which is known to produce these singular effects upon its habitual consumers. The fact that Dr. Vogel has found none in it by a cursory examination, but, on the contrary, has detected that it contains about double the quantity of nitrogen found in similar soil from the adjacent fields, lends plausibility to the view that the active substance may be an alkaloid. The whole question could be easily settled by a competent chemist, and it is to be hoped that someone will undertake its investigation.

THE PANAMA CANAL.

The Paris *Figaro* published, on Monday last, the text of the arrangement concluded between the Government of the United States of Columbia and the Panama Canal Company, according to which the following are the principal clauses of the contract:—"(1) The time allowed for the completion of the canal is extended for a further period of ten years; (2) the concessionnaire to effect the liquidation of the old company, the assets of which will be transferred to the new company; (3) work on the canal to be effectively resumed before February 28th, 1893; (4) the concessionnaire to provide for the support of 250 soldiers charged to protect the line of the canal during its construction; (5) the concessionnaire, in exchange for services rendered by the Columbian Government, will pay to the latter ten million francs in gold and five million francs in 10,000 of the new company's shares; (6) the Columbian Government will have the right of appointing a special delegate to sit on the board of the new company." The contract bears date December 10th, 1890, and is signed by Señor A. Boldan, Minister of Foreign Affairs, on behalf of the Columbian Government, and by Colonel Bonaparte Wyse, the representative of the liquidators of the old company.

THE SUDBURY NICKEL MINES.

A report on the Sudbury Nickel Mines, of which an account recently appeared in our columns (see *Industries*, Vol. IX., p. 530), has been drawn up by commissioners who were appointed by the United States naval authorities for that purpose. The report states that from the surface indications and the shafts already sunk, there appears to be an amount of mineral which cannot be exhausted by the present generation, and estimates the tons of ore above the surface of the ground as 650,000,000. With reference to facilities for treating the ores, which do not require the admixture of fluxing substances, it is stated that "the dead pine timber found in great abundance in the neighbourhood, and which can be delivered at the furnace at $1 80c. a cord, is a good fuel for roasting though hardwood would be better, but owing to the fusible qualities of the ores and the intermixed rock, it answers the purpose. Coke is hence the only material that has to be brought from abroad. This is procured from Pittsburgh, and can be delivered at the works at $7 a ton." The amount of ore taken from the mines up to the 1st October last is about 175,000 tons. The daily crushing capacity of the machinery at work on the ground is about 1,750 tons, and the daily furnace capacity is about 100 tons.

THE COTTON INDUSTRY.

The prolonged absence of demand in cotton goods from India is telling somewhat seriously upon the weaving industry in Blackburn and East Lancashire. Many of the shirting makers in low and low medium qualities are wanting orders, and here and there machinery (looms) is being allowed to stand idle. Moreover, the outlook from our dependency in regard to a cloth demand is not very encouraging. For China slightly more inquiry has this week been about in heavy goods, such as best sheetings and best drills. Altogether, however, the weaving section of our trade is discouraging, and those who buy yarns to make into cloth are having a lean trade. Those who spin as well as weave are rather more fortunately situated. Spinners, during the past three weeks, have lost ground both in point of demand and margin. In the lower qualities of cop-twist (34's) the margin is said to be ⅛d. per lb. worse than a month ago. Several things are going against spinners—viz., lessened consumption of yarn through bad weaving weather, hardening of cotton, and increased wages. Moreover, there are several new mills getting to work, and thus increasing the supply of yarn upon the market. Viewing both spinning and manufacturing, the position may be said to have gone worse since Christmas.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

5th January, 1891.

171. Gillespie, A. ..... Pumps.
174. Titley, J. ..... Pistons for gas and other engines.
179. Davy, A. S. ..... Apparatus for treating smoke and gases from furnaces.
183. Hookham, G. ..... Paper tube making machines.
190-1. Gray, A. ..... Gas and hydrocarbon engines.
198. Euler, H. ..... Alarm for indicating the level of water in boilers.
199. Jerger, H. ..... Water engine.
205. Cochrane, C. ..... Blast furnaces.
207. Jules Lussiez & Cie. ..... Apparatus for winding and dyeing wool.
213-14-15. Edwards, D. ..... Apparatus for making tin and other coated metal plates.
216. Edwards, D. ..... Rotary steam engines (*Gwinner & Schraivogel*).

6th January, 1891.

225. Tower, C. A. ..... Steam engine.
227. Bickerton, H. N. ..... Gas engines.
234. Hanson, F. ..... Screwing machines.
241. Edge, C. ..... Engine governor gear.
245. Ethbert, H. ..... Balls for ball-cocks, ball-valves, &c.
246. Scott, W. ..... Printing presses.
248. Corning, F. G. ..... Mechanism for transferring electric car batteries. (9th June, 1890.)
267. Dolby, E., Jun. ..... Relief valve and drain and indicating cock for steam engines.
276. Thompson, W. P. ..... Rotary engines (*Chapleau*).
286. Chapman, Petrie, Petrie, Gilbert, & Jones ... Nut-tapping machines.

7th January, 1891.

287. Hahlo, Liebreich, & Hanson ..... Drop box looms.
289. Townson, T. ..... Steam engine pistons.
297. Bickerton, H. N. ..... Gas engine governors.
304. Sharp, T. ..... Method of and means for rolling metallic bars and plates having taper longitudinal sections.
305. Sargeant, T. C. ..... Engine governors.
310. Jones & Jones ..... Grinding mills.
316. Coleman & Ackland ..... Machinery for making paper bags.
333. Sampson, J. ..... Valves and their seats.

8th January, 1891.

342. Hollingworth, E. ..... Machines for milling bolts (*Webb*).
343. Hollingworth, E. ..... Bolt-heading machines (*Webb*).
348. Ashworth, Ashworth, & Ashworth ..... Card-setting machines.
354. Dent, H. ..... Grinding mills for pulverising clay, &c.
355. Dent, H. ..... Brick-making machinery.
360. Parkes & Wheeler ..... Grinding and polishing machinery.
362. Hill, W. T. ..... Machines for making horseshoes.
364. Whitaker, G. ..... Pistons of steam and like engines.
380. Silvester, J. ..... Signalling apparatus.
383. Boult, A. J. ..... Valve reversing gear of gas, petroleum, and other engines (*Berliner Maschinenbau-Aktiengesellschaft*).

9th January, 1891.

396. Cohnen, B. ..... Stop motions for looms.
414. Burrell, F. J. ..... Compound portable and traction engines and road rollers.
431. Perkins, W. J. ..... Wood-working machines.
441. Doloire & Golay ..... Mill for grinding cereals. (30th June, 1890.)
447. Smith & Binney ..... Machinery for polishing plate glass.
455. James, R. ..... Device for holding tools while grinding.
459. Hardingham, G. G. M. ... Steam boilers (*Morrin*).
460. Webster, J. M. ..... Box-nailing machines.

10th January, 1891.

465. Musgrave, W. ..... Steam boilers.
469. Hughes & Catchpool ... Attachment for lathe, drilling machine, or brace, for drilling square and polygon holes.
472. Veska, A. ..... Stamping mills for disintegrating ore.
477. Hughes & Evans ..... Lateral movement chucks.
505. Munns, W. H. ..... Railway switch (*Copeland*).
507. Munns, W. H. ..... Car coupling (*Bowling, Follett, & Follett*).
518. Jones, A. P. ..... Steam boilers (*The Société Anonyme du Générateur du Temple*).
523. Phillips & Hughes ..... Drilling machine for forming square, polygonal, or mortise holes.

ELECTRICITY.

5th January, 1891.

176. Garnett, W. T. ..... Dynamos and motors.
184. Crompton, R. E. B. ..... Armatures of dynamos.
185. Crompton, R. E. B. ..... Dynamos.
200. Brianne, L. ..... Arc lamps.

6th January, 1891.

223. Todd, W. H. ..... Primary batteries.
258. Gay & Hammond ..... Arc lamps.
271. Schoennerstedt, A. ..... Arc lamps.
284. Mayer, E. L. ..... Telephone transmitter.
285. Mayer, E. L. ..... Method of telephonic transmission and apparatus therefor.

7th January, 1891.

303. Harding, C. K. ..... Electric railway systems. (9th June, 1890.)

8th January, 1891.

361. Webb & Thompson ..... Dynamos.
389. Teague, F. ..... Electricity meters.
394. Goolden & Evershed ... Electricity meters.

9th January, 1891.

439. Mills, B. J. B. ..... Torpedoes propelled and steered by electricity (*Sims*).

10th January, 1891.

476. Banta, W. E. ..... Coupling for electrical conductors. (11th June, 1890.)
508. Munns, W. H. ..... Underground electric conduit (*Young*).
536. Atkinson & Atkinson ... Dynamos and motors.

CHEMISTRY.

6th January, 1891.

266. Anderson & Brand ..... Manufacture of alkalies and chlorine.

7th January, 1891.

340. Claus, C. F. ..... Manufacture and carburetting of hydrogen.

9th January, 1891.

440. Haddan, H. J. ..... Anti-corrosive composition for boilers.

10th January, 1891.

517. Bonne, C. R. ..... Method of combining acetic radicles with aromatic amine (*Köhler*).

MISCELLANEOUS.

5th January, 1891.

180. Langley-Smith, W. T. ... Propelling ships.
210. Langer, T. ..... Fusible mass for case-hardening.

6th January, 1891.

229. Talbot, H. ..... Manufacture of steel and iron wire.
247. Hughes, F. ..... Metallic packing for stuffing-boxes, pistons, and the like (*Pickhardt*).
275. Pike, H. ..... Metallic alloys.
283. Mayer, E. L. ..... Extraction and recovery of gold.

7th January, 1891.

298. Ryves, E. J. ..... Manufacture of explosives and apparatus therefor.
300. Hirst & Hirst ..... Method of and apparatus for hardening and tempering wire.
324. Dahlgren & Svensson ... Turning of angular sections on lathes.

10th January, 1891.

516. Watt, A. ..... Treatment of copper ores.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

15865. Jackson. 19310. James Watts, Edmund Benson Styring, & Herbert George Froud.

1890.

199. Rouse.
352. Robson.
393. Wilson.
456. Mary Ann Marshall (Administratrix of the late Edward Marshall & Charles Burgon).
476. Lawrence.
585. Meredith.
595. Phillips.
836. Gwosdeff & Bunge.
873. Perry.
880. Foster.
897. Greenaway.
1017. Dammann.
1059. Tribe.
1143. Chadburn.
1306. Smith (*Hellesen*).
1307. Capillery.
1320. Avery & Avery.
1504. Williamson & Styles.
1521. Tickle.
1555. Elliott.
1623. Warner.
1638. Harcourt.
1656. De Chardonnet.
1661. Moore.
1722. Teer & Forknall.
1755. Tomkins.
1790. Edwards.
1792. Appleyard.
1795. Roff.
1801. Bolens.
1829. Roydhouse.
1830. Little.
1894. Robinson & Wheatley.
2070. Sahlström & Hill.
2091. Thompson (*The Gibson Electric Company of Europe*).
2198. Lavender.
2281. Cole.
2319. Scott.
2403. Williamson.
2427. Fryer.
2565. Miller.
2653. De Ferranti.
2656. Leadbetter.
2681. Brining & Lister.
2699. Sherwill.
2759. Timmis.
2799. Young.
2807. Mortimer, Mortimer, & Wright.
2818. Kiefer.
2839. Hopkinson & Hopkinson.
2872. Newton.
2912. Badams.
2999. Wanecek.
3002. Weber & Zachau.
3052. Brogden.
3150. Gudgeon.
3203. Leigh.
3212. Redman.
3242. Doty.
3257. Cooper & Holdsworth.
3275. Simonin.
3319. Kelly.
3349. Taylor.
3372. Newmann.
3392. Griffiths.
3397. Willcox (*Farbenfabriken vormals Fried. Bayer & Co.*).
3398. Willcox (*Farbenfabriken vormals Fried. Bayer & Co.*).
3401. Hinde.
3427. Harwar.
3428. Edwards.
3442. Pegg.
3450. Little.
3469. Denne & Denne.
3482. Van Neck.
3488. Ledward.
3489. Thomas & Stabb.
3490. Shaw.
3499. Needham.
3505. Eckert & Wilson.
3528. Albert Edward Bayley.
3532. Crookes.
3542. Leech.
3543. Elwell.
3564. Baker.
3571. Slingsby.
3576. Jones & Nield.
3604. Acland.
3608. Morris, Wilson, & Strickland.
3616. Willoughby.
3649. Wittkugel.
3655. Morris.
3656. Morris.
3657. Morris.
3672. Chautems.
3678. Tosh.
3681. Keith.
3699. Hetherington.
3709. Squier.
3724. Brooke.
3728. Clapham.
3730. Evans.
3733. Robertson.
3734. Elphick.
3735. Hayes.
3740. Causer & Ward.
3745. Horrocks.
3760. Fifield.
3767. Wenzel.
3780. Haddan (*Kortum*).
3783. Wich.
3807. Whitaker.
3841. Siemens Bros. & Co., Ld. (*Taylor*).
3842. Siemens Bros. & Co., Ld. (*Taylor*).
3879. Pinkerton.
4013. Willingale.
4017. Pride.
4033. Ashford.
4064. Willoughby & Horsfield.
4131. McEwen.
4188. Begg.
4194. Hahn.
4283. Hookham.
4426. Hunt.
4440. Ayres.
4729. McLauchlan & McLauchlan.
5151. Edwards (*Wolff*).
5294. Bailey.
5310. Sharp.
5338. Schneider.
5339. Grosselin.
5552. Dardier.
6463. Neave.
6464. Pielsticker.
6751. Meyers.
6895. Parker.
7626. Johnson (*Loutsky*).
8551. Stokes
9402. Potelune, Rivet, Rivet, & Sautour.
10286. Woodfield.
11236. Low.
11177. Justice (*Brownell*).
12935. Hulseberg.
11401. Bardtholdt.
13170. Wise (*Witwe Andreas Saxlehner Geb. Emilie Pelikan*).
13098. Stanley & Wass.
13319. Townley.
13427. Odell.
13827. Gray.
14115. Lake (*J. Lundström & Co.*).
14118. Roskilly.
14194. Baldwin.
14333. Thunderbolt & Fulton.
14596. Emery.
14911. Perera.
15021. Thompson (*Seymour & Staver*).
15091. McDonald.
15194. Phillips.
15244. Conkle & McCulloch.
15435. Robertson.
15484. Davis & Brown.
15547. Iliffe & Teague.
16064. Pumpelly & Butterworth.
16525. Lee.
16653. Currie.
16761. Thompson (*Mason & Wilson*).
16793. Patterson.
16979. Bielski.
17149. Adams.
17181. Allison (*McGregor, Wallach, & Wallach*).
17227. McMakin & Parsons.
17355. Holland.
17456. George Roberts & John Hally.
17503. Bayly (*Arnold*).
17717. Hard, Franks, & Loomis.
17721. Lake (*The Scovill Manufacturing Company*).
17795. Oschwald. (5th July, 1890.)
17842. Booth & Pickersgill.
17869. Turner & Chestle.
18018. Boult (*Rudel*).
18086. Mills (*Reynolds & Williams*).
18202. Smith.
18369. Thompson.
18412. Robertson.
18580. Holzmann.
18630. Tatro.
18634. Groves. (19th April. 1890.)
18664. Lake (*Lauchlan*).
18684. Soper.
18954. Connell.
19058. Eichert.
19133. Colling.
19156. Lake (*The Winchester Repeating Arms Company*).
19200. Leighton.
19438. Aronsohn.
19645. Gardner.

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19808. Vaughan.
19872. Daudetrau.
19887. Lake (*Pederson*).
19957. Dubè & Messier.
19958. Böhme.
20087. Walker.
20107. Richwine.
20117. Johnson (*Edson*).
20142. Hamilton.
20170. Tabor & McChesney.
19816. Pride.
19881. Thompson (*Oudschans*).
19896. Heys (*Schaffer & Budenberg*).
20004. Arrow.
20093. Bowron.
20116. Rüger.
20187. Ferguson & Fleming.
20168. Lazarus.
20194. Thompson (*See*).
20221. Robinson.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Faller Drilling Machine.—*W. Fortune & F. H. Bentham, both of Bradford.*—In the annexed illustrations Fig. 1 is a side elevation, Fig. 2 a plan, and Figs. 3, 4, 5, 6, and 7 details of the gantry and other parts of an ordinary faller drilling machine, embracing the improvements of this invention. The drill spindle A is traversed longitudinally in the ordinary manner by means of slide B and lever C, mounted on stud D, to which is connected the strap E passing over pulley F, and carrying a weight F^1, which regulates the feed pressure of the drill. The drill is withdrawn from the hole at each rotation of a cam G on shaft H, which latter is revolved from I. The cam G acts upon a loose pin K in the slide B, so traversing the latter to withdraw the drill at each revolution of the cam. The pin K may be raised and held out of contact with G when it is desired to use the machine for hand drilling. The fallers are mounted, as usual, in the holder L formed on saddle M sliding on slide N, and operated by the screw O carrying ratchet wheel P engaging pawl Q pivoted to disc R, which also carries a winch handle S. This handle, when the disc is free, revolves the latter until a

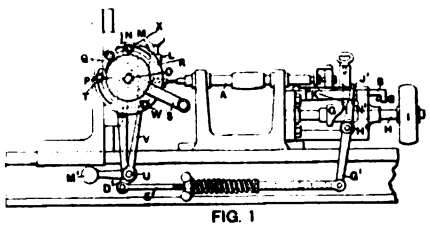


FIG. 1

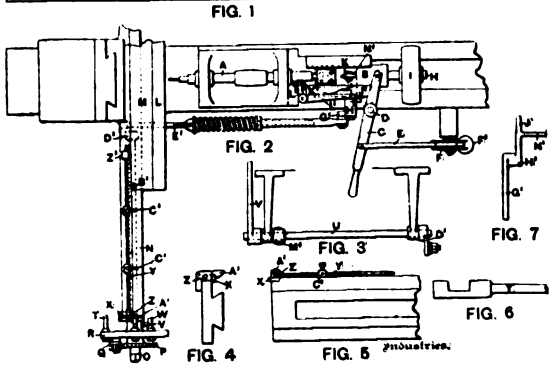


FIG. 2

FIG. 7

FIG. 3

FIG. 4

FIG. 5

FIG. 6

stud T, projecting from the back of the disc, comes against N, so slipping the pawl back upon the ratchet. The forward motion of O and traverse of M is communicated from the rocking shaft U (Fig. 3), provided with an arm V, which, when its shaft is rocked, strikes against the stud W and turns R, and with it P and Q, until X comes against N. To stop the traverse of M a rod Y (Fig. 6), mounted in bearings Z Z^1, and capable of a little longitudinal motion, is used. A hook A^1 is pivoted in a slit across Z, and is normally held up clear of X by its shank resting upon the extreme end of Y (Figs. 5 and 6). But by slightly moving Y the shank of A^1 drops into recess in Y, and the hook engages X so that the disc is held stationary. The movement of Y is effected by a stud B^1 fixed on the saddle, which strikes against the adjustable studs C^1 projecting horizontally from the rod Y. The shaft U is mounted in hangers (Fig. 4) fixed to the underside of N. The short arm D^1 fixed at the other end of U is connected by rod E^1 to arm G^1 of the catch lever H^1. The catch lever H^1 is normally held in the position shown by the spring catch I^1 engaging the top J^1 of such lever, but when the drill completes each hole in the faller and passes through, the parts are so relatively arranged that the end of the slide B reaches the adjusting screw K^1 in the arm L^1 of the catch, and turns the latter on its pivot. Then the lever H^1 is free to allow the weight M^1 to turn the shaft U and its connections, so that the arm V leaves W and allows the disc R to turn until its stud T touches the back of the slide N. The motion of H^1 is limited so that the back of the pin K does not reach the projection N^1 on the arm J^1 until the drill is completely clear of the faller, then it pushes the lever back until it again engages the catch and actuates the pawl and ratchet by the connecting mechanism so as to traverse the saddle and bring the faller into position for drilling the next hole. Four claims are made.—No. 20466. December 20th, 1889. 8*d.*

Boiler Furnaces.—*H. H. Lake, London.* (*R. L. Walker, Boston, Massachusetts, U.S.A.*)—The object of the present invention is to save fuel and prevent smoke. For this purpose the inventor forms the grate in two sections. The front portion of this grate is stationary, and the bars are placed parallel to the length of the furnace. The second portion, or back of the grate, over which the products of combustion pass to the flues, is made so that it can be rocked independently of the rest of the grate, being actuated and constructed in the usual manner, the bars being supported at right angles to those forming the front portion of the grate. Fixed to the top of the furnace and projecting downwards is a deflector placed about midway between the two portions of the grate, so causing the unburnt gases from the front part of the grate to be thrown down upon the second part of the grate, the fuel upon which is in a looser and freer, and therefore a brighter state, owing to the rocking action of the bars. Two claims are made, embracing the arrangement of furnaces substantially as described, and with modifications.—No. 17727. November 4th, 1890. 6*d.*

Presses.—*A. M. Clark, London.* (*W. C. Spelman, New York, U.S.A.*).—The object of the invention is to construct a press for effecting the forming and punching of corrugated strips of metal at one operation. In the annexed illustrations Fig. 1 is a front

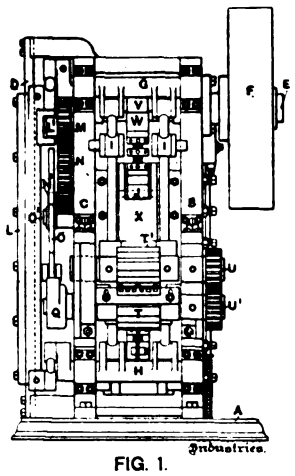


FIG. 1.

elevation, Fig. 2 a side elevation, and Fig. 3 a side sectional elevation of a machine embracing the principle of this invention. Fixed to a base A are three uprights B C D, carrying the main driving shaft E driven from F, and also two pairs of rocking shafts G H, the upper pair being connected by means of toggle-joints to the cross-head I and block J, supporting as shown (Fig. 3) the upper corrugating block K, the lower pair being also connected by toggle-joints to a suitable block carrying the lower corrugating block K^1. Sliding in D is a slide-box L, carrying at each end gudgeons pivoted to toggle-joints connected to the two pairs of rocking shafts G H. The slide-box is raised and lowered so as to revolve the shafts G H, and so actuating K K^1 by means of a block L^1 and crank L^2 fastened to a cog-wheel M on the end of shaft E. Gearing with M is a second cog N carrying a pin N^1 moving in a slot in a lever O, pivoted at O^1, so moving the latter backwards and forwards. The opposite end of O is connected by means of an adjustable connecting rod P to a loose ring Q carrying a pawl R working in a ratchet wheel on a spindle S. Thus by the movement of O the wheel on spindle S is revolved. Fixed on S is the corrugating wheel T (Fig. 3), gearing with and placed above which is a second corrugating wheel T, whose shaft is suitably connected to that of T by gear wheels U U^1. The punching operation is effected by a crank V on the shaft E, attached to which is an adjustable rod W, pivoted to the block X carrying the punching device Y. The device Y passes through holes in K K^1, and is so operated that this is effected whilst K K^1 are together. Claims: (1) In a machine for corrugating and "truing" metallic strips, the combination of the corrugating rollers with the corrugating plates, and with means, substantially as described, whereby said corrugating rollers are brought into motion when the corrugating plates are separated, and remain at rest when said corrugating plates are brought together, as and for the purpose set forth; (2) in a machine for corrugating, "truing," and

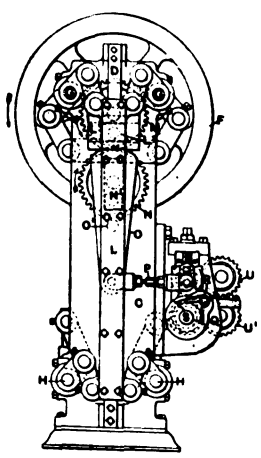


FIG. 2

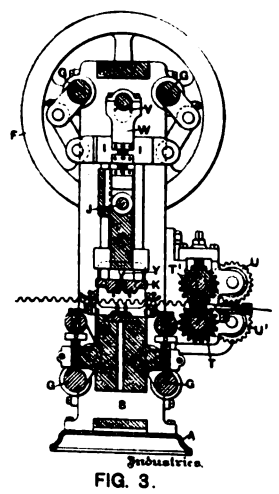


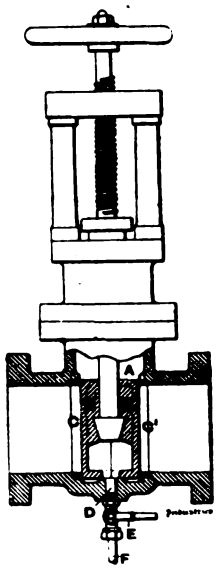
FIG. 3.

perforating metallic strips, the combination of the corrugating rollers with the corrugating plates, and with a punching device, and with means, as described, whereby said corrugating rollers are brought into motion when the corrugating plates are separated, and remain at rest when said corrugating plates are brought together, and with means, substantially as described, whereby said punching device is passed through and wholly withdrawn from the corrugating plates whilst the same remain together, as and for the purpose set forth.—No. 16772. October 21st, 1890. 8*d.*

Textile Machinery.—*F. Garniss, Manchester.*—The invention relates to the bearings of the vertical spindles of "slubbing," "roving," winding, doubling, and intermediate frames used in the preparation of textile fibres, the object being to provide an automatic self-adjusting top bearing. This improved sleeve bearing is formed in two parts, consisting of an upper and a lower tube. The lower part is bored to clear the spindle, and is formed with a collar at the top. The usual jamb nuts are applied beneath to secure it to the upper rail. The interior of the collar is hollowed out to form a socket to receive and fit a rounded or ball-shaped nose on the upper part of the bearing. This upper part is bored to fit the spindle accurately, and is connected to the lower part by a union ring or coupling which screws upon the collar of the latter, and so confines the spherical nose of the upper part in the socket of the lower part, the two parts being thus connected by a ball and socket joint, which allows the upper part to move freely relatively to the lower part. Claims: The improved mode of mounting the spindles of roving, slubbing, winding, doubling, and intermediate frames used in the preparation of textile fibres substantially as described.—No. 574. January 13th, 1890. 6*d.*

Stocks for Boring Bits.—*J. Gutmann, Frankfort-on-the-Main, Germany.*—The stock constructed according to this invention consists of a circular block having attached to one end of it centrally a suitable shank, and having a hole of a suitable depth formed in its other end. Radially converging grooves are formed in the inner periphery of this block, in which slide wedge-shaped blocks. The outer ends of these wedges rest on the face of a nut or cap which screws on to the end of the circular block. The wedges are held against the face of the block as follows:—Working in a small hole leading centrally from the back of the larger hole in the circular block is a spindle, on the outer end of which is a disc held against the inner ends of the wedges by means of a spiral spring around the spindle attached to the disc. From the above it will be seen that, by placing the shank of a boring-bit into the hole in the circular block, and then, by means of the nut screwed on to one end thereof, forcing the wedges into the converging guide grooves, the wedges will be caused to close on the said shank, so holding it firmly. Four claims are made, embracing the construction of a stock for boring bits substantially as described.—No. 2509. February 15th, 1890. 6*d.*

Steam Valves.—*M. H. Robinson, Kingston-on-Thames, Surrey.*—The object of the present invention is to ensure perfect tightness in stop valves for steam and other pipes. The accompanying illustration shows a cross-section of a stop valve embracing



the modification of this invention. A is the body of the valve, B B^1 are valves pressed outwards against the faces C C^1, D is the leak hole closed by a cock E to which a drain pipe F is shown connected. If B be the valve exposed to the higher pressure, it is evident that leakage past it will be carried away by the pipe F, and will not be able to establish a leak past B^1 as well. The cock E may be used also as an ordinaay drain for removing water of condensation. Claims: (1) The use of a leak-hole with suitable means of closing the same, in the body of a valve having two working faces, so arranged as to carry away any fluid which may leak past one of the faces (when the valve is closed) into the space between the two faces; (2) the combination of two valves of any kind in one casting, or otherwise in immediate connection with each other, with a leak-hole from the space between the two valves; (3) the use of a leak-hole in valves, arranged substantially as and for the purpose set forth.—No. 1958. February 5th, 1890. 6*d.*

Pipe Wrenches.—*T. W. Fisher, Helena, Montana, U.S.A.*—The shank of the wrench is formed at its forward end with a fixed jaw, and an adjustable jaw is formed in one with a head or carrier fitted to slide along the shank, and is moved along same by means of a rack bar fitted to it. This bar is fitted to slide on the shank and is pivoted at one end to the handle, which in turn is pivoted to the shank. This handle thus forms a lever by which to throw the rack bar and the movable jaw backwards and forwards according to the direction in which it is moved. The handle, and so the rack, is normally held in its forward position by means of a spiral spring interposed between the handle and a projection on the end of the shank. The movable jaw-head is connected with the rack bar by a spring-pressed locking toothed catch pivoted to the jaw-head within which it is received, a thumb piece being provided by means of which the catch may be pressed out of engagement, so allowing the jaw head to be adjusted to suit the size of the pipe. Two claims are made, embracing a pipe wrench consisting of a wrench shank, having a jaw at its outer end, and another jaw fitted to slide upon the shank by means of a handle lever pivoted to the inner end of the shank, a bar pivoted to the handle lever adapted to move the sliding jaw, and an engaging and disengaging device between the sliding jaw and bar adapted to provide for the independent adjustability of the sliding jaw, substantially as described.—No. 2639. February 18th, 1890. 8*d.*

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PIT CAGES.—*J. Dustin & W. Thomas, both of Moss Bay, Workington, Cumberland.*—This invention refers to a method of connecting wire ropes to pit cages or other objects, and consists of an internally conical shaped box with double eyes at its upper end, by means of which it can be fixed to the cage. The wire rope is put through the small end of this conical box, and a tapered pin is driven into the centre of the wire, thereby jamming the strands of the wire against the sides of the box. When once the wire gets a weight on it, it will further tighten itself, and cannot possibly be drawn through the hole. Claims: Simplicity and cheapness of construction. The improved means for connecting wire ropes to pit cages or other objects saves a great deal of time, it being capable of being connected in a few minutes as there is no lapping of the rope with copper wire or riveting to be done.—No. 9689. June 23rd, 1890. 6*d.*

HYDROCARBON ENGINES.—*C. D. Abel, London.* (*The Gas Motoren Fabrik Deutz, Köln-Deutz, Germany.*)—Referring to the annexed illustrations, Fig. 1 is a side elevation, Fig. 2 an end

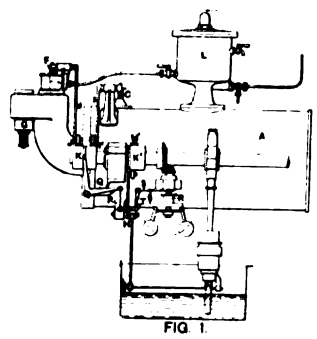


FIG. 1.

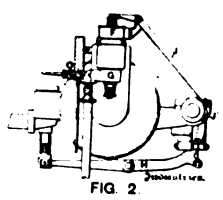


FIG. 2.

elevation, Figs. 3 and 4 sections through the cylinder, and Fig. 5 section through the oil spray and mixing apparatus of a hydrocarbon engine constructed according to this invention. The piston of the cylinder A in its reciprocating motion leaves a charging and compressing space to which is fitted the escape valve B, air supply valve C, and an igniting passage D, containing the igniting tube E, the valve F for the admission of oil spray, and also a self-acting air valve G. The valves B, C, and F are actuated through levers H, I, and J, from cams H^1 I^1 J^1, on sleeves K K^1, revolving on the way-shaft K^2. Oil is supplied to the pressure regulator L, and passes from thence to the regulating screw valve M (Fig. 5); thence it passes to the supply valve F. As the suction stroke of the piston commences the valve F is opened, and, the valve G opening automatically, the air enters, and, passing at a high velocity through nozzles N and N^1 formed around the end of valve F (Fig. 5), mixes with the oil spray supplied by F. During the suction stroke the valve C is also opened, so allowing air to pass into A and mix with the mixture of air and oil therein. During the return stroke the mixture of oil and air is compressed, and at the end of the stroke it is ignited by tube E supplied with gas from pipe O. The piston is thus forced outwards, and during the return stroke forces the result of the combustion out through valve B. For the purpose of regulating the speed of the engine the regulating sleeve K, which is moved to and fro by means of the lever H that works the escape valve and by the link P and lever Q, is held in its one end position

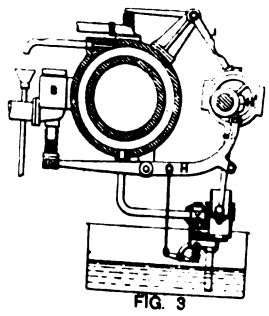


FIG. 3

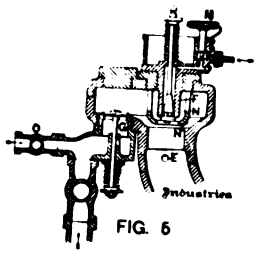


FIG. 6

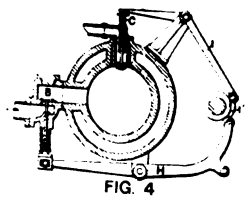


FIG. 4

corresponding to the opening of the escape valve B by the action of the governor R, lever S, and notch T, so that the cams I^1 and J^1 revolve out of gear with the levers I X J when the speed of the engine is too great, in consequence of which the oil valve F and the air valve C are kept closed in a similar manner to that described in the previous application No. 20892 of 1889. In a similar manner the suction valves of a pump U are closed, the pump being operated by means of an eccentric, as shown (Fig. 3), from K^2, and is for the purpose of supplying water to the cooling jacket of A. Six claims are made.—No. 1943. February 5th, 1890. 8*d.*

LATHE CHUCK.—*J. Gutmann, Frankfort-on-the-Main, Germany.*—The object of the present invention is to provide a chuck for boring tools, whereby the latter can be easily and rapidly centred. For this purpose the inventor uses a metal ball of a suitable size having conical-shaped holes of different sizes formed therein to receive the tapered shank of the drill. This ball is held as follows:—A cylindrical block, having a central shank whereby it can be attached to a lathe, has screwed to its end a cap or nut having a hole formed in it of a somewhat larger diameter than that of the shank of the drill to be carried. The opposite faces of this block and its cap are recessed to receive the ball carrying the drill. It will thus be seen that when "truing" the drill it is only necessary to unscrew the nut on the cylindrical block sufficiently to allow the ball to move with a moderate amount of friction. After truing the nut is tightened up, so holding the ball, and consequently the drill, rigidly. Claims: A chuck for holding boring bits and for accurately embracing the same, constructed substantially as described (in two claims). —No. 2545. February 17th, 1890. 6*d.*

LOOMS.—*F. Leeming & R. Wilkinson, both of Bradford.*—The invention relates to the construction and combination of parts connected with the dobbies or shedding mechanism of looms. On the pin in the end of the shedding or "jack" lever, a combined connection and guide is mounted, having a cam surface or slot formed therein, one end of which is connected to the healds. A cross shaft fixed to brackets on the loom frame passes through said cam slot. When the "jack" levers are operating, raising and lowering the healds, the guides are also raised or lowered, and by reason the cam slot and fixed cross-rod are raised or lowered in a perfectly vertical direction, and one of such guides and cam slots being attached to the end of each "jack" lever, the healds also are raised and lowered vertically, so that better results in the weaving are obtained. Claims: The guide connecting link having a cam surface or slot, a cross-rod or shaft, and an adjustable lug, all in combination with a "jack" or shedding lever, as and for the purpose described.—No. 2800. February 21st, 1890. 6*d.*

LOW PRESSURE OR CONDENSING ENGINES.—*J. Darroch, Springhill, Windsor Crescent, Newport, Monmouthshire.*—This invention refers to improvements in low-pressure or condensing engines, and has for its object to facilitate the working thereof by disposing to as great an extent as possible of air which is readily absorbed by the water of condensation. Referring to the annexed illustrations Fig. 1 is a sectional elevation of an air pump, hot well, and feed plunger pump, Fig. 2 being a half-sectional elevation of the upper portion of Fig. 1 taken at right angles. A is an air pump barrel, B the bucket, C the hot well, D the overflow, E the feed plunger pump, having the valves F all arranged in the usual way. The parts which constitute this invention are the pipe or port G connecting the upper extremity of the air pump barrel with the hot well and the valve H on or in connection with

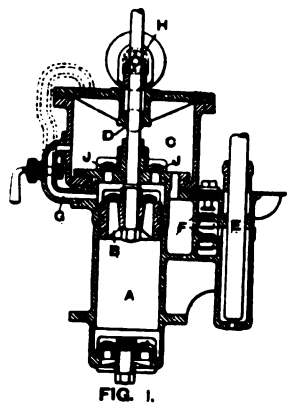


FIG. 1.

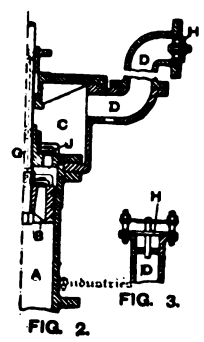


FIG. 2.

FIG. 3.

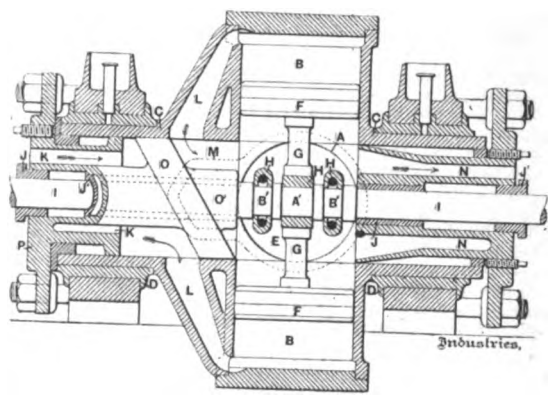
the overflow pipe D of the hot well. The operation of the apparatus is as follows:—At each upstroke of B a volume of water and air is discharged through the head valves J into the hot well, but in performing this operation the stratum of air lying between the surface of the water overlying the bucket and the head valves is more or less compressed, causing air cushioning and knocking of the engines. The water and air thus discharged to the hot well may be then transferred by the pump E to the boilers, the displacement in the hot well being accompanied by a further inrush of air from the atmosphere through the open end of the overflow pipe D. By means of G and valve H the inrush of air aforesaid is prevented on account of the action of the downstroke of the air pump bucket automatically closing the valve H, and on the upstroke the stratum of air overlying the water below the head-valves finds free egress through G to the hot well and thence (under the action of the upstroke of the air pump bucket) through the automatic valve H to the atmosphere. Claims: (1) In condensing engines connecting the upper end of the air pump barrel with the hot well by means of a pipe or port G for the purposes set forth; (2) in combination with an air pump and hot well, the arrangement or combination of parts consisting of the pipe or port G and valve H on the overflow of the hot well; (3) the arrangement or combination of parts constituting the improvements in low-pressure or condensing engines, substantially as and for the purposes described.—No. 5952. April 19th, 1890. 8*d.*

PRINTING MACHINES.—*J. Kelley, Otley, Yorkshire.*—The invention embraces improvements in the method and apparatus for mounting, lifting, and connecting the cylindrical flyer apparatus of printing machines. Instead of the usual framework, the inventor fixes on each cylinder stand a perpendicular pillar, of small section, in such a position as to cause no obstruction to the operator. The two side presses which contain the flyer apparatus are prepared with long bosses, which embrace these pillars, and guide the apparatus in its reciprocating motion. Across the top of the pillars, in suitable bearings, is mounted a shaft, on which are fixed a hand-wheel, two pulleys of equal size, and also a larger one. To the first-named pulleys are connected chains, which are also connected to the flyer apparatus, and to the larger pulley is attached a chain and weight, which, acting together with the other pulleys, facilitate the lifting of the flyer, which is effected by means of the hand-wheel. The cam bar for actuating the flyer the inventor places in such a position that it is away from the flyer and out of the way of the operator. This is effected by means of an intermediate bar with a toothed rack attached at such a position thereto as to gear with a toothed wheel on the flyer shaft. This intermediate bar may be placed in a horizontal position supported by suitable bearings, and to be lifted at the opposite end to that of the rack. The free end of the said bar is so arranged as to be automatically engaged with and disengaged from the cam bar, and when in operation the cam bar imparts motion to the flyer through the intermediate bar. Three claims are made.—No. 1374. January 27th, 1890. 8*d.*

LOOMS.—*J. Hall, London.* (*A. Lockwood, Meerane, Germany*).—The invention has for its object the application of an automatic combined fast and loose reed action to looms. A cam fixed on a crank-shaft communicates an oscillating motion to a pivoted lever the end of one arm of which has a projecting part, which, during the inward oscillating of the lever, comes against a bar carried on a second shaft. The shaft, when contact or engagement is effected, is caused, by reason of the action of the cam and consequent oscillation of the lever, to slide laterally, carrying with it a number of arms fixed thereon and fitted with steel pins, so as to disengage these from the reed locks and thereby convert the loom from a fast into a loose reed loom. As soon as the bar has got to the end of its stroke, communicated to it by the oscillating lever, a helical spring on the sliding shaft brings it back again so as to re-engage the locking pins in the reed locks to convert the loom from a loose reed into a fast reed loom, until the oscillating lever is brought to perform another inward stroke. During the loose reed action the reed holder is held in position by a spring. Two claims are made.—No. 2809. February 21st, 1890. 6*d.*

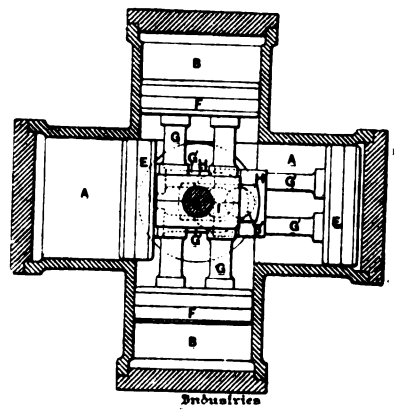
ROTARY ENGINES.—*O. Kohn, Wiener Neustadt, Vienna, Austria.*—Fig. 1 in the annexed illustrations is a sectional elevation, and Fig. 2 a section through the cylinders at right angles to Fig. 1 of an engine constructed according to this invention. Two pairs

FIG. 1.



of cylinders are used, A being one pair and B the other, formed substantially as shown, and with hollow trunnions C revolving in bearings D cast to them. E are the pistons of A, and F of B. The pistons E and F are connected by rods G G^1 respectively to their crank-pins A^1 and B^1, by means of sliding blocks H. The crank-shaft I runs in bearings J J^1, the latter bearing serving also as the glands of the crank-shaft stuffing boxes. K is the main steam supply port, and L L^1 the subsidiary ports to the cylinders B, the subsidiary ports M to B being indicated by dotted lines. N is the common exhaust, the direction of the steam being indicated by arrows. O is a stationary elliptical disc

FIG. 2.



connected to the cover P by means of sleeve O^1, and by means of which the steam distribution is effected as the cylinders revolve about it, as will be readily understood. Three claims are made, embracing the construction of a rotary steam engine substantially as described.—No. 2044. February 7th, 1890. 8*d.*

TUBE EXPANDER.—*D. Jones, Inverness.*—The invention relates to the fixing of tubes in plates, such as boiler tube-plates, the method being that first an annular V or other shaped groove is formed in the peripheral surface of the hole in the tube-plate, and then expanding the tube when in the hole so that it will fill the said groove. The apparatus for preparing the holes comprises a spindle or cutter-holder adapted to be secured to the tool spindle of a drilling or boring machine. This holder is made with a slot, wherein is pivoted a bell-cranked lever, having at one end a cutting edge, the form of which will depend upon the shape to be imparted to the surface of the hole. This cutting edge, and that arm of the lever on which it is formed, is normally within a longitudinal recess formed in a reduced part of the holder, which part is of such a diameter as to fit the hole in the tube-plate. A second recess is made in its reduced part of the holder for the escape of the cuttings. The other arm of the bell-cranked lever, which normally projects outwards at right angles to the spindle, has hinged to it one end of a screwed rod, the opposite end of which passes through a hole in a small bracket or lug fixed to and projecting from the upper part of the spindle. Screwed on to this screwed bolt is a hand-wheel arranged to work against the face of the lug or bracket, and by revolving which in a direction tending to screw it off the bolt the bell-crank lever would be so actuated that its cutting end would be caused to stand out of the recess in the cutter-holder or spindle, so that

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as the whole is revolved it would cut a groove in the peripheral face of the hole in the tube-plate. When screwing the hand-wheel in the opposite direction the cutting end would be caused to recede into the groove in the spindle by means of a spiral spring, one end of which is connected to the lug or bracket, and the other to one arm of the bell-crank lever. The tube expander for expanding the tubes in the holes formed with annular grooves as described comprises three segmental blocks held within two loose rings in grooves therein, and mounted upon a tapered mandrel by which they can be expanded and rotated. Each block is formed with an external curved ridge adapted to expand the tube into the annular grooves in the hole in the tube-plate, and with a flange so curved at one side as to cause the projecting end of the tube to be beaded over to the required form when rotated in contact with such end. The end of the tube is reduced before being placed in the hole in the tube-plate preparatory to being expanded. Claims: (1) Reducing the tube end, expanding it by means described into a hole previously prepared as described, and beading over the end portion of the tube projecting beyond the tube-plate as described; (2) for grooving the holes in tube-plates to receive tubes: the apparatus constructed substantially as described.—No. 774. January 15th, 1890. 8*d*.

Drills.—*H. Hilditch, Whitmore Reans, Wolverhampton.*—The object of the inventor is to construct a drill by means of which holes, with inwardly increasing diameters, may be drilled. A pair of fingers or arms, pivoted in a jaw on the end of a holder carried by the spindle of the drilling machine, are formed with a cutting edge down one side, the two fingers together forming a divided cutter, the diameter of which can be increased as desired by causing the lower and cutting ends of the fingers to cross one another more and more. The upper ends of the fingers are continued beyond the fulcrum, and a rubber band is placed around them to tend to draw them, and thus the lower ends, together. A conical collar is screwed upon the shank of the tool holder above the jaw wherein the arms or fingers are fulcrumed, by causing which to descend the conical surface would be brought between the upper ends of the fingers, so causing them and the lower ends to be gradually forced apart, and increasing the diameter of the drill. The tool described may be used for under-cutting a cylindrical hole, or may be used for forming a hole with inwardly increasing diameters, in which case the ends of the fingers are also formed with cutting edges. Three claims are made, embracing the construction and operation of drills substantially as described.—No. 2548. February 17th, 1890. 8*d*.

Polishing Lathes.—*J. C. Dalman & E. J. Blincoe, both of Birmingham.*—The invention relates to the bearings or double bearings of spindles, axles, and shafts of polishing, buffing and other lathes. According to this invention the two arms of the headstock are bored axially, and placed into these holes are adjustable and inside-coned shaped bearings. The enlarged taper ends of these bearings are directed inwardly. Fixed on the spindle carrying the buffs, bobs, or polishers are two coned collars placed with their larger ends opposite. These collars are placed at such a distance apart that when the spindle is in position the collars run in the adjustable inside-coned bearings. Passing through the arms of the headstock are suitable set screws, the ends of which, coming against an inclined face formed on the outer periphery of the inside-coned bearings, tend to force the latter inwards, so tightening it upon the coned collars of the spindle. Claims: (1) Providing the spindles, axles, &c., of polishing and other machinery with adjustable coned bearings, consisting of fixed collar cones working within adjustable or she-cones held in the hollow heads of the framing of the machinery as described; (2) in adjustable coned bearings consisting of fixed externally coned collars working in conical bearings, made separate or in one piece with the framing of a machine, all constructed, arranged, and working substantially as described; (3) the combination, with adjustable coned bearings of an inclined sided recess, wherein the point of the set screw "takes" for bringing the coned sleeve up to its bearing as described.—No. 3051. February 26th, 1890. 8*d*.

Tube Connections.—*R. W. & T. S. Lewis, both of Wolverhampton, & W. H. Lewis, Goldthorn Hill, Wolverhampton.*—The ends of the tubes are flanged or turned back at right angles, and these flanged ends are joined together in the following manner. Between the flanges of the tubes a cast or wrought iron or other metal ring is placed, having a T-shaped cross section—that is, a flat ring which has projecting from its outer periphery at each side, and at right angles to it, a flange. This ring is of such a size that when placed between the tubes the flanges thereof project over the flanges of the tubes, so preventing the two rings of packing placed at each side of the ring being blown out. To press the two flanged ends of the tubes together a loose gripping ring is placed on each tube behind the flange on the end thereof; these gripping rings are drawn together, so tightening the flanges of the tubes together between them by means of screw bolts and nuts. The inner side of each of these gripping rings is provided with a projecting boss of the same depth as the flanged ends of the tubes, by means of which bosses the rings when drawn together in forming the joint press the flanged ends of the tubes against the collar placed between them. Three claims are made, embracing the arrangement as described, with modifications.—No. 12476. August 9th, 1890. 8*d*.

ELECTRICITY.

Railway Conduits and Conductors.—*C. J. Van Depoele, Lynn, Massachusetts, U.S.A.*—The invention relates more particularly to the use of tubular conductors and of conduits therefor. In one form the conduit comprises a flat metallic base-plate, upon which are secured at suitable distances apart suitable side brackets. To the inner and opposite side of these brackets are secured hollow U-shaped side pieces, which are set up edgewise upon the base-plate, and so secured. The opposite projecting arms of these side pieces do not meet, the slot above being for the insertion of the collector, which consists of two insulated metallic plates clamped together and with the ends tapered. This collector runs between two tubular conductors fixed in the recesses in the U-shaped side pieces. The conductors are coated with some non-conductive material, and holes are formed at suitable distances apart in their opposite sides. In these holes, which are screw-threaded, are screwed suitable insulating collars, the inner ends of which project some distance into the tube. Sliding in these collars are metallic pins of a length slightly greater than the diameter of the tube conductors, having suitable heads formed on each end thereof. Between the outer ends of these pins and the insulating collars are placed helical springs, which tend to force the pins outwards, so keeping their inner ends from contact with the opposite internal side of the tube, except when they are forced inwards by the collector passing between the tubes. The inventor also describes several modifications of the above arrangement. Six claims are made.—No. 15084. September 24th, 1890. 8*d*.

Electromotors.—*M. Leblanc, Paris, France.*—This invention relates to the construction and arrangement of electromotors to be worked by alternating currents. Fig. 1 is a vertical section and Fig. 2 a part section of the ring and part end view of a motor embracing the object of this invention, the field magnets being excited by a continuous current, and the armature by an alternating current. Fig. 3 is a diagram showing the method of transmitting the continuous and alternating currents by the same

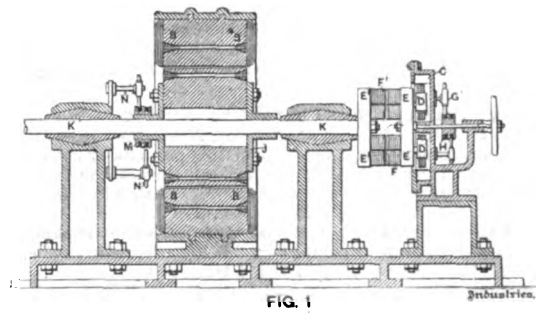


FIG. 1

conductor. In Fig. 2 A is a Pacinotti ring with teeth parallel to the axis; it is made of a number of iron sheets separated by insulating material and held together by bolts insulated by ebonite sleeves B (Fig. 1). The coils are connected to the segments of a commutator C in the same manner as in multipolar continuous current machines having only one pair of brushes. The brushes D are caused to revolve by the disc E carrying the electromagnets F. The continuous current is supplied by the rubber G on the revolving disc H to the electromagnets F, whence it passes by one of the brushes D to the coils on A, returning by the other brush and the disc H^1 and rubber G^1. The armature of this machine is made like the ring L of iron sheets bolted together and carried on discs J keyed on the shaft K of the machine. Six coils A are traversed by the continuous current so that the cores of all the odd coils present the one polarity and those of the even present the opposite polarity. The entering wire of the first is connected to a disc M, and the leaving wire of the last to a disc M^1; on these discs bear the brushes N N^1, which conduct the alternating currents for the armature. As the electromagnets F cannot act concurrently on the armature, a disc E^1 fixed on the shaft K facing the disc E carries a set of electromagnets F^1, the coils of which are

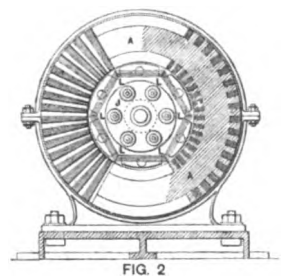


FIG. 2

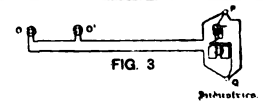


FIG. 3

traversed by the same alternating currents as those of the armature, so that the forces developed between them and the magnets F are the same as they would be if developed between the coils of the armature and the magnets F. In a modification the inventor describes a motor of the disc form, arranged according to this invention. Referring to Fig. 3, O is the continuous current generator, and O^1 the generator of alternating currents connected in series in one circuit to the terminals P Q, from which there are two branches, the one including the induction coils of the motor and the other its armature coils, this latter being intercepted by a condenser. Claims: (1) In an alternating current electromotor the combination of an armature and a coiled ring provided with collector and brushes revolving synchronously with the generator of the alternating currents, as described; (2) the method of transmitting by the same conductor the continuous currents for exciting the inductors of the machines and the alternating currents for their armatures, and of separating these currents at the place of their application into two branches, the one for the inductors including a coil of small resistance, but high self-induction, the other for the armatures including suitable condensers.—No. 19450. December 3rd, 1889. 8*d*.

CHEMISTRY.

Production of Tartaric Acid and Cream of Tartar.—*A. Martignier, Montpellier, France.*—This invention relates to a method for the extraction of tartrate of lime contained in lyes, argals ("Sablons"), and other tartarous matters and its transformation into cream of tartar and tartaric acid, the method being based upon the fact that when tartrate of lime is added to a saturated solution of sulphate of potash there is formed neutral tartrate of potash and sulphate of lime according to the following equation:—

$$C_4H_4CaO_6 + 4H_2O + K_2SO_4 = C_4H_4K_2O_6 + CaSO_4 + 4H_2O.$$

The lyes or other tartarous matters finely pulverised are treated with a saturated solution of sulphate of potash, the treatment taking place cold, under ebullition or pressure, according to the quantity of material being treated. If the lyes contain bitartrate of potash it must be neutralised with chalk. The reaction being terminated, the residuum containing the sulphate of lime and the insoluble matters is separated from the liquid containing the neutral tartrate of potash and the excess of sulphate of potash, by decantation or otherwise. The liquid is then decolorised by animal charcoal and treated with an equivalent quantity of sulphuric acid, which, in precipitating nearly the whole of the bitartrate of potash, regenerates the half of the sulphate of potash entered into the reaction. The cream of tartar thus precipitated is purified, and for the manufacture of tartaric acid transformed into tartrate of lime in the usual manner. The sulphate of potash, when it may be done with advantage, may be replaced by sulphate of soda, the process being slightly modified. Claims: (1) The extraction of tartarous compounds contained in lyes, argals, tartars, and other tartarous matters, and their transformation into cream of tartar by the use of sulphate of potash as described; (2) the extraction of tartarous compounds as above set forth, and their transformation into cream of tartar or tartaric acid by the use of sulphate of potash or soda, and by a mixture of both.—No. 20078. December 13th, 1889. 6*d*.

MISCELLANEOUS.

Lubricators.—*C. Muellor, Boston, Massachusetts, U.S.A.*—Fig. 1 in the annexed illustrations is a vertical section of a lubricator constructed according to this invention, Figs. 2, 3, and 4 being details thereof. The oil vessel A, preferably of glass, has an opening formed in its upper and lower parts as shown,

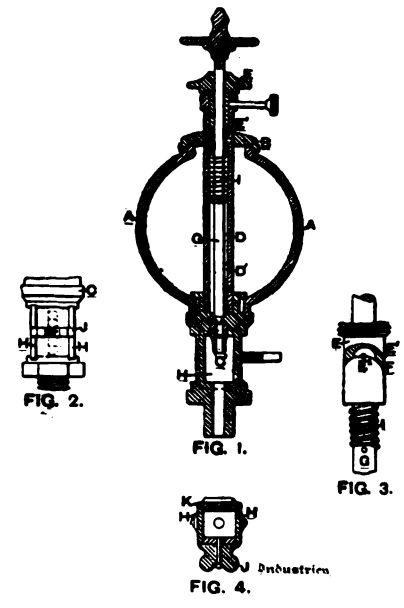


FIG. 2. FIG. 1. FIG. 3. FIG. 4.

which are normally closed by covers B C. Screwed into C is a tube D, having suitable feed-holes D^1, which pass up through A and B. Screwed into the top of this tube is a hollow regulating plug E, having its lower part made plain (Fig. 3) and provided with a slot E^1 having at E^2 a notch to receive a pin F on a spindle G extending through E and D. The lower end of G is conical, so as to close an opening in C leading through a nozzle C^1 into a chamber H. A spiral spring I on G between a pin passing through the latter and the end of E tends to force G downwards and so close the hole in C. Two opposite sides of the chamber H are made of glass, the said sides forming sight-windows, which are removable, but are normally locked in place by the thumbscrew J pivoted on one side of the chamber and having arms which extend beyond the edge of the said side and fasten the removable windows in place, the rear edge of the said windows abutting against the projecting edges K of the opposite sides, which are cast on C (Fig. 4). From the above it will be seen that the feed may be regulated by revolving E, and the supply may be cut off by slightly turning G, so moving the pin therein out of the notch, and, owing to the slanting of the slot E, to allow G to descend. Two claims are made.—No. 16610. October 18th, 1890. 6*d*.

Paper Pulp Boilers.—*C. A. Davies, Manchester.* (*C. Kellner, Vienna, Austria.*)—The invention relates to lining such boilers with a material that will resist the action of the acid or corrosive solutions employed in the manufacture of paper pulp. For this purpose the inventor applies to the boiler after it has been put together a layer or coating of an acid-resisting cement, in place of the lead lining hitherto used. Portland cement mixed with fine sand in about equal proportions the inventor has found suitable for the above purpose. Claims: In the manufacture of paper pulp the use of a jointless and seamless lining for the boilers therein employed of Portland or other acid-resisting cement or composition in place of the lead lining hitherto generally employed.—No. 2064. February 8th, 1890. 4*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE CHIGNECTO SHIP RAILWAY.

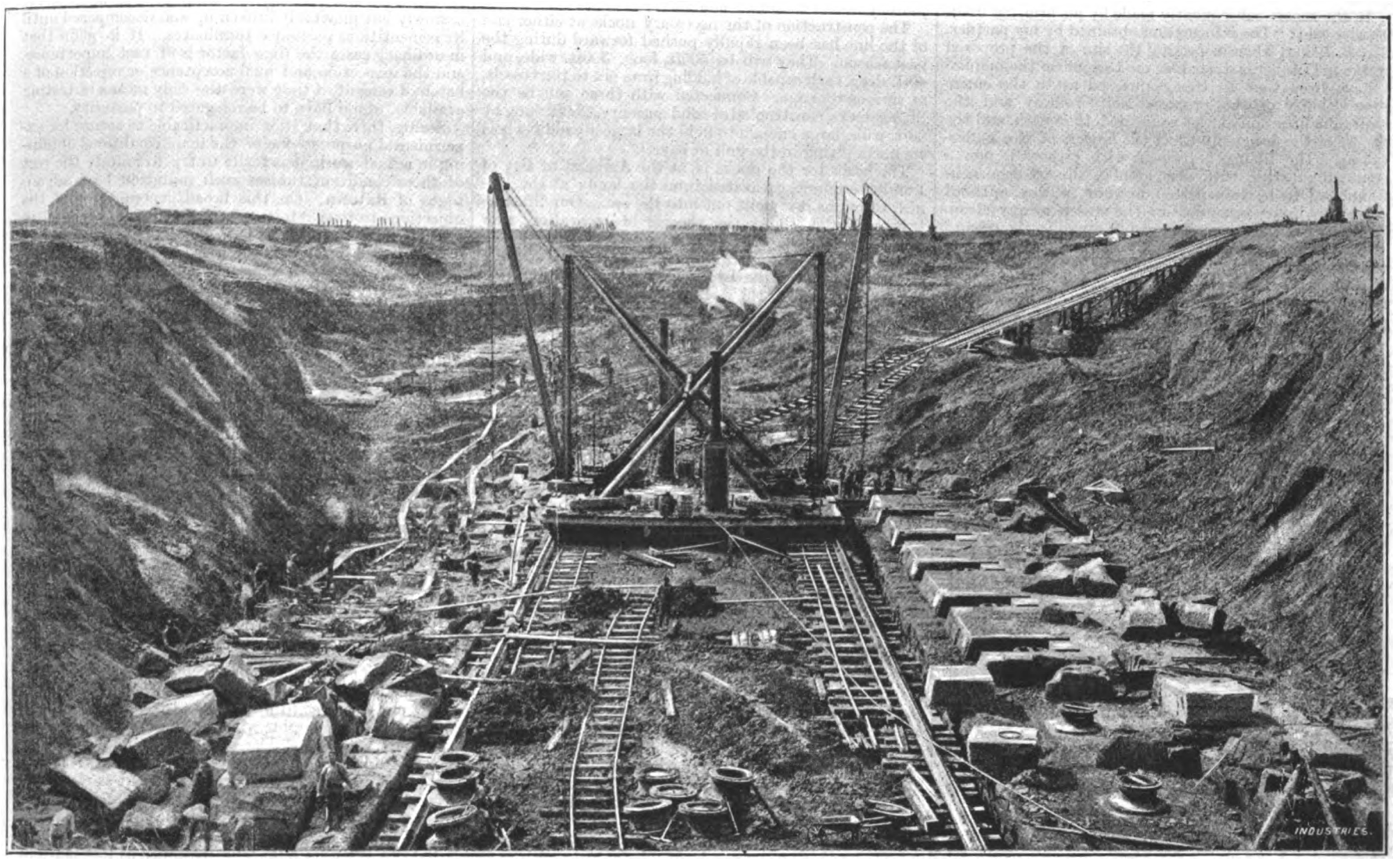


Fig. 1.—Excavation of Dock Basin at Amherst, with the Masonry of Lifting Dock in the Foreground.

THE CHIGNECTO SHIP RAILWAY.

I.

The construction of a ship railway for the transport of vessels across the Isthmus of Chignecto, which separates the Gulf of St. Lawrence from the Bay of Fundy, was begun in the autumn of 1888, and has been prosecuted with so much vigour that it is expected to be in full operation before the end of the present year. Canada will thus be able to claim the honour of being first in submitting to the test of practice an idea which has been much talked of for some years. Both from a commercial and an engineering point of view the enterprise is of very considerable importance, and as it approaches completion attracts an increasing amount of public attention.

Should this bold undertaking be crowned with anything like the success which its promoters anticipate, there can scarcely be any doubt that it will lead to a further application of the principle. To shorten routes is an object upon which no effort or expense is spared in these days, and it is not difficult to imagine the ship railway becoming to ocean transport what the Mont Cenis Tunnel or the Forth Bridge is to transport on land. Already in Canada the idea is seriously entertained of connecting the waters of the Georgian Bay with those of Lake Ontario in a similar way, by which a saving in distance of more than 400 miles will be made by vessels coming from the upper lakes. When we read, in the last Canadian statistical record, that the tonnage which comes through the Sault Ste. Marie Canal is already almost as great as that which passes through the Suez Canal, the possibilities of such a shortened route can be easily understood. In connection with this and like projects in other parts of America the progress of the Chignecto enterprise is watched with keen and interested attention.

When Captain Eads proposed some years since to construct a ship railway across Central America in order to connect the navigation of the Atlantic and Pacific, he seems to have carried along with him the opinion of the engineering world as to the practicability of his plans, but he failed to get for an improved scheme the large amount of capital required for a railway at Tehuantepec, where the distance to be crossed was 135 miles. The primary experiment of the kind was to be made under more favourable conditions.

The Chignecto Ship Railway owes its inception and execution largely to the persistent energy of a Canadian engineer, Mr. Henry E. Ketchum. The fact that Mr. Ketchum secured the approval of his plans in the first instance by the chief Government engineers of the Dominion, and later by Sir John Fowler and Sir Benjamin Baker, with whom he is now joint engineer in carrying out the work, is a sufficient guarantee that his energy has been directed by skill and practical judgment.

A glance at the map, Fig. 2, on the next page, shows at once the relation of the enterprise to the large commerce, actual and potential, of the Canadian coast. The Isthmus of Chignecto connects the province of Nova Scotia with that of New Brunswick on the mainland of the continent, making a loop in the coast line of 600 miles or thereabouts. At its narrowest point the isthmus is only 17 miles wide. So serious an impediment to the trade of the coast was the circumnavigation of Nova Scotia, so slight the obstacle to a shorter route interposed by the isthmus, that many years ago an agitation was begun to secure the construction of a canal, as this was believed to be the only way of overcoming the difficulty. Several surveys were made at the expense of the Colonial Governments. One of these was conducted under the direction of Thomas Telford, founder of the Institution of Civil Engineers. The reports of this great authority furnish striking proof of the importance assigned to the question of communication nearly fifty years ago. Divergent opinions were expressed, however, by the different engineers employed as to the possibility of constructing a satisfactory canal. Some anticipated great difficulty from the diversity of level existing at times between the waters of the gulf and the bay, due both to the difference in the height of their respective tides and the hour at which high water occurs. The Bay of Fundy is 21ft. higher than Baie Verte at high tide, and 18ft. lower at low tide, while the average rise of tide at the head of the Bay of Fundy is 36½ft. and in the Baie Verte 5½ft.

It was also urged that the deposition of the sediment peculiar to the tidal waters of the Bay of Fundy, and from which the great marshes of the vicinity have been formed, would be a permanent obstacle to the maintenance of a canal. Meanwhile, public opinion became more decided as to the commercial necessity for means of communication. A Royal Commission, of which Sir Hugh Allan was chairman, and composed of delegates from the Boards of Trade of the chief cities of Canada, was appointed in 1871 by the Dominion Government, and after an exhaustive inquiry reported as follows:—"Inseparably connected with the growth of intercolonial trade is the construction of the Baie Verte Canal. . . . The advantages which must accrue, not merely to the Dominion as a whole, but to the commerce of the maritime provinces, are so clearly pointed out by the Boards of Trade of all the leading cities of Canada, and by men interested in the development of our commercial interests—not merely by the merchants of St. John and other places in the locality of the proposed canal, but merchants of Hamilton, Toronto, Montreal, Ottawa, and Quebec—that it is superfluous to do more than to briefly refer to a few of the salient features of the scheme."

It was while engineers hesitated about the canal, and commercial men grew impatient, that Mr. Ketchum first brought forward, in 1875, his already-matured plans for a ship railway, in doing which he anticipated the plans of Captain Eads. He secured such strong support from chambers of commerce, the Press, and the trading and shipping community in various parts of Canada that, when he brought the question before the Dominion Government in 1882, the Cabinet felt justified in recommending the scheme to Parliament. Sir Charles Tupper, then Minister of Railways, gave the enterprise his strenuous support, and in that year provision was made for a substantial subsidy, finally fixed at $170,300 per annum for twenty years. Sir John Fowler, after examination of the plans and estimates, expressed a decisive opinion that, from an engineering point of view, the construction and working of the line were perfectly

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practicable, and consented to assume the position of engineer-in-chief. Later, Sir Benjamin Baker visited Canada to make a special and detailed examination of the proposed line and of the facilities at either extremity for the construction of the necessary lifts and docks.

In the report subsequently made by his firm, Sir John Fowler said: "The information obtained by my partner, Mr. B. Baker, when inspecting the site of the proposed works in October last, enables me to confirm the opinion I have from time to time expressed as to the entire practicability of the proposed ship railway and the hydraulic lifts and docks connected therewith, and the fitness of the designs to effect the objects of the undertaking. The lifting of vessels with cargoes is now a common practice, with even double the tonnage contemplated to be transported on your railway, without doing any injury or subjecting the vessels to any strain beyond what they were designed to stand in the ocean."

Such opinions, together with the substantial aid of the Canadian Government, soon made it possible to form a company for carrying out the work. All the land necessary for the railway was gratuitously expropriated and granted to the company by the county of Cumberland, Nova Scotia. A formal contract was signed in 1886 with the Canadian Government, and work was begun in the autumn of 1888 by John G. Meiggs & Son, the chief contractors, since which time it has been carried on continuously.

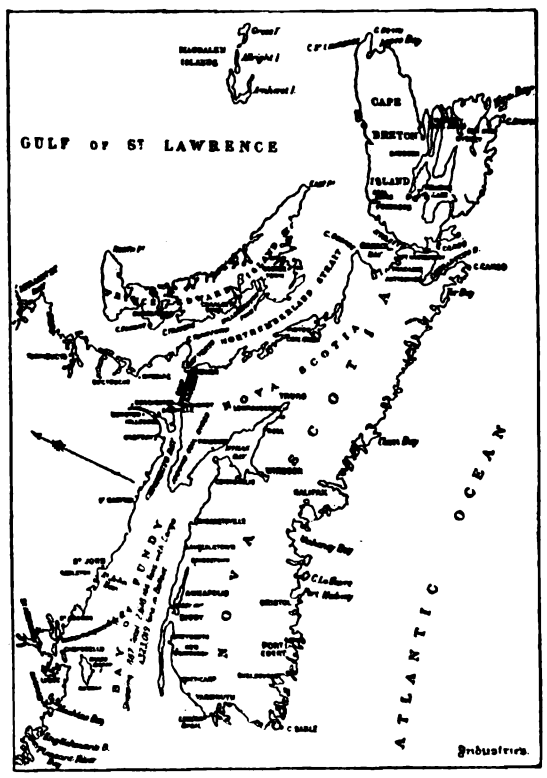


FIG. 2.

After this slight historical sketch, we may proceed to describe the chief features of the work. From the terminus at the head of the Cumberland Basin to the Tidnish terminus on Baie Verte the distance is seventeen miles. Owing to the favourable nature of the ground it was found possible to make the road perfectly straight. The gradients are light, in no case exceeding 1 in 500, or 10ft. in a mile, while, for the most part, the line is quite level. Great care has been employed to get a solid road bed. Where the line crosses the Tantramar marshes, which consist of soft mud many feet in depth, rock, borrowed for the purpose, was used for the embankment, and filled about 8ft. above grade to secure additional weight, and leave no doubt that the road was resting on hard pan. The line crosses one floating bog of moss about half a mile wide. Here the moss was excavated to the hard bottom preliminary to the construction of the embankment. Elsewhere little difficulty was experienced in finding a perfectly stable and satisfactory road bed.

In describing the track it should be mentioned that the line is constructed with the intention of carrying ships of 1,000 tons register or 2,000 tons displacement. The track is a double one, the distance from centre to centre being 18ft. The steel rails for the four lines of track are probably the largest yet made, weighing 110lb. to the lineal yard, 6¼in. in height, with spikes and fish plates heavy in proportion. The sleepers are of southern pine, 9ft. by 7in. by 12in., excepting at the joints, where they are 27ft. long, so as to connect all four rails. Stone ballast will be used throughout. The rails and other material for the permanent way have been supplied by Messrs. Cammell & Co., of Sheffield.

Four locomotives of unusual weight and power are being constructed, from special designs, at the locomotive works, Kingston, Ontario. Two of these are expected to move the heaviest ship to be taken across at a speed of ten miles per hour, thus completing the whole journey in less than two hours.

The construction of the necessary docks at either end of the line has been rapidly pushed forward during the past season. They will be 500ft. long, 300ft. wide, and 40ft. deep, each capable of holding from six to ten vessels, of various tonnage. Connected with these will be the lifting docks, constructed of solid masonry, 250ft. long by 60ft. wide, large enough to hold the largest paddle-wheel steamers plying in the gulf or bay.

The basin for the docks is, at the Amherst or Bay of Fundy terminus, excavated from the land; at the Tidnish terminus it is built out into the sea. Our illustration, Fig. 1, shows the process of excavation, now nearly completed, at the Fundy terminus, with the masonry of the lifting dock in the foreground, and the cast-steel bases of the hydraulic rams in position. At the seaward end of the dock will be a gate 60ft. wide by 30ft. high, to retain the water after the fall of the tide. Each of the lifting docks will be fitted with a ship lift worked by means of twenty hydraulic presses, ten on each side, somewhat similar in construction to the lifts now in use at Bombay, Malta, and the Victoria Docks. The powerful hydraulic machinery for these lifts has been supplied by Messrs. Easton & Anderson, Limited, of London and Erith. Fig. 3, on the next page, shows the progress made in the erection of this machinery, all of which is now upon the ground at the Tidnish terminus, within the cofferdam.

(To be continued.)

A NEW METHOD OF TESTING PORTLAND CEMENT.

FEW "new" things are absolutely novel, and most improvements have been foreshadowed ere they have received definite shape. If it be considered necessary to fix the exact date at which a novelty is produced, it is perhaps well to choose the time when it first took tangible form and began to have practical significance, rather than that of its more or less misty inception. On these grounds the method about to be described may be termed "new," but, judged by a more rigorous standard, its claim to novelty might be found invalid.

From time to time experts have striven to improve existing methods of testing hydraulic cements, with more or less success. Both in this country and abroad numerous series of experiments have been carried out with this object, and have sometimes resulted in giving both maker and user better criteria than they possessed before. Owing largely to the tendency of engineers in this country to work each by his own specification, methods of testing are at present very various and often woefully obsolete, and for improvement we must look elsewhere. Since the researches of M. le Chatelier, it is to French engineer-chemists that we must chiefly look for help.

The latest contribution to our knowledge, the author of which may apparently claim to belong equally to both professions, is by M. Deval, Chief Superintendent of Bridges and Roads, and in charge, under M. Salle, of the Public Works Laboratory of the City of Paris, and has been presented to the Société d'Encouragement pour l'Industrie Nationale. That body, having referred it to the Committee of Applied Chemistry, has received a favourable report through M. le Chatelier, acting for the Committee, and the paper has accordingly been published in a recent number of its "Bulletin."

The mechanical tests of Portland and other hydraulic cements generally in use are made cold; the briquettes, after setting and being exposed for a certain term to harden in the air, are immersed in water at the ordinary temperature. The use of *hot* water was originally advocated by Michaelis, and the proposal undoubtedly contained the germ of an important improvement, but was unfortunately discredited by assertions of the existence of a definite relation between the results obtained hot and in the cold.

Objection, that is at first sight not unreasonable, may be taken to this method of testing, on the ground that such a condition as immersion in hot water is almost never encountered by hydraulic cements in actual use, and that in consequence a hot test is superfluous and irrational. But on closer consideration this objection loses force. It must ever be remembered that from the moment a cement is made until it finally ceases to exist as cement it is ceaselessly changing in constitution and properties. Neglecting as adventitious the alteration it undergoes by aëration, either intentional or accidental, its first notable change is that produced by the complex phenomena of hydration, known generically as "setting." This is followed by the slower but generally more important process of "hardening," to which it is difficult to set a term, but which usually ceases to be noticeable after the elapse of one or two years. When fully hardened and exposed—in the work of which it forms part—to natural eroding and disintegrating agencies, it is slowly but inevitably broken up and decomposed until its cementitious existence terminates. It is plain that in ordinary cases the *time* factor is of vast importance, and the inspection and final acceptance or rejection of a batch of cement, if time were the only means of testing available, would have to be relegated to posterity.

Seeing, then, that it is impracticable to secure for experimental purposes one of the main conditions obtaining in actual work, it is futile to try to imitate the rest of those conditions, unless such imitation have advantages of its own. On this broad general ground the objections to tensile tests, when cement is never used in tension, neat tests, when it is never used neat, and hot tests, when it is always subjected to the ordinary temperature of the air, may be met and refuted. The sole object of any test or code of tests is to ascertain what cement will prove reliable when used as a building material and what will not, and, of those cements which are accounted reliable, the order in which they may be ranked. Having thus disposed beforehand of sundry "practical" objections, the method of investigation adopted by M. Deval may be described.

Acting in accordance with the principles enunciated above, he was content to adopt the conventional processes generally used; the briquettes were 5 sq. cm. in section, the tests being made in tension. The mixture used consisted of one part by weight of cement to three of normal sand, and was gauged with the minimum quantity of water necessary. After being made, the briquettes were allowed to harden for a period ranging from twenty-four hours for Portland cements to thirty days in the case of certain hydraulic limes, which were very slow in setting and hardening, owing to the alteration of one of the conditions prescribed above—namely, the use of as little water as possible. At the end of the period of setting the briquettes were immersed in water at 80° C., and remained therein for two or seven days. Parallel tests were made in the cold, the period of immersion being seven or twenty-eight days, these times being found to give results comparable with those of the hot tests at two and seven days. The briquettes were then broken in the ordinary way. On carrying out a series of such tests with six samples of Portland cement as representative as possible of the typical differences in quality that are encountered, the following conclusions were arrived at:—

1. Cold tests are fallacious, inasmuch as they may fail to detect, or may even hall-mark as good, thoroughly bad cements.

2. Portland cement of good quality, gauged in the manner described above, will resist the action of water at 80° C., attaining, moreover, in seven days, about the same tensile strength as is reached in the cold after twenty-eight days.

3. Where for any reason, such as the presence of much inert matter—as may be the case with a poor cement—setting has not been completed before immersion, disintegration will occur, even though the cement be sound. A longer period for setting must then be allowed.

4. The presence of *free lime* in appreciable quantity is detected by the hot test, the tensile strength being lower than that given by the cold test at twenty-eight days, and the briquettes cracking, swelling, or disintegrating in a highly significant manner. In cases where the percentage of free lime is small, the cement will withstand the action of water at 80° C. if the period of setting be extended, but will have a lower tensile strength at two and seven days than when tested cold at the corresponding times—viz., seven and twenty-eight days.

This last result is the most important contribution to our means of judging of the quality of Portland cement that has been made for years. Attempts have been repeatedly made to devise chemical methods for the detection and determination of free lime in Portland cement, but without success. A very obvious plan, and one still practised at times with refreshing simplicity, consists in treating a weighed portion of the cement with water or a solution of sugar in order to "dissolve out the free lime." The free lime is certainly dissolved out, but with it goes into solution the lime combined to form the silicates and aluminates which constitute hydraulic cement. Analyses professing to give the percentage of free lime, and stating it as 25 per cent., are not of extreme rarity, and have no other claim to be considered valuable.

Data have been accumulated concerning fifteen other samples of Portland cement, both the "natural" variety from cement stone, and that made in the ordinary manner from chalk and clay. During these experiments a further advantage was shown to result from the use of the hot test, inasmuch as the acid silicates that play the part of puzzolanas in certain highly silicious

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THE CHIGNECTO SHIP RAILWAY.

(*For description see page* 97.)

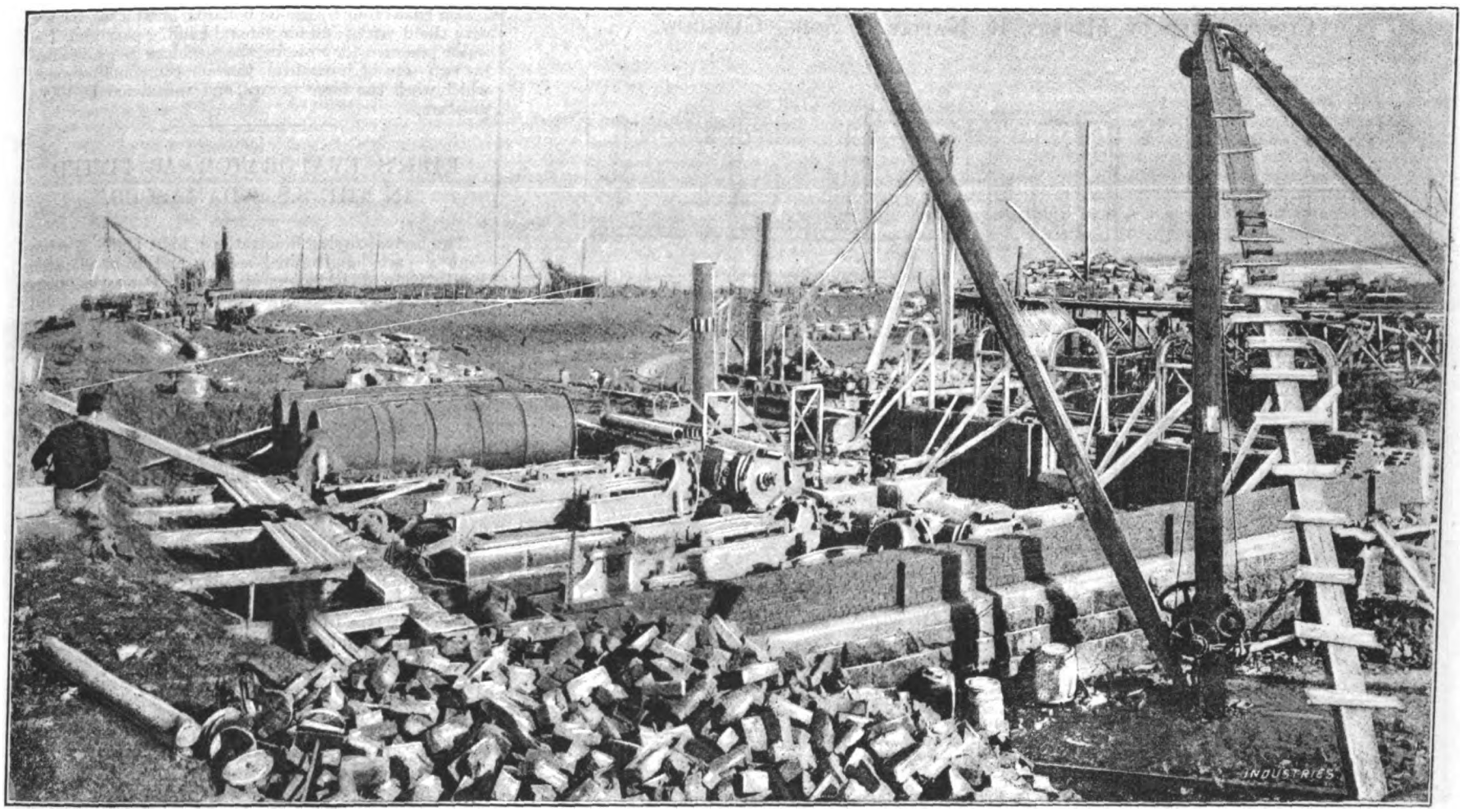


FIG. 3.—ERECTION OF THE HYDRAULIC PLANT FOR WORKING THE LIFTING DOCK.

cements have their hardening hastened by the high temperature, and raise the tensile strength, causing the cement to assume its proper rank in the scale of quality—a result impossible with the ordinary cold tests on account of the slowness with which such silicates react at a low temperature. Similar proofs of the general utility of the hot test were obtained in the case of slag cement, which has now become a considerable article of commerce and a factor that must be reckoned with both by maker and user. Experiments were also carried out with certain special quick-setting cements, and with a good variety of hydraulic limes, with the same main result.

Certain weighty conclusions which M. Deval appends to his paper demand careful consideration. Admitting the value and wide applicability of the hot test, it is obvious that its greatest utility will appear in the case of "natural" cements, the composition of which is less directly under control than is that of Portland cement. The reason for this is that such cements are made by burning the raw material (argillaceous limestone) without attempting to render it homogeneous. Thus, though analysis may show that the raw material, taken in mass, has the composition necessary for the production of good cement, a given lump may contain altogether wrong proportions. As no actual fusion takes place in burning cement, the evils of imperfect mixture cannot be remedied in the kiln, and one and the same piece of clinker may be on one side composed of overlimed, and on the other of overclayed, cement. Considering the periodical spasms of activity in the exploitation of "natural" cement, one of which is only just waning, a method capable of detecting its chief weakness cannot but be useful. Portland cement offends less frequently in this way, but the irrational demand for a cement of very high tensile strength sometimes leads to it being overlimed, and disastrous effects may result.

With regard to the adoption of the hot test as a supplement to or substitute for those with which we are familiar, it may be safely predicted that manufacturers will be vigorously opposed to it, as it discriminates too nicely between fairly good cements and those of really high quality. The prejudices born of inherent conservatism will delay its use by some consumers, but a slowly wakening regard for their own interests will finally lead to their conversion. The erroneous belief of Michaelis, already referred to, that a definite relation exists between the results of hot and cold tests, will doubtless have a retarding effect. To diminish that effect a consideration of the following statement should suffice:—The whole merit of the hot test consists in the divergencies of the results obtained by it from those given by the cold test; where the latter leaves a bad sample undetected, or only throws intangible suspicion upon it, the former condemns it without fail, the discrepancy being a measure of its success.

No sweeping change in our mode of testing is possible, or even desirable. More data—above all things those comprising the comparison of laboratory tests with the behaviour of the stuff in the work—must be collected, and to that end it is of urgent necessity that every engineer already having his cement habitually tested should include the hot test among the methods used.

HYDRAULIC HOISTING PLANT FOR H.M.S. "VULCAN."

THERE have been recently carried out on board the new torpedo depôt ship "Vulcan," at Portsmouth, a series of trials of hydraulic boat-hoisting machinery, supplied by Sir W. G. Armstrong & Co., of Elswick, which have attracted some interest in consequence of the novelty of the fittings introduced for the first time in a ship. Chief among these is a pair of enormous "goose-neck" cranes, placed one on each side of the deck, almost amidships. These cranes are, in fact, huge davits, whose total height is 65ft., with an overhang of 38ft. It will be readily understood that a bent beam of these dimensions, and weighing about 27 tons, requires special arrangements for its support and security. To provide these about 30ft. of the total height lies buried in the hold, passing down through the upper, main, and protective decks to the bottom of the ship, where the foot rests upon a special steel casting bolted to the structure of the vessel. In the upper deck is secured a heavy steel socket, in which the crane rotates. The beams themselves are built of steel plates and angles on the box-girder principle, but specially strengthened and stiffened. By this method of construction the lifting machinery is permitted to be erected within the pillar of the crane, well down in the hold, and consequently protected from gunfire, while the portion above the protective deck is screened by an armoured tube. The lifting machinery consists mainly of two cylinders, 17½in. and 5½in. diameter, fitted with rams, which have a vertical travel or stroke of 10ft. The small cylinder plays a very important part in the working of the mechanism. Both rams are rigidly attached at their upper ends to a huge cross-head, which carries four sheaves on a pin at right angles to the axis of the cylinder. At the lower end of the cylinders are four sheaves, corresponding in a vertical plane with those above, the whole thus forming a system of pulleys. The thrust exerted on the cross-heads by the rams at the ordinary working pressure of 1,000lb. per square inch is about 118 tons, one-fourth of which only is available for lifting purposes, owing to the multiplying power of the pulleys, which increases the 10ft. stroke to a lift of 40ft. The ropes, 5½in. in circumference, are of steel wire. The most interesting feature in the mechanism is the attachment of the small cylinder already mentioned, the special duty of which is to hold and keep taut the slings after they have been hooked on until a favourable moment for hoisting the boat presents itself. This is of the utmost importance in a seaway as a preventive against accidents. The arrangement of valves is such that the main lifting power cannot be applied until the small cylinder has been brought into action. It also provides for the escape of the water when the ram is driven back by the falling of the boat. The turning motion of the cranes is effected by means of two cylinders fitted with rams 16in. in diameter, and having a direct thrusting force of 90 tons. These are placed vertically alongside the pillar of the crane, and the rotatory motion is given by admitting the pressure to one or other of the

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KIRK'S EVAPORATOR FOR MARINE BOILERS.

CONSTRUCTED BY MESSRS. R. NAPIER & SONS, GLASGOW.

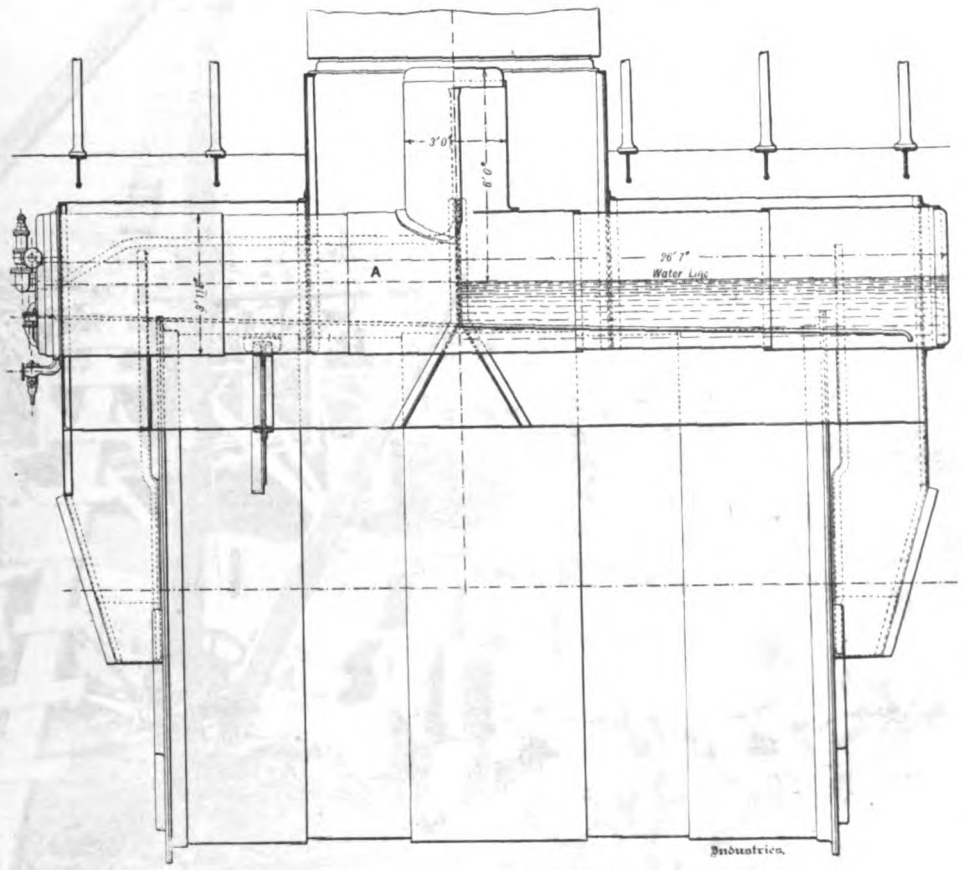


FIG. 1.—PART LONGITUDINAL SECTION OF BOILERS AND EVAPORATOR.

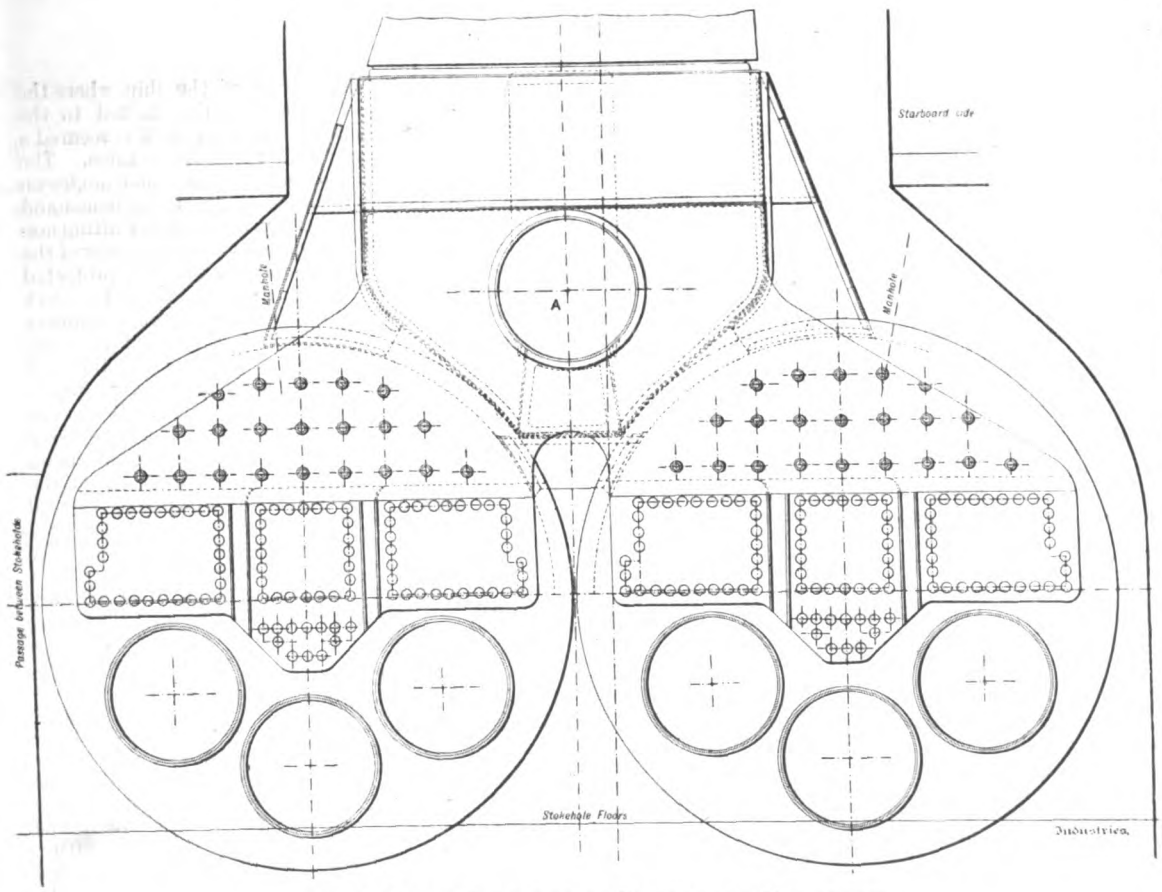


FIG. 2.—FRONT ELEVATION OF BOILERS AND EVAPORATOR.

presses. The cranes have a turning range of 250 deg., which will enable a boat to be picked up from alongside the ship and deposited in almost any position on deck. It is, however, obvious that, since the "Vulcan" is 58ft. wide and the cranes are 40ft. apart, it would be impossible, without special devices, to lift a boat remotely situated from the part where the crane is fixed. In order, therefore, to provide for the contingency of one of the cranes becoming disabled in action or by accident, the torpedo boats (of which the ship carries six) are stowed in crutches fitted on trolleys actuated by worm gearing and moving upon rails, by which means they can be conveyed from one side of the ship to the other. The cranes have been tested, and every part of the machinery successfully withstood the tests.

The service derrick attached to the mainmast for boat-hoisting purposes has also been fitted with hydraulic machinery. In addition to the cranes and derricks, there are on board four hydraulic bollards, or winches, for use with the derricks and for general hauling purposes. The water pressure for working the machines is maintained by two sets of horizontal tandem compound engines, which work the force pumps, and use steam at 100lb. pressure.

KIRK'S EVAPORATOR AS FITTED IN THE S.S. "DAMASCUS."

THE accompanying illustrations, Figs. 1 and 2, represent a part longitudinal section and front elevation respectively of the boilers of the s.s. "Damascus," fitted with Dr. Kirk's evaporator. In Figs. 3 and 4, on page 101, we further give end and side elevations respectively of the portion of the evaporator which projects through the boiler front, showing the valves employed. The evaporator A is of the simplest construction, and consists of a plain low-pressure egg-ended boiler placed in the uptake between the two main boilers, and of sufficient size to allow a man to get into it for cleaning or for repairing purposes. It is fed from the sea and blown off in the same way as an ordinary boiler, the feed being supplied by any of the pumps supplied with water from the sea, or by a special pump. Practically it is found most convenient to work with a continuous feed and a continuous blow off, although from the quantity of water contained in the evaporator the blowing off may be done intermittently if preferred.

The evaporator was originally worked under a vacuum, the steam pipe from it being connected to the condenser, but it was found that under these conditions priming took place so readily as to be somewhat troublesome.

The best working condition is under a pressure of 10lb. to 20lb. above the atmosphere. This may be attained by allowing the steam to escape through a safety valve on its way to the condenser, or, better still, by connecting it to the low-pressure cylinder casing, with an alternative escape through a safety valve, as above described. The advantages claimed for this special evaporator are (1) its simplicity of construction, and consequent ease of cleaning; (2) the evaporation of salt water at a much lower temperature than the evaporation in the main boilers, consequently the heat that would be with difficulty utilised in the main boilers is efficacious in the evaporator. It has also been found that even when by accident the feed or blow-off has been omitted the heat of the uptake is not sufficient to injure the riveting. The evaporator, which is being introduced by Messrs. R. Napier & Sons, Glasgow, has, we are informed, proved adequate to keep the boilers of the "Damascus" fully supplied with fresh water. After a run of forty days the scale formed in the evaporator was found to be only about one-eighth of an inch in thickness, and was easily removed.

MINING IN SPAIN.

LEAD mining and smelting in the Garrucha district of Spain, we learn from a Foreign Office report, is on the decline, owing to the continued stoppage of the general pumping station on the mines. Steps have, however, been taken towards remedying this state of affairs.

The principal iron ore mines of the district are situated in the Sierra of Bedar, and have recently been greatly developed. The Sierra, where the deposit occurs, may be broadly defined as consisting of very old schists capped by limestone. These schists are, as far as can be learned at present, absolutely azoic, not a single trace of organic remains having yet been found, but, judging from their lithological character, they may be described as of lower Silurian or Cambrian age. They are overlaid by a thick-bedded yellow crystalline limestone. The occurrence in this of fossil remains, together with the presence of magnesia, points to these limestones being of Permian age. The leading lode is probably a contact lode between the schists and the dolomites. The secondary lodes are sometimes parallel, and sometimes at varying angles and dips to it, and pass both into the schists and limestones. The slopes of the Sierra are covered in places by Tertiary limestones and conglomerates, but the lodes never pass into these, and are, without exception, confined to the paleozic rocks.

In one of the mining setts near the village of Bedar there are as many as twelve workable lodes, the principal one being upwards of 100ft. wide, and extending for a

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considerable distance across country. In another sett, near the village of Serena, about two miles to the westward, the great lode has been followed down to a depth of over 100ft., without showing any indication of narrowing or of the ore giving out, whilst in the properties adjoining the lodes have been worked to a depth of upwards of 120ft., with a result that, although on the surface the size of the lode may be small, in depth it is found to widen out very much. In one case a narrow surface lode widened out to 45ft. below. The ore is worked both in open cast and in high galleries. It is let down an incline to a wire rope tramway station, whence it is conveyed to Garrucha at the rate of about 45 tons per hour, at a cost of about 3s. 2¾d. per ton, including repayment of cost of tramway and delivery from stock to steamer. The production is naturally governed by the quantity which can be transported by the tramway. It is now about 120,000 tons per annum, but it could be greatly increased if a more suitable means of transit were provided. The ore is black and brown hematite, and contains from 55 to 62 per cent. of metallic iron, and its freedom from sulphur and injurious quantities of phosphorus, low percentage of silica (in some cases under 1 per cent.), together with the presence of a considerable quantity of lime, makes it highly suitable for steel making purposes. Its physical condition varies considerably, and it is curious to note that the ore in the eastern group around Bedar is hard and lumpy, while that in the mines to the westward is soft and purple, and consists of only about one-tenth in lumps.

The great desideratum for this magnificent deposit is a railway connecting it with the coast. The present means of transport is altogether inadequate to the importance of the mines, many of the best of which are unworked for the want of means of communication. A good broad-gauge line would not cost more than £60,000, and would pay for itself in a couple of years if worked in combination with the mines. The supply of really good ore is no doubt very great, and there is little doubt that this line would have been constructed had the late high prices of iron continued. The sudden fall appears to have checked the influx of capital into the iron industries, although in this case it would appear to be sound policy to build the means of transport whilst prices are low and material cheap.

THE ENGINEERING SCHOOL, CORNELL UNIVERSITY.

It has been said that the great ambition of a rich Briton is to found a family, while that of a rich American is to found a college. No doubt there are exceptions to both those statements, but it must be admitted that there is a considerable amount of truth in them. The latter especially has had many exemplifications during recent years, and colleges and universities are being instituted and endowed in America at a rate which is apt to raise the envy of educationists in this country. We need not attempt an enumeration of them, but will confine our attention to one which is destined to take a high position in the advancement, not only of the higher learning, but also of technical education. We refer to Cornell University, which seems in many respects to be the ideal of a modern university, combining as it does an education in the learning of the past with the knowledge rendered necessary by our present state of civilisation. We believe that it is in the happy, or unhappy, position (according to the point of view from which the matter is considered) of being as rich as it can possibly be—that is to say, it now holds property and investments to the utmost amount allowed by its charter. Whether such a state of affairs can be amended or not we cannot say, but it must be admitted that it is a very peculiar position for any institution to occupy. During the past year alone it received for general purposes about one million dollars, a share of which will, of course, be spent on the engineering department. We understand that not less than $200,000 have been spent on apparatus and material in the engineering department and accessories alone, a great part of which is employed in instruction and research in Sibley College. This college, which forms an essential part of the University, was founded by Hiram Sibley, an old friend and comrade of Ezra Cornell, the founder of the University, and is devoted to the mechanical arts and to mechanical engineering. In one of our early volumes (see *Industries*, Vol. I., page 566), we described its general arrangements, and we shall now only notice a few of its recent developments.

What is of more importance even than its endowments, Sibley College has been fortunate enough to secure the services of a first-class man as its director, and of an efficient staff of teachers, for in education money is not the only, nor, indeed, the main thing. Unless an institution is managed in the proper spirit, and by men who are able to keep it up to the demands of the times, its teaching may degenerate into a mere matter of official routine, however excellent its buildings and equipments may be for their purpose. The director of Sibley College is Professor R. H. Thurston, whose name is as well known in this country as in America, and who, by his energy and ability, has done so much to make the College what it is. Professor Thurston was for many years connected with the Stevens Institute, and his experience there and his early training well fitted him for the position which he now holds. His papers and articles on subjects involving not only theoretical considerations, but also a large amount of experimental work, testify not only to his unwearied activity, but also to his great ability and the extent of his knowledge. He is seconded in all his efforts by a most able staff of teachers, and we have no doubt that, with all his advantages, Professor Thurston will be able to make Sibley College one of the most complete engineering colleges in the world.

What may be called the general and preparatory subjects, such as languages and the pure sciences, are taught to the students of engineering in the University proper, so that the whole resources of Sibley College can thus be devoted to the applications to engineering and to experimental work. The main department of the College is, of course, that devoted to mechanical engineering. This is subdivided into the sections of electrical, steam, marine engineering and naval architecture, and chemical engineering, all of which have their basis in a good knowledge of mechanics, both theoretical and practical. Each of these subjects is fully represented by a course of theoretical instruction and of laboratory work, for it has been fully recognised that the latter is most essential in the training of engineers, and that, in fact, the lecture-room, the drawing-office, and the laboratory are only departments of the same class. While there is no pretence of training apprentices, still there are opportunities for the students to become skilful with the tools of all the trades subsidiary to engineering, and by the time they leave college they are thus well equipped to begin a course of practical experience in some department of engineering. It must be admitted that in America formal apprenticeships have almost disappeared, and young men after leaving school or college generally enter works as improvers, and pick up experience as best they can.

Although the workshops and laboratories at Sibley College are already very extensive, we believe that during the present year they will be nearly doubled. New chemical and physical laboratories are to be supplied, and additional opportunities are to be given to the increasing number of those who intend to pursue semi-professional in conjunction with their professional studies, and to study advanced mathematics, political economy, and patent law.

The usual course of instruction extends over four years, and includes a systematic curriculum in mathematics (pure and applied), in physics and chemistry, and in their application to the different departments of engineering. General culture is not forgotten, special attention being paid to modern languages, history, and political economy. The first two years are taken up with what may be called the more general subjects, the third with those of the department selected by the students, while in the fourth they specialise still further by selecting the section belonging to their special calling. This seems a very good arrangement, as it first lays a broad basis of education, and then proceeds to give the students a useful introduction to the main work of their lives.

The College is now being largely used by graduates of other colleges who come up to take advantage of the opportunities for experimental research and to fit themselves for advanced degrees. Many of these intend to pursue the vocation of instructors in science and in technical schools. Indeed, we believe that many professors of engineering go to Cornell and Sibley College to get experience in laboratory work, and to make scientific and engineering researches such as their earlier opportunities failed to offer them.

A great movement in this country for the improvement of engineering education and of technical education generally is now being made. Our object in writing of Sibley College is to direct the attention of educationists to a well-organised experiment now being made in America, which is well worthy of their careful study.

KIRK'S EVAPORATOR FOR MARINE BOILERS.

CONSTRUCTED BY MESSRS. R. NAPIER & SONS, GLASGOW.

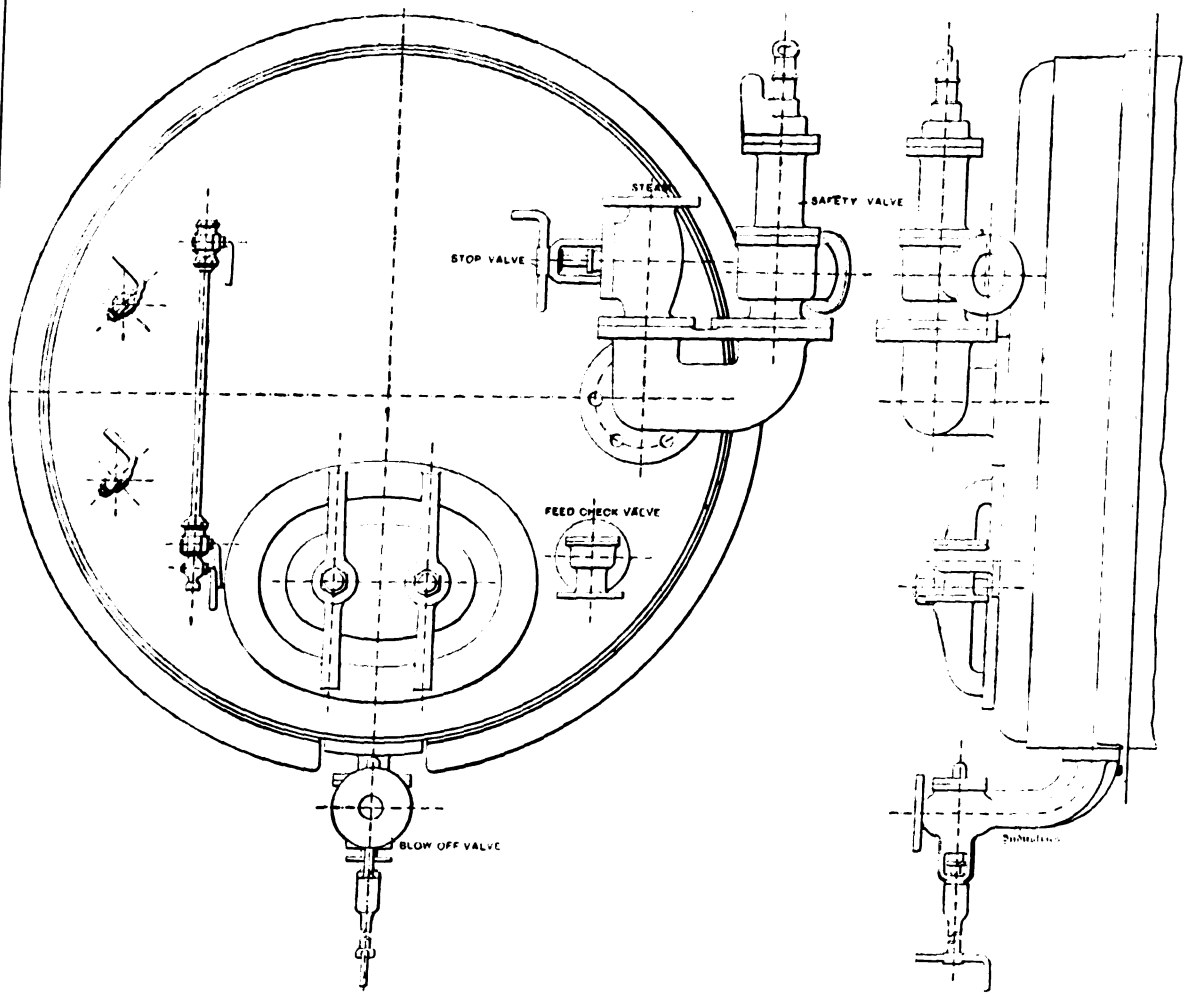


FIG. 3.—FRONT VIEW OF EVAPORATOR.

FIG. 4.—SIDE VIEW OF EVAPORATOR.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 27th January, 1891.

Iron.—Business in the iron market is still very inactive. It may be hoped that a change for the better will make itself felt with the resumption of the building and other industries which have been interrupted for the last two months by the exceptionally severe weather. There are some heavy contracts to be given out, amongst others one for the furnishing of cast-iron pipes for the extension of the water supply of Paris at an estimated cost of about 1,500,000fr. The P. L. M. Railway Company are on the point of soliciting tenders for the delivery of 20,000 tons of steel rails, but this has not yet influenced the market, and no improvement has taken place in prices. A like report reaches us from the provinces, where the amount of business done is very limited, and the prices officially quoted much higher than those obtained. At the last meeting of the Paris Syndicate the following prices were established:—First-class bars, 128s. 6d., and joists, 136s. 6d. per ton. The improvement in the English market and the steadiness in the price of coal here will doubtless contribute to a speedy rise in quotations.

The Coal Market.—The coal market continues to be very firm. This is to be accounted for partly by the continuous growth of industries in general—with the exception of the production of metals, which has not increased in France of late years—and partly by the augmented domestic consumption during the winter months.

Copper, Lead, Tin.—The copper market is slightly firmer than it was last week. Best Chilian bars command £57 10s. to £58 the ton. The prices for tin remain unchanged, with the exception of Billiton, which has fallen 9s. per ton. Lead has gone up slightly, ordinary marks being quoted at £13 5s. the ton.

Importation of Iron Ore into France.—During the first eleven months of 1890 1,419,400 tons of iron ore were imported, showing an increase on the first eleven months of the preceding year of 174,000 tons. Of this total Germany supplied 886,526; Spain, 441,320; Belgium, 34,178; Algeria, 41,070; Italy, 10,969; and other countries, 5,437 tons.

Hardening Tubes for Guns.—An interesting experiment in hardening these tubes on a large scale took place recently at Rive-de-Gier. The piece to be operated on was a tube for a 34-centimetre gun 54ft. long, and weighing nearly 26 tons. The experiment proved a general success, and there is a probability of even better results being arrived at, but we think this is the most important operation of the kind that has been hitherto successfully carried out.

BERLIN, 26th January, 1891.

Electrical Transmission of Power at Königsbronn.—An installation for the transmission of power for the use of the Government foundries at Königsbronn, in Wurtemberg, has recently been opened. The supply of power is obtained by means of a turbine from a stream at that place, and the dynamo and the turbine each make 600 revolutions in a minute. By means of a conductor, which is carried over the roofs of the houses across the railway to the opposite side of the valley, 40 horse-power is transmitted for the working of twenty-five powerful lathes, which are employed in the turning and polishing of shafts for the Königsbronn foundries, and had been previously driven by steam power. The installation was carried out by the Esslingen Machine Works, and the turbine was erected by the machine works of Herr J. M. Voith, of Heidenheim. By means of an automatic regulator, invented by Herr Pfarr, of these works, the power transmitted is independent of the varying conditions of the stream. Other installations may be expected to follow this, which is the first erected in Wurtemberg.

International Electrical Exhibition at Frankfort.—A conference between representatives of the Berlin General Electricity Company, the Oërlikon Machine Works, and the Lauffen Portland Cement Works, with reference to the Frankfort Exhibition of 1891, was recently held at Munich. An agreement was entered upon as to the apportionment of the expenses of the electrical transmission of 300 horse-power from Lauffen to Frankfort, in view of the fact that previous trials at Oërlikon had shown that the undertaking would probably meet with success. The carrying out of this interesting undertaking depends on the Exhibition Committee obtaining the loan of the necessary conducting poles from the Postal Administration and the Wurtemberg Telegraph authorities. The question is now continually arising as to the use of streets and roads for the transmission of electric light from a distance, and it may be hoped that the authorities will afford facilities for the carrying out of such an important work as the present.

Industrial Berlin.—There are in Berlin 1,627 fixed steam boilers and 1,353 fixed steam engines, indicating 45,821 horse-power. In addition there are 285 portable boilers and engines indicating 2,229 horse-power, making a total of 48,050 horse-power. A comparison between the present state of industry and that of 1879 shows to what a large extent the industries of Berlin have been developed during that period. In 1879 there were in Berlin only 1,211 boilers and 983 steam engines, indicating 20,286 horse-power, thus showing an increase on the ten years of no less than 27,764 horse-power.

VIENNA, 26th January, 1891.

The Iron Market.—There is no important change in the Austrian iron market. The trade in bar iron and boiler plates shows no increase, but the tendency is firmer, and with better weather an amelioration of the situation may be expected. An important order for thirty-four passenger carriages has been given by the Northern Railway Company. The prospect for the year is good, and the enlargement of the city will probably lead to increased building operations.

The Coal Market.—During the past week the coal market has continued active. The demand both for home and export purposes is very brisk, and railways have some difficulty in coping with the traffic. There is a need of more rolling stock, especially in the Bohemian district. Bohemian brown coals found a sale in this market when Silesian coal could not be forwarded by rail owing to the recent snowstorms. Representatives of works situated on the Dux-Bodenbach Railway have been sent to Dresden to obtain more waggons from the State Railways of Saxony, as the greater part of the coal produced is forwarded by these lines. From the 7th to the 10th inst. the export to Saxony amounted to 84,000 tons, against 79,000 tons in the same period last year. The total transport on the Dux-Bodenbach Railway in the second week of this month amounted to 47,000 tons, and that on the Prague-Dux line to 31,000 tons.

Electrical Engineering.—The central station of the Vienna Electricity Company, in the Kaunitz Street, will shortly receive an important extension. The installation for the electrical lighting of Sophia, in Bulgaria, was taken over by Messrs. B. Egger & Co., of Vienna. During this week the Vienna Town Council has been deliberating on the concession granted to the International Compressed Air and Electricity Company (Popp), and the proposals of the company have been adopted, with small and unimportant alterations. The building of the central station for the supply of compressed air will soon be commenced. The question of an electrical railway in Vienna has been again brought forward through the enlargement of the city. Last week Herr Hochenegg read a paper on electrical traction at a meeting of the Electrical Association. On the conclusion of the paper, the Association passed a resolution that suitable measures should be taken to ascertain the best mode of employing electricity in Greater Vienna. This resolution seems to point to the construction of an electrical railway at an early date.

Bohemian Exports to America and the McKinley Act.—Bohemian exports have suffered no damage from the effects of the McKinley Act, but, on the contrary, the exports to the United States during the last quarter of 1890 show an increase, the total exports from Bohemia during this period amounting to $2,500,000, as against $800,000 in the corresponding period of the previous year. The export of raw sugar has the largest share in this increase. The export of porcelain and earthenware was increased by $40,000, beer by $10,000, cloth and woollen goods by $12,000, and linen and cotton goods by $20,000. The exports of certain raw materials have also shown a large increase, which is a sign that the McKinley Act has not produced the ill effects which were feared.

DÜSSELDORF, 27th January, 1891.

Iron Market.—The iron market is quiet, and there has been no great alteration since last week.

Coal Market.—In consequence of difficulties in transport the price of coals is rising. Many manufacturers have paid for a waggon of 10 tons from 180 to 200 marks, which might recently have been bought at from 90 to 100 marks. On the 23rd inst. there occurred at the Hibernia pit, near Gelsenkircher, an explosion of fire-damp, by which 41 men were killed and 24 men injured.

Transportation Difficulties.—The heavy falls of snow continue to cause serious inconvenience to traffic in all parts of the German Empire. The Upper Silesian and the Ruhr districts suffer most largely. In the latter the number of delayed waggons becomes greater from day to day. The Rhine is frozen from Emmerich to Düsseldorf, and from the Loreley upwards to Mainz, and the thickness of the ice is in some places more than 20ft. In consequence of the recent thaw it is feared that the banks of the Rhine will suffer extensive inundations from the drifting of ice. Similar difficulties exist on the Weser and Elbe, and the harbours of Bremen and Hamburg suffer much. The transatlantic steamer "Augusta Victoria" left Cuxhaven on the 23rd inst. for Southampton.

General Engineering.—The makers of engineering work of almost every description have fairly bright prospects. Makers of locomotive engines have got large orders and expect to receive others shortly. The German mining industries are now placing plenty of orders for hauling and pumping engines. Besides this some firms have got good orders from foreign houses. Amongst these are two sugar mills which are to be erected near San Francisco in California by Messrs. Langer and Kundhauser, of Grevenbroich. The Halle'sche Maschinenfabrik u. Eisengiesserei in Halle is busily engaged in finishing a series of sugar mills for Java. Messrs. Siemens & Halske, of Berlin, have recently received an order from the town of Stockholm to erect there a central electrical station for the supply of 15,000 glow lamps.

German Pig Iron Production.—According to the statistical records compiled by Dr. Rentzsch, the German pig iron production in the year 1890, excluding charcoal and scrap iron, was in tons of 1,000 kilogs. each:—

Forge pig and spiegel	2,029,139
Bessemer	438,527
Thomas	1,555,693
Foundry	539,666
Total	4,563,025

The total production in 1889 was 4,387,504 tons. The monthly production was in

	1890.		1889.
January	374,066	...	367,111
February	362,026	...	334,912
March	416,948	...	380,500
April	398,457	...	372,742
May	400,234	...	306,299
June	387,852	...	330,812
July	391,982	...	371,467
August	371,102	...	378,500
September	363,324	...	373,185
October	373,090	...	391,337
November	361,384	...	389,116
December	362,560	...	391,523
	4,563,025	...	4,387,504

Electric Transmission of Power.—An interesting installation has been put up at a saw mill at Neuss by the Deutsche Elektricitätswerke, of Aix-la-Chapelle. The motor employed is one of 20 horse-power, which serves to haul logs of wood up to the works from the neighbouring Erft Canal. The dynamo supplying current to the motor is also used for lighting the premises.

AMSTERDAM, 26th January, 1891.

The Weather and Navigation.—The change in the weather has brought a welcome revolution in the means of communication, although the effect of the thaw upon the frozen rivers is as yet slight. The snow has almost disappeared, and with it one of the chief hindrances to regular railway traffic. The goods train service with Belgium and Germany has at last been partly resumed.

Report upon the State of Navigation.—At Rotterdam an interesting report has been published, prepared at the request of Mr. J. de Kuyper, the Dutch Consul-General at Antwerp, by Mr. J. W. Welcker, State Civil Engineer, employed upon the new waterway. He had to solve the important problem how it comes that Antwerp has been a closed port, whilst Rotterdam was, and is, available for all ocean steamers, despite the late severe frost. Mr. Welcker's report tends to show that the action of the Maas helps to keep the port of Rotterdam free from ice, by means of a strong current, which takes the floating ice away to sea. At Antwerp the tidal movement of the sea causes a contrary effect. It forces the ice back, and this consequently blocks the approaches of the port, and the Scheldt itself, where it soon solidifies into a compact mass forming an impenetrable barrier to all ships.

The Dutch South African Railway Company.—The management of this undertaking has decided to stop all work upon the lines during the season in which pestilential fevers cause great mortality among the staff of workers. But the building of the railway bridge over the Komati River near the Portuguese frontier will be pushed on as much as possible, and the operations upon the first section likewise.

Dutch Artisans in London.—The Dutch Consul in London has issued a warning against Dutch artisans going over to the great Metropolis in search of work. He points to the already overstocked labour market, and opines that there is no chance whatever for foreign workers to earn a living there under present circumstances.

International Association of Customs Tariffs.—The Dutch Government has submitted a Bill to the approval of the States-General for a vote of 1,600fr. towards the cost of instituting an International Board of Fiscal Statistics, to be established at Brussels, and 4,100fr. a year thereafter towards the expense of maintenance. The idea of forming this Board originated with Belgium. The Belgian Government summoned a conference, which met last July at Brussels—forty-one States participating—and decided to found the Bureau, whose function consists in collecting international statistics bearing upon trade, industry, and finance, but principally customs, to be translated into the various languages of the States participating, for distribution. The primary cost of establishment is computed at 50,000fr., whilst 125,000fr. a year will be required for maintenance.

An International Agricultural Congress.—In the coming month of September the unusual spectacle will be witnessed at the Hague of an International Exhibition organised by a foreign Government in a country not its own. The French Government will organise and open there an International Agricultural Exhibition, the idea of which originated in 1889 during the Agricultural Conferences at the Paris Universal Exhibition. Naturally enough, the French Government has sought the support of the Dutch Government, and the latter has already cordially promised to lend it.

STOCKHOLM, 24th January, 1891.

The Stockholm General Telephone Company.—This company has offered to members of Parliament to instal telephones in their private residences on payment

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of 30kr. for the whole of the session. Telephonic communication is extensively used by the general public in Stockholm.

THE SWEDISH NORWEGIAN RAILWAY COMPANY.—The fate of this concern will probably soon be decided, as Mr. L. Annerstedt has gone to London as the representative of the Swedish Government in order to negotiate with the vendors. The debenture-holders must look upon an arrangement with the Swedish Government as their last chance, although the sum of about £400,000, which the Swedish Government is prepared to pay, is a very small percentage of the millions sunk in this undertaking.

TENDERS FOR COAL AND COKE.—The Swedish State Railways are inviting tenders for the supply of a large quantity of coal and coke. Of locomotive coals 21,000 tons are required at Stockholm, 20,000 tons at Gothenburg, 30,000 tons at Malmö, 10,000 tons at Stugsund, 13,000 at Sundsvall, and 3,500 tons at Trondhjelm.

PROJECTED RAILWAY.—Another outlet from the North Trunk Railway to the sea is under contemplation, the Hernosand-Solleftea Railway Company having applied for a Government loan of 2,350,000kr., which is half the calculated cost of the projected line. There is every prospect of the loan being granted.

UTILISATION OF WATER POWER.—Electricity is likely to prove a great boon in the utilisation of the large amount of water power which Sweden possesses in its numerous and large waterfalls. One of the largest schemes of this kind is that in connection with the Elfkarsby Fall, in which several prominent engineers and capitalists are said to be interested. It is a question of the transmission of power by electricity on a large scale.

THE MUNKSUND SAW MILLS.—The saw mills at Pitea and the Bergfors Estate have been sold to Mr. P. Wikström, of Stockholm. This valuable property has been in the hands of Englishmen since 1867, and the opinion with regard to this sale seems to be that it seals the fate of the "Gellivara Aktiebolag," as its remaining property entails a less and will probably soon have to be sold. This part of the property may, however, become valuable when the iron industry in those parts is a little more advanced.

CHRISTIANIA, 24TH JANUARY, 1891.

THE UNION PAPER MILLS COMPANY.—This company, which possesses the largest paper mills in Norway, has now bought the southern half of the Skotfos waterfall, at a price of 70,000kr. The Union Company is thus owner of the whole of Skotfos, and has at its disposal water power of about 8,000 horse-power. The Skotfos is one of the largest waterfalls in Norway which has been turned to industrial account.

THE ICE EXPORT.—The export of ice from Norway shows a steady and continuous increase, and the figures for last year head the list. Up to the end of November the export amounted to over 308,000 tons, and the total export for the year probably amounts to 316,000 reg. tons. The figures for the previous four years are 254,000 tons in 1886; 266,000 tons in 1887; 244,000 tons in 1888; and 290,000 tons in 1889. The financial result of last year's ice export is satisfactory, although it varies very much for the different shippers. Those who sold early did far better than those who held back. The encouraging reports from America in the spring buoyed up the market, but the rise was only temporary. In October and November ice was sold at one-fifth of the price which had been refused in May. Owing to the present severe winter the prospects are not of the brightest. Last year's exports to America from Norway amounted to about 16,000 tons.

FOG HORNS.—Mr. O. C. Hausen's manufactory of fog horns at Skadesnäshaven has made nearly 7,000 fog horns during the last ten years. Mr. Hausen has supplied fog horns to the Norwegian, Swedish, Danish, Dutch, German, and United States navies, and to the lighthouse services of Norway, Sweden, Denmark, and France. The Spanish navy has quite recently sent an order. The works, which were started on a small scale, have been constantly increasing.

THE "DEIMEL" LIGHT COMPANY, LIMITED.—Mr. J. Werner has been appointed agent for the "Deimel" lamp in this city.

COPENHAGEN, 24TH JANUARY, 1891.

TRAMWAYS.—The Copenhagen tramways have proved first-rate investments, and none more so than the Nörrebro Tramway Company, of which the balance-sheet for last year shows receipts amounting to 326,970kr., and expenses to 224,605kr., leaving a net profit of 102,364kr. The Board get 12,098kr., the sinking fund 2½ per cent., the reserve fund 6 per cent., the sick and pension fund 3 per cent., the heirs of the builder 1 per cent., and the shareholders a dividend of 16 per cent.

PROJECTED NEW RAILWAYS.—Several new railways are projected in Denmark, both Government and private lines. One plan comprises a Tange-Silkeborg railway, in connection with a Lunderskov and a Veile-Brumminge railway, which lines are expected to prove of great importance, as regards both the local traffic and the communication with Germany and England. The promoters hope that these lines will be built as State railways.

ICE-BREAKING STEAMERS.—The capital service rendered by efficient ice-breaking steamers has been amply illustrated during the last few weeks' frost. They are almost daily at work, both in the Copenhagen harbour, and occasionally used right across the Sound, in the Great Belt, in order to keep up the important connection between Korsör and Nyborg, and in the Little Belt. It is only during the last few years that the immense practical value of ice-breakers has been realised, but now they are being generally adopted.

MARSTRAND BREWERIES.—These breweries, which have stood in the way of an amalgamation of the Copenhagen breweries, have issued their balance-sheet for the year ending 31st October, 1890. The result is by no means satisfactory. The gross profits amount to 143,997kr., but the net profits show a deficiency on the year's working of 14,975kr. The share capital is 1,800,000kr., and there are debentures for 867,069kr. It is difficult to understand why this large capital has not been able to yield any profit to the shareholders.

THE EFFECT OF FROST UPON RAILS.—The recent severe frost has caused much damage on the Danish railways through the snapping and cracking of the rails. Between Korsör and Copenhagen—a distance of some sixty miles—sixteen rails had given way the other day, the metal being rendered very brittle by the cold.

MADRID, 26TH JANUARY, 1891.

THE TRANSATLANTIC COMPANY.—The annual meeting of the shareholders of this company was held recently. For the past six years no profits have been available for distribution, all the earnings having been spent on the improvement of the fleet. Although the report attempts to show that the business is improving, the balance sheet teaches a different lesson. With a capital of £1,000,000 there is a debt of about £2,500,000, while the assets, which consist chiefly of the value of the ships, are stated to amount to £2,400,000. This state of affairs is not reassuring to the shareholders. Though some few of the ships are new and well constructed, many others are slow and old-fashioned. If the company were to liquidate, it is possible that the whole of the capital would be lost.

LAUNCH OF A STEAMER AT CADIZ.—The first merchant steamer built of iron or steel in Spain will be launched at Cadiz this week. It was built by the Transatlantic Company in their repairing shops and dry dock, established at the Trocadero, in Cadiz Bay.

ELECTRIC LIGHT COMPANY.—The Electric Light Company La Madrileña General de Electricidad, a half of which belongs to a group of German bankers and a half to the Gas Company, intend to increase their capital by £80,000, in order to establish two more stations. As long as the company are able to maintain their price of 1s. 4d. per 1,000 watts, their business is very profitable, but it is doubtful whether consumers will continue to acquiesce in this price.

GAS ENGINES.—The German company which manufactures gas engines of the Otto type is trying to extend their use in Spain. The company supplies them, together with the means of making some special gas for their working, and estimates that the expenditure of fuel will be 1 kilogramme per horse-power per hour. This seems to show that the gas is not Dowson's gas, which has been used in only one instance in Spain. Anthracite is found in Asturias, which can be easily worked, and gas coke is sold at Cadiz and Xerez at a lower price than that of coal.

TELEPHONE LINES.—Six direct telephone lines are to be laid between Madrid and some of the most distant provincial capitals. It is intended to connect all towns, including even the small ones, by telephone with the nearest telegraph station. At the present time there is great activity in the telegraph department.

NEW YORK, 17TH JANUARY, 1891.

LOCOMOTIVE BUILDING IN 1890.—The locomotive building in the United States by private firms was considerably more in 1890 than in 1889. In 1889, 16 firms built 1,860 locomotives. In 1890, 14 firms built 2,213, and, according to the *American Manufacturer*, several of those who have not yet reported were very busy through the year. It may, therefore, be concluded that the year's product has been materially greater than that of 1888, when 17 firms built 2,180 locomotives. Eleven of the firms that have reported up to date built over 18 per cent. more engines in 1890 than in 1889. All but two of those firms increased their output, and one of the two is the Grant Locomotive Works, which have been practically at a standstill for a good while. The Baldwin Works lead with 953 locomotives, an increase of 14 per cent. The Schenectady Works were the next largest builders, and their increase in output was over 53 per cent. The average yearly product of 19 firms for eight years, 1881-1888, was 1,645 locomotives. It will be seen that the product of each of the last three years has been far above that average.

RAILROAD REPRESENTATIVES' MEETING.—On the 8th inst. a meeting of representatives of all the Western railroads was held here in order to devise some plan for the formation of an advisory board to equalise and maintain rates. A motion was adopted for the appointment of a committee, consisting of one representative from each company, to report as to the bye-laws necessary for the carrying out of the purposes of the association.

RAILROAD IMPROVEMENT.—The third annual report of the Western New York and Pennsylvania Railroad shows a gratifying increase in all branches of the service. The net earnings have increased $311,144·50 over the preceding year, while the percentage of expenses has decreased from 78·3 to 69·4 per cent. In the nine months nearly thirty-one miles of new 67lb. steel rails have been laid, 176,000 ties put in the track, twenty miles of road ballasted, and important bridges renewed with steel, iron, and stone.

IRON AND STEEL WORKERS' WAGES.—Attempts are being made to change the basis of the scale on which the wages of iron and steel workers is based from bar iron to some other specialty which will give more nearly an average condition for the trade. Bar iron has been the basis for a good many years, but is of little moment when compared with iron and steel in other shapes. Either skelp iron or sheet iron has been suggested as fair basis, and a committee of the Amalgamated Association of Iron and Steel Workers are now collecting data by which an intelligent choice can be made.

THE SAULT STE. MARIE CANAL.—Some idea of the importance of this canal may be formed from the following comparative statement of the business passing through it for the seasons of 1890 and 1889:—

	1890.	1889.	Increase.	Per Ct.
Number of lockages	4,970	4,684	286	6
Number of vessels passed	10,557	9,579	978	10
Registered tonnage	8,454,425	7,221,935	1,232,490	17
Tons freight carried	9,041,213	7,516,022	1,525,191	20
Estimated value of freight	$102,214,949	$83,732,527	$18,482,422	22

The vessels passing the canal this year included 7,268 steamers, 2,872 sailing vessels, and 417 unregistered craft.

RAILWAY CONVENTION.—Judge Cooley, Chairman of the Inter-state Commerce Commission, has issued notices for a National Convention of Railroad Commissioners and any State officers charged with the supervision of railroads or railroad interests, to be held in Washington, on March 3rd, 1891. The general subjects for consideration as suggested in the notice are:—Railway legislation, how harmony therein may be attained; uniformity in railway accounting; statistics; apportionment of expense to freight and passenger traffic; safety appliances for railroad cars, and what legislation, if any, should be by Congress; the question of reasonable rates, and the elements to be considered in the determination thereof.

PHILADELPHIA, 16TH JANUARY, 1891.

RAILROAD STRIKE.—As a result of the refusal of the Chicago, Milwaukee, and St. Paul Company to accede to the demands of the station agents and telegraph operators on the line of that system a strike has been determined on, to begin to-day. The Chief of the International Order of Railway Telegraphers has ordered every station agent and telegrapher to send in his resignation. This course was taken by the men in order to protect their bondsmen, who would be liable for resulting damages if there had been a strike without previous notice.

BOBBINS.—The New England spool, bobbin, and shuttle industry seems to be going into the hands of foreign capitalists. The business has been a lucrative one, as the goods are used in all the textile mills. The present movement is supposed to have originated in the concern of Mr. H. J. Norwood, which is one of the largest in the East, having shops in New Bedford, Fall River, Woonsocket, R.I., and in Guilford, Me. Consumers of these articles are becoming interested in the matter, and threaten to establish a joint plant for manufacturing rather than allow a syndicate to dictate prices.

SUGAR.—The effect of the reorganisation of the Sugar Trust was seen in Boston when the properties of the refineries interested in the trust were re-leased to the America Sugar Refining Company, of New Jersey, which succeeds the Trust. The properties transferred in Boston amounted to $2,575,000. Over 160,000 Sugar Trust certificates were held in New England, and in the reorganisation holders of these certificates will be given one share of preferred stock, paying 1 per cent., and one share of common stock, which has averaged 10 per cent. for several years, for each two certificates presented for redemption.

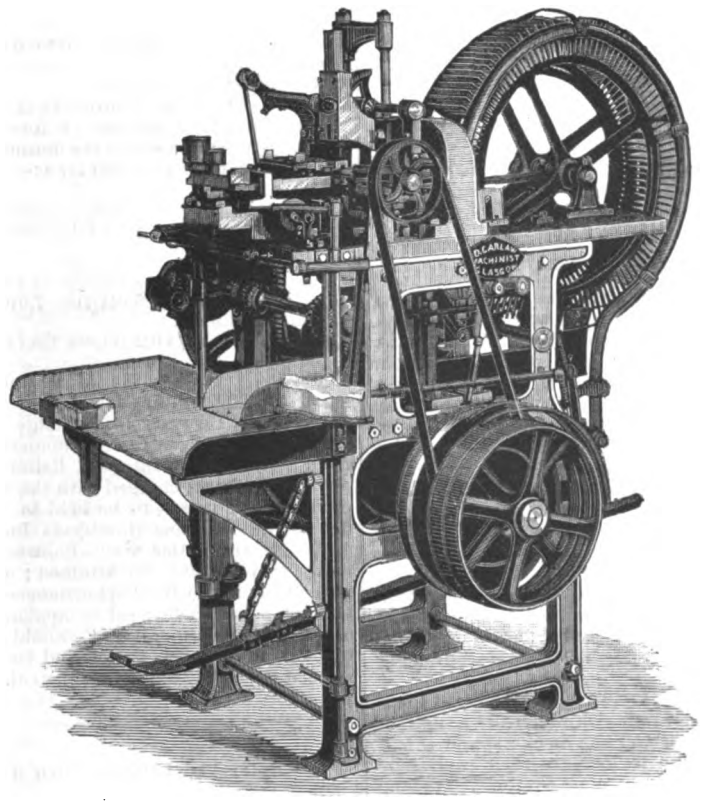
GAS.—The report of the Bureau of Gas for this city for the past year gives as the total receipts $3,659,644·20, an increase of $1,419·37 over the previous year. The expenditure was $2,851,019·51, a decrease of $84,751·84. The total amount of gas made was 3,311,995,000 cubic feet in 1890, as against 3,151,156,000 cubic feet in 1889. The cash profits for the year amounted to $893,376 53, and adding to this $862,810·31 for 575,206,872 cubic feet used by the city departments, at $1·50 per thousand feet, makes the total profit for the year $1,656,186·84, an increase of $128,482·12 over the year 1889.

AMALGAMATION OF STEEL COMPANIES.—The Scranton Steel Company and the Lackawanna Iron and Steel Company's steel mill are to be consolidated, to enable the two companies to compete on better terms with Western mills, as it has been evident for some time that such a combination would be mutually advantageous. The output of the two mills will probably not be affected. An arrangement has been arrived at, and has been recommended at a meeting of the directors to the stockholders as desirable, and now awaits ratification by the stockholders. The output from the Scranton mills is nearly one-sixth of that of the entire company.

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IMPROVED ENVELOPE FOLDING MACHINE.

CONSTRUCTED BY MR. DAVID CARLAW, 56, ROPEWORK LANE, GLASGOW.



IMPROVED ENVELOPE FOLDING MACHINE.

THE above illustration represents a new envelope folding machine, introduced by Mr. David Carlaw, 56, Ropework Lane, Glasgow, which possesses several novel features, including the use of boxed or inside cams, which obviate the necessity for springs in producing the different movements of the mechanism, and thus increase the smoothness of working and durability of the apparatus.

In the course of working the pile of prepared paper blanks is placed on a rest-plate in front of the machine. The blanks are then automatically raised, so that the top of the pile is maintained at a constant level in relation to the gumming and folding mechanism above. The feeding apparatus for accomplishing this may be lowered as requiring for replenishing, by means of a chain and treadle below the table of the machine. The blanks are lifted one by one from the top of the pile by brass picker plates, partially coated with gum. Two of these, making alternate movements, are employed, the required quantity of gum being imparted at each stroke by metal rollers, revolving in gum boxes.

The picker plates deliver the gummed blanks to a sliding carrier, which deposits them under a plunger, where they are creased and the flaps closed, with the exception of the seal flap, which is only partially folded over. At the same time, by means of an ingenious adjustable appliance, the envelopes have any desired amount of bulk, or roundness of the edges, imparted to them. This operation makes the envelopes more convenient for use, and also adds to their strength by lessening the liability to split at the edges.

After folding, the envelopes are transferred to wired divisions on the periphery of a revolving wheel at the rear of the machine, where they are dried by currents of hot or cold air forced through perforators in pipes coiled at the sides of the wheel. On reaching the bottom position of the wheel during its revolution the envelopes are dropped into a race, and gradually advanced to the front table to be banded by the attendant. All the operations, from the placing of the blanks to the receipt of the finished envelopes, are entirely automatic; and a single machine is capable of making from 30,000 to 40,000 envelopes per day.

THE GRAYDON DYNAMITE GUN.

The following interesting description of the Graydon dynamite gun appeared in the *Times* on the 27th inst.:—

The practically resistless energy developed by dynamite and other high explosives has long indicated them to be the best agents for producing a maximum destructive effect when used as bursting charges in shells for artillery fire. The difficulty, however, which has stood in the way of their practical application in this direction has been the great sensitiveness of such compounds to heat and concussion. It is easily conceivable that the blow exerted on the base of the shell by the explosion of the gun charge would cause the explosion of the bursting charge within the shell, which would thus destroy the gun and probably those serving it. This result might also be brought about by the heat generated by friction during the passage of the shell through the gun, which might cause the ignition of the bursting charge. Two things, therefore, have to be done—namely, to protect the charge of explosive so that the shell may not prematurely burst, and to eliminate, or reduce as far as possible, all concussive action at the moment of discharge. These two things have been accomplished by Lieutenant James W. Graydon, late of the United States Navy, in his dynamite shell and his dynamite gun. His shell is lined with asbestos cloth, which is an excellent non-conductor of heat as well as a cushion, and the charge of dynamite contained within the shell is divided up into small pellets or cartridges, each enclosed in a wrapper of waxed paper. These pellets are designed, first, to prevent the nitro-glycerine accumulating at any one point, should it exude from its absorbent; and, secondly, to cushion the charge and to prevent the shock from the propelling charge being transmitted to the dynamite in the shell in such a manner as to explode it.

Such, briefly, is the Graydon shell, which is to be discharged from the Graydon gun by means of highly compressed air, the bursting charge being 600lb. of dynamite, which is intended to be projected three miles in 30 seconds. The shell has already been tried in the United States, but with guns firing ordinary gunpowder. Three series of experiments were made there a year or two ago, the first of which consisted in firing several rounds from a 2·9in. field gun at the Presidio, San Francisco. The second series was carried out at Fort Winfield Scott, where 52 dynamite shells were fired from a 4·5in. siege gun. Later on the third series of experiments was carried out on a large scale at Sandy Hook, before the permanent Ordnance Board of the United States. Amongst others, a 7in. rifled gun was used, firing a 23lb. powder charge, with a 122lb. projectile, charged with 2¾lb. of dynamite. The target was part of an iron turret, 14in. thick, which was practically wrecked by two rounds, a third utterly demolishing it. Satisfactory as this was, there still remained the contingency of the blow on the base of the shell, imparted by the explosion of the gun charge, causing a premature burst in the shell. This point is met, as we have already indicated, by the propulsion of the shell being effected by compressed air in the Graydon gun. The first of these guns has been manufactured in this country by Messrs. Taunton, Delmard, Lane, & Co., of Birmingham, and has just been completed. This gun is to be discharged by the expansion of condensed air at a pressure of 5,000lb. per square inch, the impulse of which is a safer propelling energy than the ignition of any kind of powder, because it does not operate so suddenly as to cause danger of the premature explosion of the missile.

The dynamite gun has a tube or barrel made of Whitworth forged steel, 30ft. in length, and weighing about 11 tons. It is a smooth-bore, breech-loading gun, with a calibre of 15in. It is supported at the breech end on fixed trunnions 15in. in diameter, which are made hollow, for the passage of the compressed air into the gun. Towards the muzzle it is carried on movable trunnions, which engage with two steel arms or levers. These levers have sliding fulcra, and are actuated by a hydraulic plunger for the purpose of elevating or depressing the gun. The breech piece is a steel screw block with interrupted screw threads, as in heavy service ordnance. The gun is mounted on a carriage built of heavy steel plates, with trunnion bearings of cast iron secured to it by turned bolts. The carriage is supported on conical rollers running on a circular roller path. The rollers are geared together, and are actuated by a Heenan and Froude spherical quick-speed engine, the motive power of which is also compressed air. The roller path, which will ultimately be embedded in concrete, is 21ft. in diameter, and is made in sections of cast iron planed on the bearing surfaces. The gun can be trained for an all-round fire to the full circle of 360 deg. A peculiar feature of this gun is that it can be loaded at any degree of elevation within its working range. Pivoted to the breech trunnions is a loading slide or tray for the reception of the projectile or shell, which latter is 6ft. 3in. long, and weighs, with its bursting charge of 600lb. of dynamite, 1,300lb. The true flight of this shell is secured by a tapering, telescopic tail. By this telescopic arrangement Lieutenant Graydon is enabled to shorten the shell 50 per cent., and to reduce proportionately the length of the impulse tube. At all times when the barrel of the gun is elevated above the horizontal line the loading slide is raised by hydraulic pressure to receive the shell from a carrier running on a light tram line. By the opening of a valve the slide is caused to descend with the shell and to become in line with the barrel of the gun. On each side of the barrel is a small, double-acting, hydraulic cylinder, the plungers of which not only control the movements of the loading slide, but also, by their continued action, draw the shell up into the barrel, where it is held. The breech-closing block, which has hitherto been held suspended above the trunnions by counter-weights, then descends, and is also drawn into the breech by the cross-heads of the hydraulic plungers, and locked. The gun is now ready for being discharged.

The arrangements for effecting the propulsion of the shell from the gun consist, first, of a set of compressed-air reservoirs, thirty-two in number. These are 4ft. high and 10in. in diameter, and are made of metal ¾in. thick, tested up to a pressure of four tons per square inch. They are mounted on the gun carriage in four sections of eight each, two sections being placed on either side of the gun. Filled with air compressed to 5,000lb. per square inch, or about 1-340th of its original volume, the capacity of each at the working pressure is 17,000 cubic feet of air, weighing 11 cwt. in its compressed condition. Any number out of the four sections may be discharged, according to the range desired or the weight of the projectile. The discharging valves are a peculiar arrangement of the piston type, and are packed on the hydraulic system. The valves and pipes are of Whitworth steel, either forged or cast. The air is admitted from the reservoirs through the breech trunnions to the base of the shell, and the gun can be loaded, elevated, trained, and discharged by one person, who actuates a simple system of levers. It is stated that, if necessary, the shells can be discharged from the gun at the rate of one per minute.

The abnormally high pressure at which the air is used necessitated, as a matter of course, special apparatus for compressing it. The compressor adopted is one which has been devised by Mr. Lane, a partner in the firm which manufactured the gun. It is a modification of the

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high-pressure apparatus invented by him and used for compressing oxygen, hydrogen, and carbonic acid gas. The air is compressed in four operations, the pistons decreasing in diameter at each stage. The first, which draws the air from the atmosphere, is 12in. in diameter, and the last, which delivers it to the reservoirs on the gun carriage, is 2¼in. in diameter. After each operation the air is cooled by a tubular coil surrounded with water. The air from the compressor is passed to the reservoirs on the gun carriage through a central pivot or swivel tube. The Graydon gun is now ready for trial by the British Government with live shell, but the place of trial has not yet been decided upon. The results of the trials will doubtless be looked for with much interest, as being likely to indicate the direction of a new and important development in warfare.

TRIPLE EXPANSION MILL ENGINE.

Our illustration on page 108 shows a type of triple-expansion engine constructed for driving machinery in mills and factories. The engine is constructed in three different sizes—viz., with cylinders 8in., 13in., and 21in., by 16in. stroke; 10in., 15in., and 25in., by 24in. stroke; or 14in., 22½in., and 37in., by 36in. stroke—and has been designed and constructed by Messrs. Ross & Duncan, Whitefield Works, Glasgow. The design secures economy of space by placing the cylinders overhead, as usual in marine engines. The three cranks are set at equal angles. In the engine we illustrate the condenser is of the ordinary jet type, but where necessary the same general construction can be combined with surface condensation. The air, feed, and injection pumps are worked by levers from the crosshead of the low-pressure engine, and are guided by brackets from the back of the columns. The cylinders are all fitted with indicator gear, and all drain and injection cocks are carried to the front of the engines. The high-pressure cylinder has a throttle-valve regulated by a high-speed governor, and has also Bremme's patent expansion gear to vary the cut-off. The crank-shaft is carried on six bearings, having bushes filled with white metal. The fly-wheel is cast in halves, and is made for belt or rope driving according to requirements. The advantages aimed at in this kind of engine are economy of space and fuel, smooth running, and symmetry of design.

SHIPBUILDING NOTES.

On the 17th inst. the s.s. "Glenisle," built by Messrs. Edward Withy & Co., Hartlepool, for Messrs. Livingston, Conner, & Co., West Hartlepool, was taken to sea for her trial trip. The vessel is built of steel and to the highest class at Lloyd's, and has a very large deadweight carrying capacity. She is fitted with triple-expansion engines by Messrs. T. Richardson & Sons, Hartlepool, with cylinders 20in., 31½in., and 53in., with 36in. stroke, and they have all the latest improvements for economy of fuel and efficiency in working. During the trial trip a mean speed of 11 knots was obtained, and the engines worked with great smoothness.

Messrs. Fleming & Ferguson, shipbuilders and engineers, Paisley, have received an order from the Union Steamship Company, of New Zealand, to build for them a steel screw steamer for their passenger and fruit trade between Fiji and New Zealand. This firm has also received an order for a steel screw yacht from Mr. Peter Coats (of Messrs. S. & P. Coats, Limited), Paisley, to be built to the design of Mr. G. L. Watson, naval architect, Glasgow. Both vessels are to be fitted by the builders with their patent quadruple-expansion engines.

On the 23rd inst. the ss. "Yung Ping," built by Messrs. Craig, Taylor, & Co., of Stockton-on-Tees, to the order of Messrs. Russell & Co., of Shanghai, New York, and London, and under the superintendence of Messrs. A. & W. Dudgeon, of 112, Fenchurch Street, London, was taken out to sea for her trial trip, which proved very satisfactory. The dimensions of the vessel are:—Length, 223ft.; breadth, 32ft.; depth, 13ft. 11½in. She is to trade in Chinese waters, and is fitted with teak decks. She has water ballast, and is classed 100 A1 at Lloyd's. The engines, by Messrs. Wm. Allan & Co, Scotia Engine Works, Sunderland, are 15in., 25in., and 41in., with 24in. stroke, and on the measured mile, after a number of runs, a mean speed of 9·8 knots was easily obtained, the weather at the time being fairly rough. The vessel, which was loaded, proceeded at once to China.

Messrs. Sharp & Kent.—In our account of the work done in electrical engineering during the past year a misstatement occurred which we regret. We should have stated that Messrs. Sharp & Kent supplied the engines, boilers, and "Goolden" dynamos, and the underground mains for the Houses of Parliament. This firm also supplied the boilers and dynamos to the Westminster Company, and have large orders for Brighton and elsewhere.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, January 30th, at 7.30 p.m. Students' meeting. Paper to be read: "The Counterbalancing of Locomotive Engines," by Mr. E. L. Hill.

Royal Institution.—Friday, January 30th, at 9 p.m. Lecture on "The Rejuvenescence of Crystals," by Professor J. W. Judd, F.R.S.

Sanitary Institute.—Friday, January 30th, at 8 p.m. Lecture on "Ventilation, Warming, and Lighting," by Sir Douglas Galton, K.C.B., F.R.S.

Sheffield Society of Engineers.—Saturday, January 31st, at 7.30 p.m. Paper to be read: "Elliott's Smoke Annihilator," by Mr. C. F. Shrewsbury.

NEXT WEEK.

Society of Engineers.—Monday, February 2nd, at 7.30 p.m. Presidential Address by Mr. W. N. Colam.

Society of Chemical Industry.—Monday, February 2nd, at 8 p.m. Paper to be read: "On Standard Sperm Candles," by Mr. W. C. Young.

Royal Institute of British Architects.—Monday, February 2nd, at 7 p.m. Sessional meeting.

North East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne.—Monday, February 2nd, at 7.30 p.m. Discussion on the following papers: "The Unsinkability of Cargo-Carrying Vessels," by Mr. Hök, and "Main Steam Pipes," by Mr. M. Sandison. Paper to be read: "The Influence of the Relative Dimensions and Proportions of the Screw Propeller on the Vessel's Performance," by Mr. A. Blechynden.

Institution of Civil Engineers.—Tuesday, February 3rd, at 8 p.m. Paper to be read: "Electric Mining Machinery," by Messrs. L. B. and C. W. Atkinson, Assoc.M.M.Inst.C.E.

Sanitary Institute.—Tuesday, February 3rd, at 8 p.m. Paper to be read: "Principles of Calculating Areas, Cubic Space, &c.; Interpretation of Plans and Sections to Scale," by Mr. H. Law, M.Inst.C.E.

Owens College Union Engineering Society.—Tuesday, February 3rd, at 7 p.m. Paper to be read: "Stationary Engines," by Mr. A. Saxon.

Society of Arts.—Wednesday, February 4th, at 8 p.m. Paper to be read: "Decimal Coinage, Weights, and Measures," by Mr. J. E. Dowson.

PRICES CURRENT, 28th January, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	5 15 0	6 5 0	f.o.t. wks.
„ Angles	5 10 0	6 0 0	„
„ Plates	5 12 6	6 2 6	„
Staffordshire Bars	6 17 6	7 7 6	London.
„ Angles	7 0 0	7 10 0	„
Crown Sheets	7 5 0	7 15 0	„
„ Hoops	7 0 0	7 10 0	„
"Siemens-Martin" Steel Boiler Plates		8 0 0	„
„ Ship and Girder		7 0 0	„

Market quiet.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3.		42/- Cash.
Scotch Warrants, m/n		47/1½ „
Hematite Warrants, m/n		52/7½ „
Stocks in Stores. Scotch	569,677—Dec. for week	3,175 Tons.
Middlesbro'	122,529—Inc. „	195 „
Hematite	212,710—Inc. „	429 „

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.	
Coltness	... .	...	f.o.b. Glasgow.
Gartsherrie	... .	...	„ „
Langloan	... .	58/6	„ „
Summerlee	69/6	59/6	„ „
Glengarnock	... .	...	„ „
G.M.B. ex Store	47/6	47/3	„ „

METALS.

Spelter: Ordinary	£24	5	0	to	24	10	0
Copper: British Cakes and Ingots	58	10	0	„	59	0	0
„ Chili Bars, G.O.B.'s	58	2	6	„	53	7	6
„ Other sorts, G.M.B.'s (equal to Chili Bars)	53	2	6	„	53	7	6
„ Manufactured (strong)	65	0	0	„	66	0	0
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	90	12	6	„	91	0	0
„ Australian	90	15	0	„	91	5	0
„ English Ingots	94	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: Very steady, and prices unchanged. Demand continues slow, and the amount of business small. Chili bars have fluctuated but slightly of late, quotations to-day being the same as on the 21st—viz., £53 2s. 6d. to £53 7s. 6d. cash, with moderate sales reported. Manufactured quiet at £65 to £66, "strong."

Tin shows a weaker tendency, values having declined during the last few days.

Lead: Dull, with small demand, but values unchanged.

Spelter continues firm, and prices advancing, owing to small supplies.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 4½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 3	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	10 12 6	—	10 15 0
„ Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 10 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 8	—	.....
„ (50/90 %)	„	0 3 7	—	.....
Copper Sulphate	ton	18 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 0 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 9	—	.....
„ White	„	0 3 9	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Epsom Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	5 0 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	11 5 0	—	11 7 6
„ „ „ 60%)	„	10 5 0	—	10 7 6
„ „ (Cream 60%)	„	9 5 0	—	9 5 6
„ Crystals	„	3 0 0	—	.....
„ Bicarbonate	„	7 10 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 1 10	—	.....
Tartar, Cream of	cwt.	4 18 0	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: The values of all articles controlled by the Chemical Union are firmly maintained, and any small re-sale parcels that may be available are only to be obtained at a very slight discount upon Union prices. Caustic soda is rather slow of sale, but its value is not affected. More business is passing in acetates of lime, and prices are firmer. Acetate of soda is scarce on spot. Acetates of lead in fair inquiry. Nitrate of lead dull.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	33 10 0
„ Ceylon	„	28 5 0
Cottonseed	„	18 0 0
Cod	„	23 0 0
Lard	„	34 10 0
Linseed	„	22 0 0
Olive, Spanish	„	43 0 0
Palm, Lagos	„	25 5 0
Rapeseed: English	„	29 5 0
Seal: Pale	„	25 0 0
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	22 0 0
Turpentine	per cwt.	1 9 6
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 6
Spirit	„	0 0 8

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HOME INDUSTRIES.

LONDON, 29th January, 1891.

THE MONEY MARKET.—The abnormally small demand for money keeps rates very low, in spite of a well-maintained outflow of gold, chiefly to Holland. Loans for short periods are in excess of the demand, and those who have balances to lend find it almost impossible to employ them, even below ¾ per cent. Discount rates are also very easy, the fact that three months' Treasury Bills were allotted in the beginning of the week at 1⅛ per cent. giving a fair idea of the condition of the market. Stocks have been inactive and generally dull, the settlement affording a good excuse for a relaxation of even the small amount of "professional" dealing that had been going on. The settlement has been chiefly interesting because of the insight afforded into the state of the account in home railway stocks. The falling off in dividends through the increase in working expenses has induced speculative "bear" selling on a considerable scale, but investors do not seem to have been alarmed into parting with their securities, and stock has been very scarce. The experience has been the same in most departments of the market, but the usual consequence of an oversold account—a revival in prices—has not followed. The more select investment securities are firmer in consequence of the abundance of money and the difficulty of employing it, but other departments are dull in tone.

ACCESS TO THE EMBANKMENT.—A plan has been proposed by Sir J. Whittaker Ellis, M.P., for improving the access to the Embankment, and also for widening the Strand, in order that the traffic over Waterloo Bridge from the South of London may be facilitated. In a letter addressed to the London County Council, he suggests that that portion of Wellington Street lying between the Strand and Waterloo Bridge should be widened on the western side to the frontage of Lancaster Place, and that the roadway of Waterloo Bridge should be thrown out on each side to an equal width by carrying it out in its present form to the water-line of the Embankment. A roadway, say, 60ft. wide, should then be run down parallel with the Embankment itself to the Embankment level. These spurs from the bridge, which would take a gradient of 1 in 33, would take all the traffic going east or west from Waterloo Station and the South of London. They would also be convenient for the relief of the Strand itself east and west. These improvements would afford readier access from the Strand eastwards to the Temple Station, and westwards to Charing Cross along the Embankment.

THE JUNIOR ENGINEERING SOCIETY.—The sixth annual dinner of this flourishing Society was held at the Holborn Restaurant on Friday evening last. Professor S. P. Thompson, B.A., D.Sc., presided. The growth of this Society, which numbers amongst its past and vice-presidents some of our leading engineers, has been exceedingly rapid. At the commencement of the present session the membership roll, including honorary members and associates, numbered 180, as against 88 during the preceding session, showing an increase of more than 100 per cent. We are informed that it is the intention of this Society, at an early date, to further add to its useful features an employment bureau for the use of members disengaged.

THE SANITARY INSTITUTE.—Donations to the amount of £600 have been made to the Institute during the past year by the honorary officers and members of council, and a considerable portion of this amount has been devoted to re-arranging and improving its museum of sanitary appliances, and to the preparation and printing of a catalogue. The museum being open free to the public, want of funds has hitherto prevented the Council from undertaking this work, although they long felt it to be much needed in order to make the teaching of the museum fully available to the public.

BOWMAN'S OXYGEN LIGHTING COMPANY.—This company have stated that they will not proceed any further with their Bill in Parliament for the generation and supply of oxygen to the metropolis. The Bill included powers to lay mains for the supply of oxygen, and to make agreements with the gas companies for the use of oxygen in combination with coal gas, in order to increase its illuminating power.

BUSINESS ANNOUNCEMENT.—The Delta Metal Company, Limited, of 110, Cannon Street, E.C., inform us that they have appointed as secretary Mr. Y. W. Meyjes, who has been connected with that company for several years.

THE WHITECHAPEL CRAFT SCHOOL.—Practical handicraft classes in carving and modelling suited to the needs of wood carvers, cabinet makers, and stonemasons are held on Friday evenings, at 8 p.m., at the Whitechapel Craft School, 27, Little Alie Street, E.

CALENDAR.—A calendar for the year 1891 has been issued by Messrs. Shand, Mason, & Co., Blackfriars Road, London, makers of steam and manual fire engines, which contains a well-executed illustration of a steam fire engine, from a picture by Mr. J. Charlton.

EXHIBITION OF METEOROLOGICAL INSTRUMENTS.—The Council of the Royal Meteorological Society have arranged to hold at 25, Great George Street, Westminster (by permission of the Council of the Institution of Civil Engineers), on March 17th to 20th next, an Exhibition of rain gauges, evaporation gauges, percolation gauges, and kindred instruments. The Exhibition will also include any new meteorological instruments invented or first constructed since last March Intending exhibitors should make application to Mr. W. Marriott, the assistant secretary, 30, Great George Street, S.W., not later than the 10th prox.

MANCHESTER, 29th January, 1891.

THE IRON TRADE.—The general trade in pig iron in this district is very languid, and this has been a very dull month. Although few engineers or ironfounders are short of work there has been no inclination to buy, and except for absolutely necessary purchases little has been done. Prices have consequently drooped, and there is a total lack of firmness in this trade. Bar iron is weaker in tone, and lower prices are ruling. At present prices of fuel and raw material, and with existing rates of wages, the manufacture of bars is much less profitable than it has been for about two years. Although the frost has not been so keenly felt as in some districts, it has had an effect upon trade, and has aided in bringing about the present depression.

THE SHIP CANAL.—The works of this undertaking narrowly escaped flooding again on the 24th instant. A large volume of rain fell in the Mersey and Irwell valleys, and as there was a good deal of snow on the ground the rivers rose rapidly. The only serious damage done, however, was to the brickfield at Lymm, which was for the second time flooded. The flooding in the Medlock led to the backing up of the water into an old sewer and caused a flooding of one of the sections of the new intercepting sewers which are being constructed by the Manchester Corporation.

THE ENGINEERING TRADES.—Employment in the engineering trades is good, the returns from local branches of the trade societies showing that only about 2 per cent. of their members are out of employment. In millwrighting work there is plenty of employment, and the same remark may be made of boiler-making, tool-making, and locomotive works. In cotton machinery extreme activity prevails, and this department continues to be actively employed. Improvements are being made in preparing machinery, both Messrs. Platt Bros. & Co., Limited, and Messrs. Asa Lees & Co., Limited, being engaged in introducing improved opening machinery with a view of getting more even laps.

THE LINEN AND JUTE TRADES.—There has been a steady movement during the week, the setting in of mild weather having stimulated business considerably in several departments. There is no perceptible weakness in prices of linen goods, manufacturers, both of low and better class makes, being firmly resolved to maintain prices at their present level. Spinners also preserve an attitude of firmness, and there appears to be little prospect of goods becoming cheaper just yet. Drills for export are slow of sale. Light damasks for the home trade meet with inquiry. The shipping trade is still quiet, both on South American and United States and Canadian account. There is no fresh news from Chili, and local shippers are now awaiting the arrival of the mails, as all hope of obtaining reliable news through the medium of the cable has been abandoned. Further failures in Canada tend to increase the gloom caused by recent events, and commercial enterprise is kept within very limited bounds, owing to the prevalent uncertainty.

BRONZE ALLOYS.—A company was registered on the 12th inst. to acquire an invention of Mr. Joseph Elton Bott, for improvements in the manufacture of bronze alloys, and to carry on the business of iron and steel founders, engineers, and boiler makers. The works will be at Openshaw.

GLASGOW, 29th January, 1891.

THE SCOTTISH RAILWAYS.—The Bill of the North British Railway Company for the acquisition of the Glasgow and South-Western Railway has been found to comply with the standing orders of the House of Commons, and will shortly come up for discussion. Sir John Burns, of the Cunard Line, who announces himself and his family as the holders of £80,000 of stock in the Glasgow and South-Western Company, has written a circular to his fellow-shareholders, protesting against the sale of the line to the North British Railway. Besides this, it is rumoured that the Bill will be received with opposition on all sides. Whatever may be the public opinion upon the conduct of the strikers, and whatever may be the relevancy of that topic to a discussion of the merits of the Bill, the North British Company has undoubtedly done much to revive the adverse feeling which existed against it in the public mind a few years ago. Such feelings had been almost obliterated by admiration for its energy and enterprise, especially in connection with the construction of the Forth Bridge and the reconstruction of the Tay Bridge.—The Caledonian Bill for the acquisition of the Glasgow and South-Western Railway by that company has been withdrawn. This is said to indicate an attempt at agreement between the companies, and a probable re-arrangement, especially as regards the Edinburgh and Glasgow traffic. At present the two railways share in the receipts in the proportions of two-thirds to the North British and one-third to the Caledonian.

THE RAILWAY STRIKE.—The Scottish railway strike is now in its sixth week. The men of the Glasgow and South-Western Railway returned to their work some weeks ago, and the Caledonian men have now almost all returned; but the North British Railway Company is still in difficulties with its men. The latest phase of the struggle, which even yet shows no definite sign of ending, is the institution of a civil action by the North British Railway Company against the executive of the men's union. The company demands £20,000 damages for injury to its business caused by the action of the executive. In addition to bringing this action the company also employed a process of law in Scotland called "diligence," which is now rarely resorted to, and seized by arrestment the effects of each of the members of the committee of the men. The company has succeeded in attaching a sum of about £3,000 of strike funds. These funds had been received by the committee from day to day from other trade unions and from the general public. The affair is a new development in the recent history of trade unionism, and has caused considerable excitement in Scotland.

STATE OF TRAFFIC.—Traffic has considerably improved. The mineral service still suffers considerably, and on some of the lines reduced services of passenger trains are being carried on. Although the worst period of the strike is now felt to be at an end, there is still a large number of men out, and their places are filled by inexperienced men. This fact must still give rise to anxiety.

THE ACCIDENT AT THE CORPORATION GAS WORKS.—Sir William Arrol and Messrs. George Livesey, Charles Hunt, and Andrew Gillespie were asked to report upon the cause of the recent explosion of two gas-holders at Maryhill. They have reported to the effect that they "found indications of some explosive material having been placed on the crown" of one of the holders, that the explosion penetrated inwards, and that the concussion was sufficient to rupture the plates of the second holder, which was also destroyed. They also report that the gas simply burned away without causing any damage either to the remainder of the works or to the neighbourhood, The authorities have offered a reward of £1,000 for the discovery of the perpetrators of the outrage. An independent report will be submitted by Colonel Ford and M. Dupré to the Home Office. It will be remembered that this is the second time that such an outrage has happened in Glasgow. One of the gas-holders at the Tradeston works of the Corporation was destroyed in 1883 by precisely similar means. In that case the deed was traced to a Fenian conspiracy.

CHEMICAL INDUSTRY.—Steps are being taken towards forming a Chemical Section in connection with the Glasgow Chamber of Commerce similar to those which exist in the London and Manchester Chambers. Its object would be to look after the interests of the chemical and allied trades of the West of Scotland, and to advise as to legislation towards enabling them to compete with foreign nations under fairer conditions than at present exist.

(From our own Correspondents.)

LIVERPOOL, 28th January, 1891.

THE LIVERPOOL ENGINEERING SOCIETY.—A large number of the members of this Society met on the 21st inst., at the Highfield Street Station of the Liverpool Electric Supply Company, and were conducted over the works by Mr. A. B. Holmes, M.Inst.C.E., one of the engineers to the company. An inspection was made of the whole of the machinery, meters, and testing apparatus, and the members afterwards adjourned to the Royal Institution, when Mr. Holmes read a paper upon what they had seen. To illustrate the growth of the company's operations, he mentioned that in January, 1888, the number of 16-candle lamps connected with the company's stations was 997; in January, 1891, the number had risen to 11,750. The company have now three stations, having a total capacity of 15,500 lamps, and capable of extension to 37,000 lamps. The system adopted was a direct current continuous supply, at a pressure of 110 volts, all the mains being in simple parallel. The accumulators are made by the Electric Construction Association and by the Crompton-Howell Electric Supply Company, and have a storage capacity of 1,700 ampere hours at ordinary rates of discharge. The largest feeding mains were composed of ninety-one No. 7 wires, having a sectional area of 1·51 square inches. The total length of single cable laid in the mains was 41 miles; there were 10 miles of feeding mains, 9 miles of distributing mains, and 1¼ mile of service line. The weight of copper in the mains was 210 tons.

THE MERSEY TUNNEL EXTENSION.—An opportunity was afforded, on the 23rd inst., for a party of local engineers and others to inspect the extension of the Mersey Railway from the James Street Station to the Central Station at the bottom of Bold Street. The tunnel is now practically completed, and the permanent way is laid and ballasted down Lord Street. The station which is underneath the Central Station is far advanced, and operations have been going on underneath to within a foot of the rails of the Cheshire Lines Railway, this part of the work being very difficult, and attended with considerable risk in consequence. The line to Bold Street will be open for traffic towards the end of June next. The work is being carried out by Messrs. Waddel & Son Mr. Francis Fox being the chairman and engineer of the company.

LEEDS, 28th January, 1891.

THE IRON AND STEEL TRADES.—Compared with the opening of 1890, the past fortnight has been quiet, though the feeling with regard to the iron and steel trades is perhaps steadier than was the case even a week ago. The quietness of the shipping trade is being felt, but some of

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the large firms are in the position of being able to give their workmen employment in other directions. A fairly large quantity of material is being turned out at the steel rolling mills. The Leeds Forge Co. continue very active, much business being done in steel bogie frames, both on home and foreign account. With reference to the engineering shops, a large number of tank locomotives are in course of construction, while contracts for the larger class of railway engines are as yet by no means exhausted. It is reported that large contracts for locomotives for foreign railways will shortly be offered, and if there should be truth in the rumour local engineers will expect to receive some of them for Leeds. The shops where specialties are manufactured seem to be still well occupied, and employers generally can keep their hands on full time.

THE COAL TRADE.—During a greater part of the last two weeks the coal trade was disorganised owing to the waterways of West Yorkshire being frozen. In Leeds householders particularly suffered from the severe frost, in that they had difficulty in obtaining coal for domestic purposes. At the time of writing, however, matters have assumed their normal condition, prices remaining firm. The recent bad weather was not taken advantage of for the increasing of quotations.

SHEFFIELD, 28TH JANUARY, 1891.

IRON AND STEEL.—A large amount of trade continues to be exported from this district, and although some of the large contractors are becoming anxious at the cessation of inquiries for new work, there is at present no cause for alarm. There are a few good orders for crank-shafts of cruisers and gunboats to be built or re-engined under the new naval programme. These are all forged under hydraulic pressure from special ingots of Siemens steel, and, however well forged they may be, a good deal of heavy machining has to be done in the shops. Almost all marine cranks under 16in. diameter are now forged solid, both for triple-expansion and for compound engines. The marine engineering trades are rather quiet just now, and little work of a special character is being done here. Some very fine gun forgings are being sent out rough machined, both for the home and for foreign Governments.

RAILWAY MATERIAL.—Manufacturers of rolling stock and railway material generally are fully employed. The last three years have been very prosperous, the machinery of some firms having run night and day during the whole of this period. There is, however, a bad time coming, as the producing power is now largely in excess of the requirements. The Manchester, Sheffield, and Lincolnshire Railway Company are pushing on with their Beighton extension, and have already completed the heavier portions of the cuttings.

NORTH STAFFORDSHIRE, 28TH JANUARY, 1891.

THE IRON TRADE.—Prices of pig iron and the finished material show a weaker tendency, and in some cases are now actually below the cost of production. Forge pig iron realises from 42s. 6d. to 45s. at makers' works, according to quality. Bars are quoted at £6 to £6 5s. per ton delivered at Liverpool. The outlook is also discouraging, orders and specifications being scarce, and competition very severe.

CHATTERLEY COLLIERIES.—The prospectus of the Chatterley-Whitfield Collieries, Limited, has been issued this week. The company has been formed with a capital of £400,000, and a debenture issue of £200,000, to take over the business of the Chatterley Iron Company, which has for many years been in liquidation. The profits for the year 1890 are certified as having amounted to £52,977.

BIRMINGHAM, JANUARY 28TH, 1891.

THE IRON TRADE.—Business generally in iron and iron goods is quiet, though there is a slightly better tone in the hardware stamping trades and hollow ware trades. Bicycle manufacturers are busy, and they keep the makers of light stamped forgings in full work. Bridge builders in the Dudley and Wednesbury districts have not much on hand, but boiler makers are busy, as also are tube works of all kinds. Edge tool makers and manufacturers of spades, shovels, and anvils find a better demand.

ADMIRALTY CONTRACT.—The Admiralty contract for bar iron has been placed with the Butterley Iron Company, Derbyshire. It has been executed by the New British Iron Company, Cradley, during the last seven years, and the 14,000 or 15,000 tons supplied in that time have given great satisfaction at the Government Dockyards. The iron for these contracts is all tested at the works of the contractors, both for tensile test and smithing qualities.

LEICESTER, 28TH JANUARY, 1891.

WOOL SPINNING AND YARN TRADES.—The amount of business doing in the local wool market has been steadily increasing, especially in the best kinds of English wools. There has been no further advance in prices, but the market is very firm at current rates. There is no speculative business, and consumers are awaiting the results of the London sales of this week. Skin wools sell freely, and lustres and demi-lustres are more inquired for. Good hog and half-hog fleeces make 23s. to 24s. per tod; superior, 24s. to 26s. per tod; choice lots, 26s. to 27s. per tod. Spinners are a little better employed than they have been, but the advance in the price of wool has lately prevented their accepting contracts at the low current quotations. There is a decided increase in the amount of business on offer, and, in the face of this, spinners are trying for better prices. Cashmere yarns are in good demand.

HOSIERY TRADE.—This industry is in a very healthy condition. There is a large business in most departments of plain hosiery. The long-continued cold weather has almost cleared stocks of underwear, and the glove and heavy hose departments have shared in the good business done. The prospects for both home and shipping trade are very encouraging. The fancy department is beginning to exhibit signs of increased activity, and sampling is very brisk. There is rather a general complaint that prices are very low, and the profit margin narrow.

SWANSEA, 28TH JANUARY, 1891.

INDUSTRIAL INCIDENTS OF THE FROST.—Llanelly, which throughout the frost has been well supplied with water, was seriously inconvenienced on the 24th inst. owing to the total cessation of the supply. Fearing an overflow over the damaged waste water weir of the Cwmlleidi reservoir, the repairs to which had been interrupted by the appearance of the frost, the flood-gates and the sluices were opened to lower the level and the water run into the river, with the effect that operations were brought to a standstill in the majority of works in the tinplate town. The frost has also caused serious inconvenience at the Dowlais Works, where, in the cogging mills, nearly forty hydraulic and pressure pipes burst during the recent severe weather. The mills had of necessity to be closed until repairs were effected.

STRIKES AVERTED.—Mr. Mannesmann has granted an advance of 2s. per week to all the smiths at his tube works after a conference with the officials of the Amalgamated Society of Engineers, the Dockers, and the Welsh Artisans' Unions.—The "flux" dispute at the Duffryn Tinplate Works has been amicably settled, the men having returned to work in accordance with the terms of a resolution of their union executive.

THE ELECTRIC LIGHT.—The directors of the Gwendraeth Tinplate Works have decided to adopt the electric light, and the installation is in a forward state.

CARDIFF, 28TH JANUARY, 1891.

IRON AND STEEL.—The new Plymouth Collieries Company, Limited, may possibly revert to the manufacture of Welsh bars or Bessemer steel, but the distance from the seaboard, where most of the large steel and iron makers are looking for prospective sites, makes such a course improbable. The manufacturing trade is in an unsatisfactory condition. While the price of tinplate bars, as well as steel rails, is decreasing, foreign ore is advancing, and even at high figures good ore is difficult to obtain. Some contracts for Bilbao ore have been entered into for shipment over the year at higher prices than were recorded at the top of the boom a year ago.

COAL MARKET.—The steam coal market continues active, and prices show little change. No. 1 quality is quoted at 15s. 6d. to 16s.; No. 2, 14s. 3d. to 15s. 3d.; No. 3 13s. 6d. to 13s. 9d.; and No. 4, 13s. to 13s. 3d.

BARROW-IN-FURNESS, 28TH JANUARY, 1891.

HEMATITE.—The business done during the week has been comparatively small. Orders have not been offered on a large scale, and the work in hand will not probably extend over more than three or four months. But the consumption of Bessemer pig iron has been lessened by reason of the fact that steel makers are not using so much as they were, and when this is coupled with the paucity of the general demand, and the fact that stocks have been gradually increasing of late, the wisdom of the action of makers in reducing the output of pig iron is at once demonstrated. Five furnaces have been blown out during this month—one at the West Cumberland Works at Workington, one at the Solway Works at Maryport, and three at the Moss Bay Iron and Steel Works, where also the steel-producing plant has been indefinitely brought to a standstill in consequence of the inability of Mr. Peet, the official liquidator, to make iron at a profit, and the indisposition of the men to accept lower wages. There are now forty-five furnaces in blast, and at this time last year fifty-six were producing iron. Prices are easier, at 53s. for warrant iron, net cash, and 53s. 6d. to 54s. for parcels of mixed Bessemer numbers, net f.o.b. Makers say it is impossible, with iron ore at 11s. 6d. and coke at 21s. to 22s. per ton, to sell iron at lower prices than those they quote.

STEEL.—Makers are well employed in most departments, and have orders in hand which will keep them busy for some three or four months to come, both in the rail and in the general departments of trade. Prices are not materially changed, except so far as regards tinplate bars, which are quoted at £5 per ton.

TUBULAR FRAME WAGGONS.—It is very probable that next week a new company will take possession of large works at Barrow, with a view of commencing the building of tubular frame waggons on the American freight car principle at Barrow.

MIDDLESBROUGH, 28TH JANUARY, 1891.

PIG IRON.—The tone of the market yesterday was rather better. No. 3 G.M.B. was inquired for at 42s. 3d., but sellers asked 42s. 6d., so there was not much business actually done. Inquiries for forward delivery are beginning to be more numerous, which is a healthy sign. For delivery over the first quarter 42s. 9d. was offered. In warrants Middlesbrough are quoted at from 42s. 1¼d. to 42s. 3d. Hematite East Coast brands are quoted at 55s. per ton mixed numbers makers' iron, and West Coast at from 52s. 10¼d. to 53s. cash. The stock in Connal's store is still increasing, standing at 122,407 tons on the 26th inst., being an increase since the beginning of the month of 6,520 tons.

SHIPMENTS OF PIG IRON.—These are improving, but mainly on account of the heavy shipments to Scotland. Up to the 26th inst. the shipments for the month amounted to 37,333 tons, 18,028 of which went to Scotland, against 7,615 over similar period last year. The continued frost has lessened the Continental demand for the present.

MANUFACTURED IRON AND STEEL.—There are more inquiries and a better feeling. Prices remain much the same. Iron ship plates, £5 15s.; angles, £5 10s. 6d.; bars, £5 15s. per ton; steel ship plates, £6 5s.; angles, £6 5s.; rails (heavy), £4 17s. 6d. per ton, all less the usual discount f.o.t. at works. The average net selling price per ton of manufactured iron for the last two months of the year, as certified by the Arbitration Board's accountant, was £5 19s. 9d. per ton. Rails sold during that period at £5 15s. 10·03d., plates at £5 18s. 10·87d., bars at £6 2s. 8·24d., angles at £5 15s. 7·68d. per ton.

NEWCASTLE, 28TH JANUARY, 1891.

IRON AND STEEL.—In the finished iron trade, though prices have receded to the point at which they stood six months ago, a tone of firmness now exists, and there appears to be little likelihood of any further depreciation of values taking place during the first quarter of the year. The manufacture of steel plates will soon be commenced at Gateshead by Messrs. Ibbotson Bros., of Sheffield, and at Newburn by Messrs. John Spencer & Sons, who are now rapidly completing extensive mills for the purpose. The Consett and Jarrow Steel Works are very busy.

THE COAL TRADE.—The shipment of coal and coke at Tyne Dock during the week ending the 24th inst. amounted to 108,761 tons, being an increase of 6,417 tons as compared with the shipments in the corresponding week last year.

ENGINEERING.—The pressure of work at the St. Peter's establishment of Messrs. Hawthorn, Leslie, & Co. shows an increase, and if the firm had not an extensive range of shops at Forth Banks, to which they can send some of the subsidiary parts of engines to be machined and fitted, they would scarcely be able to make the necessary progress with their many important contracts. The firm are also utilising the resources of the Forth Banks boiler works—where only locomotive boilers are usually dealt with—for the execution of part of the marine work, and two marine boilers of large size are now in course of construction at the latter place. On the whole, the firm are perhaps better supplied with engineering work than any other in the district. Messrs. Tangye & Co., of Birmingham, have just supplied through their Newcastle agency two 30in. centrifugal pumps to Messrs. John Readhead & Co., South Shields. These pumps, which are to be used in connection with the working of a large graving dock in the vicinity of Messrs. Readhead's shipbuilding yard, will be among the largest and most powerful in the district.

ELECTRIC LIGHTING OF WYNYARD.—One of the largest private house electric light installations in England will be that at Wynyard, Lord Londonderry's country seat in Durham, the contract for which has recently been given to Messrs. Drake & Gorham. It will comprise 753 incandescent lamps, together with a steam power electric generating plant of large dimensions. Mr. A. A. Campbell Swinton has been appointed consulting engineer to superintend the work on Lord Londonderry's behalf.

DUNDEE, 28TH JANUARY, 1891.

JUTE AND FLAX TRADES.—There is little change in the industries of this district. Cable advices from Calcutta state that loose and baled jute are in active demand and prices firmer. In New York, burlaps, 40in. 10¼oz, are quoted at 4 1/16c. per yard, and light weights at 4 9/16c. The demand in the American market has considerably improved during the last few weeks. A good business has been done here in raw jute, and prices have advanced from 15s. to 20s. from the lowest point. The jute yarn market is quiet, and the improved demand for jute goods has scarcely been maintained here. In flax few transactions are reported. Holders are asking firm prices, and spinners, being well supplied for immediate wants, are not disposed to offer. Prices of flax yarns are low, and there is a fair business.

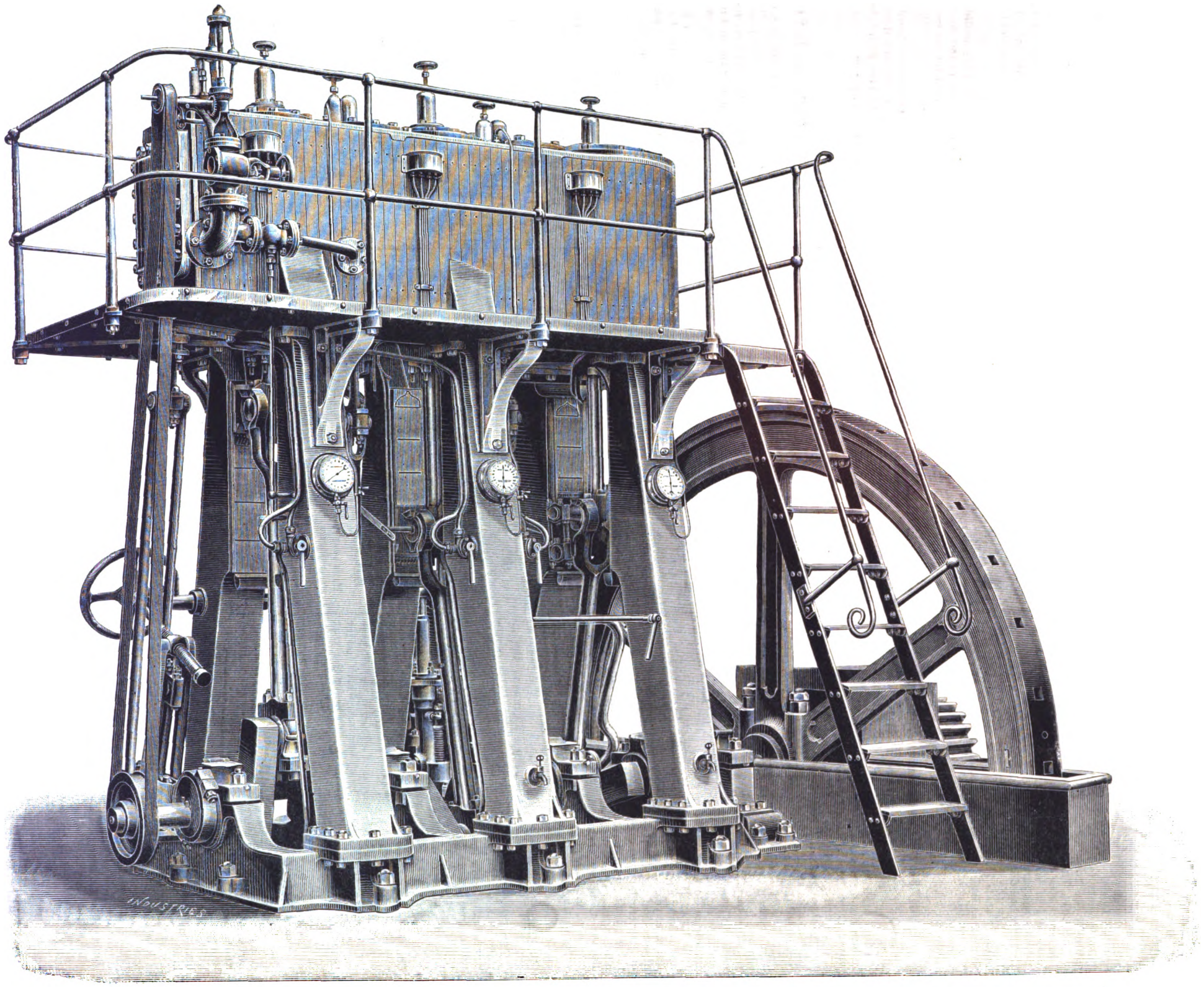
APPOINTMENT.—Mr. T. Claxton Fidler, M.Inst.C.E., London, has been appointed to the Chair of Engineering in University College, Dundee, rendered vacant by the election of Professor Ewing to the chair formerly held by Professor Stuart in Cambridge University.

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TRIPLE EXPANSION MILL ENGINE.

CONSTRUCTED BY MESSRS. ROSS & DUNCAN, WHITEFIELD WORKS, GLASGOW.

(*For description see page* 105.)



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Advertisements intended for insertion in the current week's issue should reach our London Offices not later than the afternoon mail delivery on Thursday. Scale of charges for displayed advertisements on cover and inside pages will be forwarded on application. Orders for single advertisements must be accompanied by payment in order to insure insertion, the charge for which is 2s. 6d. for the first four lines or under, and 8d. for each additional line. Situation advertisements (Vacant or Wanted) 1s. for two lines or under, and 6d. for each additional line—which averages eight words. While all practical regularity in the insertion of serial advertisements will be observed, it can only be absolutely guaranteed in the case of those ordered to appear weekly.

As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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358, Strand, London, W C.
70, Market-street, Manchester.
93, Hope-street, Glasgow.

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(Mr. G. N. Hennessey is Sole Agent for Ireland.)

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 30TH JANUARY, 1891.

PRIVATE BILL LEGISLATION.

THE subject of private Bill legislation has for a good many years been frequently discussed, especially in Scotland, and the name of the late Mr. Craig Sellar is prominently identified with the question. Mr. Sellar and those who acted with him thought it was a great hardship that when Scotch corporations or private individuals wished to carry out any engineering work, or do anything which required the permission of Parliament, they were compelled at great expense to journey to London and bring all their witnesses with them. Mr. Sellar several times introduced a Bill for having the investigations carried on in the localities concerned. Vested interests in this matter are generally very strong, and the progress made was slow. Three years ago, however, a Joint Select Committee was appointed by the two Houses of Parliament to inquire into the matter, and to report how far, and in what manner, without prejudice to the public interest, the present system might be modified with a view to the benefit of suitors, the economy of the time of Parliament, and the reduction of costs and charges. The Committee reported in favour of the devolution upon a Commission of the duties relating to private Bills, which at present are performed by Committees of the two Houses. The Government has introduced a Bill founded on that Report, as regards the nature of the Commission, the local inquiry which it is to hold, the relation in which it stands to Parliament, and the measure of control which Parliament will retain over private Bill legislation. The Bill at present before Parliament relates only to Scotland, and as it has passed its second reading by a majority of 64, and is to be pushed forward with all the influence of the Government, it may be well to consider some of the arguments which have been put forward in its favour, and also some of the objections to it.

We suppose that the reason why the Bill has been confined in its operations to Scotland is that the subject has excited more attention in Scotland than in other parts of the kingdom, but we are of opinion that this is not a good principle on which to arrange the legislation of the country, as it places in the hands of energetic agitators an amount of influence which they ought not to possess. The Government of the day should arrange its legislation strictly according to the wants of the country, and should as far as possible make its measures, at least all those of a general kind, applicable to the whole country. In the matter of private Bill legislation, it is difficult to see that what is good for Scotland should not at the same time be good for England and Ireland. The Report of the Committee stated that the convenience of suitors had pointed strongly towards local inquiry as being the best method of informing Parliament of the facts relating to such questions as are dealt with by private Bills. The Lord Advocate, who introduced the measure, while praising highly the ability and attention of Parliamentary Committees, pointed out some of the weaknesses of the present system, and indicated his preference for such a body as the Railway Commissioners. It was therefore proposed that the Commission should consist of a Judge of the Court of Session, a Railway Commissioner, a Member of Parliament, and a fourth to be appointed by the Court of Session. The decisions of this Commission are to be by no means absolute, but only to take the places of those of the Parliamentary Committees of the two Houses—that is to say, that the House of Commons should reserve its judgment on the scheme on the second reading, and should deal with the report of the Commission on the third reading, as it had hitherto been in the habit of dealing with the report of the Committees of the House. The Commission was to perform its duties in the following manner:—First, it would sit in the locality; secondly, it would sit out of as well as during the Parliamentary session; and thirdly, it would sit *de die in diem*.

The question for the public, especially that part of it connected with engineering and industry, to consider is whether this measure will make arrangements which are preferable to those at present in existence. Mr. Littler, Q.C., is strongly of opinion that it will not. It may, perhaps, be urged that he is an interested party, but he points out that he and men like him are likely to benefit pecuniarily by the operations of the Bill, for no one supposes that Scotch suitors will not—at all events for some years to come—seek the benefit, like all other suitors, of technical knowledge and experience, and, if so, they will have to pay considerably more, as election petition business proves, for making the inquiry a local one. As to distance, Mr. Littler considers that Glasgow is practically nearer to London than many English towns, so that it is absurd to treat Scotland exceptionally. The Bill proposes that the business should begin, as now, in Parliament, and, if it is unopposed, should be concluded there. At present, if there is opposition, counsel, engineers, chemists, and other witnesses are, as a rule, on the spot. The present tribunal, according to Mr. Littler, costs nothing, except the outrageous fees which the Houses themselves extort from the unhappy suitor. He thinks, however, that the proposed Commission will be far more costly, and he estimates its expense at £10,000 a year, while the expense to the suitors will be increased. He suggests that the present method might be much cheapened by abolishing House fees and keeping big deputations at home. In his opinion the Bill is worse than useless, for it is mischievous, and its only friends, so far as he can learn, are some busybodies from the Royal burghs and some briefless advocates in Edinburgh.

This may seem rather strong language, but it has been endorsed by experienced men in Scotland. Mr. Henry Lamond, who has had much experience in dealing with Scotch Parliamentary work, thinks that those persons who are urging the Government to pass this measure have not correctly diagnosed the causes of the expense and delays in private Bill legislation of which they complain, and therefore are not well fitted to suggest remedies. In addition to other objections, he points out that when the Bill is reported to the House, and the promoters are not satisfied, they may then appeal to the House, which, under the Bill, is to have all its control reserved. The House will be deluged with printed statements, and probably with garbled extracts from the evidence. These considerations show that Mr. Campbell-Bannerman had at least some justification for the amendment he moved—namely, "That the subjects dealt with in private Bill legislation ought not to be committed for inquiry to a Committee until it has been shown that it is

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impracticable to remedy the evils now complained of by amending the present system of inquiry by Parliament, and by extending the powers of municipal authorities in counties and burghs." He pointed out that the private Bill business which came before Parliament might be referred to two classes. First, there were the schemes and proposals of municipal authorities for the introduction of water, for gas works, for extension of harbours, for widening streets, or for any other municipal purpose for the benefit of health and convenience of citizens, but such measures constituted only a quarter of the mass of private business. The other three-fourths were made up of the ambitious proposals of the important railway and canal companies. It was a remarkable fact, he said, that the parties concerned in these three-fourths were satisfied with the present methods, and he was of opinion that the other cases need not come to Parliament at all, if we only had the courage to give local authorities power in the matter. Railway Bills came upon a totally different ground. They were promoted by wealthy companies in rivalry with each other. The large expenditure of money which was incurred for that purpose by the railway companies was chiefly a matter for the shareholders, although the public were more or less directly concerned. Mr. Campbell-Bannerman believed that the railway companies were satisfied in their minds that the expense of having an inquiry locally would be greater than the expense of having the inquiry in London—that the expense of taking expert witnesses down to Scotland would be greater than the expense of bringing ordinary witnesses up to London, and that, therefore, nothing would be gained.

The whole question is one involving many aspects, and, therefore, deserving of very careful consideration. No doubt many of our readers have had experience of the present arrangements, and we should be glad to have their opinions regarding them, and also suggestions for their improvement, or for alternative arrangements.

ELECTRICAL SECTION OF THE LONDON CHAMBER OF COMMERCE.

A MEETING of this section was held on the 26th inst., when several matters of considerable importance were discussed. Great dissatisfaction is felt in electric lighting circles at the action of the Board of Trade in the matter of what are known as the "telephone clauses" in Provisional Orders. The position, as we understand it, is this: In 1889 a clause was agreed upon by the telephone and electric light representatives, or was arrived at in Committee. In 1890, however, when the Birkenhead Bill was in Committee, a clause was put in, and notice was sent round to various solicitors and parliamentary agents interested that it would be adopted. The clause was fought in Committee, but what form it finally took in the Birkenhead order matters little. In December of last year the Board of Trade communicated to those concerned on both sides its intention of inserting a new clause, which has been asked for by neither the telephone nor the electric light companies. The question is of great consequence. First, as to existing telephones with "earth returns," it is generally conceded by the electric light companies that they should either render their mains innocuous, or they should provide the telephone companies with metal return wires at their own expense. The difficulty is, however, chiefly with future telephone circuits. The electric light companies may lay mains which interfere with no existing telephone circuits, and then new telephone circuits may be erected, which will be disturbed. The electric light companies argue that the telephone companies should protect themselves by using insulated returns for such circuits. The telephone companies reply, however, that that would mean altering their whole system as soon as any such new circuits were required, for their switch boards and connections are designed for earth returns, and cannot be adapted to insulated returns without considerable alteration and great expense. Moreover, in London, the Telephone Company has no statutory powers enabling it to pull up streets, and doubling the number of overhead wires would not be tolerated. It was proposed by Colonel Jackson that Mr. Morse, who is solicitor for several electric light companies—though he attended the meeting merely as a member—should meet Mr. Winterbotham, solicitor to the Telephone Company, and discuss the matter in conjunction with Colonel Jackson and Mr. Garcke.

A report from the Sub-Committee on Overhead Wires was read. The Electrical Section are trying to induce the Board of Trade to reconsider their rules relative to overhead wires, chiefly as regards suspension and insulation of the smaller sizes of leads. Electric light engineers consider the suspensions and insulation to be prohibitive as regards expense, and to be unnecessary. The Section resolved to print and circulate the report of the Sub-Committee.

More than half the agenda referred to difficulties with the Board of Trade, and there is a very strong feeling in this matter. The Electrical Section holds that questions of telephone clauses, electrical standards, and overhead wires are commercial matters which concern the electrical engineering trades. The Board of Trade, on the other hand, ignores, as far as possible, the existence of the Chamber of Commerce, and, when in doubt, has recourse to the Council of the Institution of Electrical Engineers instead. Undoubtedly this Institution contains among its members nearly all the leading electric light engineers in the country, and is therefore a thoroughly representative body, but the Council is not in any way representative, and really contains only a small percentage of men versed in such questions. Though the members of the Council do their best for their Institution, and have its interests at heart, they have, we believe, little idea how much they are at variance with the general body of the Institution. The Electrical Section, therefore, object very strongly to such questions being referred to the Council of the Institution. Whether the Board of Trade consults the Council of the Institution, a general committee of the Institution, a committee of the Chamber, or the engineers of one or two of the largest electric light companies is really of little or no importance. All that is required is that an even hand should be held between the public, whose safety must be secured, and the electrical industry, which should not be saddled with needless difficulties.

The next question considered was the electrical standards of the Board of Trade. The Electrical Section asked that makers and users of instruments should be represented. The Board of Trade replied that it would avail itself of the evidence of makers and users if needed, but they were not required on the Committee. Of course, a great deal depends on what the Committee is to settle. If it is to decide whether the standards are to be taken from particular resistance coils and from Clark cells, or by deposition of copper or silver, the matter is not one of very much commercial importance. It would be preferable, however, other things being equal, that methods should be employed which are convenient in commercial use. Above all, it is important that the Board of Trade or legal volt and ohm should not vary from day to day. That is of much more consequence than scientific accuracy of definition or exact agreement with the most accurate determination of the standards. Under the supervision of the technical adviser it is not likely that there will be any such inaccuracy, but it is most important that the public should feel absolute confidence in the work of the standardising laboratory. There is no difficulty in working with standard resistances, in conjunction with either Clark's cells or voltameters, to a much greater degree of accuracy than commercial instruments admit; but, in spite of the ease of working accurately, calibration of instruments has been treated as a sort of mystery, and each maker still thinks that he alone can work within 1 per cent. Dr. Fleming, to whose energy the standardising laboratory is chiefly due, is conspicuous by his absence from the Committee.

Two electrical exhibitions were proposed, but the feeling of the Section was strongly against further exhibitions just now. With the Frankfort Exhibition and another at Chicago afterwards, and the Edinburgh display just over, electrical engineers, we think, feel that they have had enough of exhibitions for the present.

THE PROPOSED INDIARUBBER "RING."

WE agree with a daily contemporary that there is no great danger of an indiarubber "ring" for some time to come. We can quite understand the excitement in certain minds over the enormous consumption of rubber in different branches of engineering and manufacturing, as compared with the supply of the new material. But things are not as they were in 1883, when the price of Para rubber was 50 per cent. over that of the following year. The demand for rubber goods may be greater now than heretofore, but then more has been done towards getting the raw material, and it turns out that, instead of being restricted to any definite area, it is inclined to show itself in all directions, especially in such regions as Columbia and the vast forest of the Aruwhimi. The new Columbian railway through the valley of the Cauca towards Darien is said to tap a country containing extensive supplies of the Central American species (*Castilloa elastica*). Moreover, French and Italian travellers say that in the east of Columbia, towards the watersheds of the Orinoco and the Amazon, there is an abundance, not only of "Castilloas," but of "Heveas" also.

We shall await with interest a report on the quality of the rubber from the newly discovered forests, though we may take it for granted that it will not equal that at present obtained from Para and cured by the smoking process. But if it should so happen that some acute chemist finds out a method of so improving the quality of the African rubber, which is cheap enough, so as to enable it to be mixed with the best Para, with the result of lowering the cost of the latter, we should think that any syndicate would come to look upon the progress of things with an unfriendly eye. With reference to new sources of supply, it is satisfactory to hear that under the governorship of Sir Alfred Moloney, Lagos exported in 1885 rubber to the value of £70,000, although the trade was only commenced in a very small way five years before. Mr. Alvar Millson, Acting Commissioner at Badagry, has been very prominent in connection with new sources of rubber supply in the West Coast colonies, and we would refer those interested to his papers in the Kew Reports. If we are rightly informed, the rubber yielded by the Liberian forests, in the working of which Englishmen are interested, is of a quality quite equal to that of Para. Although this is a somewhat startling statement, it gives ground for hope that other sources of supply, together with the possibility of improvements in our manufacturing processes, may save the necessity of depending so much on the expensive productions made from the best Para rubber.

REVISION OF THE ORDNANCE SURVEY.

THERE are few things of so much importance to the country as a good set of thoroughly trustworthy maps of the different districts, and on the whole the people of Great Britain have been well served by the maps of the Ordnance Survey. It is rather a curious fact that in proportion to the area of which Government maps are procurable, the demand for them has not increased. This subject was discussed at the last meeting of the British Association, being introduced by Mr. Henry T. Crook, C.E., and several suggestions were made, but, so far as we are aware, the matter has been allowed to drop. As, however, it is one which is of considerable importance, in relation especially to industry and engineering, it is well that we should direct the attention of our readers to some of the points which were raised, so that steps may be taken for having them pressed home on the authorities.

The first reason given for the apparent want of appreciation by the public of the maps of the Ordnance Survey was that they were not accessible, and therefore not known, but on the whole we think that there is not much in this, as the arrangements for their supply are now fairly good. We attach more importance to the opinion that the maps do not meet popular requirements, and are, therefore, not in demand. Mr. Crook gave the following reasons why, in his opinion, the maps fail in many cases to meet the requirements of the classes of users for which they are presumably designed, viz.:—(1) Age. For want of revision large portions of even the 25in., but more particularly the 6in. and 1in. maps, are very incorrect, and in many cases quite obsolete. (2) Bad impressions or impressions from old and worn-out plates. (3) Complexity (in the 1in. map) through overcrowding of detail, causing confusion, the map being printed in only one colour. (4) Deficiency in information as to ground forms, particularly in the 6in. map (excepting Lancashire and Yorkshire). (5) Want of uniformity. (6) High price, especially in the case of the 6in., quarter sheets, and on all scales where sheets are partially blank. (7) Lack of explanatory information with the maps. Each of these points was discussed in detail. The Director-General of the Ordnance Survey admitted that he was quite sensible of a pressing need for a revision of the maps, but he pointed out that the question is really one of money, which it is for Parliament, and not for the Department, to decide. The extension of the 25in. survey has been so much pushed forward at the expense of revision that in many places revision must now be virtually a re-survey, as, in consequence of the length of time which has taken place since the maps were made, and the neglect to provide for a timely revision, the great part of them are obsolete and of little more than historical interest. The other points which have been mentioned as requiring attention are matters of minor importance, and are capable of comparatively easy

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arrangement, but we would urge that the work of revision be at once commenced, and pushed forward with vigour, so that the maps may be of the greatest possible use to the public, for, without exactness, they may be very misleading. We may state that we refer to the matter simply for the purpose of increasing the efficiency of a Department which has done most valuable work for the advancement of geodetical and astronomical science.

Letters to the Editor.

OUR BIG GUNS, AND HOW THEY ARE MADE.

To the Editor of "Industries."

Sir,—Your correspondent, "C.E.," appears to be a little mixed. Rodman, the inventor of the Rodman gun, could not have heard of the name of Siemens at the time of the war between the Confederates and Federates. "C.E." would appear to be more intent on advertising the name of Siemens than in adding information on the subject.

Yours, &c.,
Yankee.

Liverpool, 21st January, 1891.

GAS AND ELECTRICITY.

To the Editor of "Industries."

Sir,—If, as sometimes happens, anything goes wrong with a central electric light station, and consumers are left in the dark, the fact is heralded all over the country, and the gas journals rejoice, and say, "We told you how it would be with this new-fangled invention." When, however, a gas company does the same thing, silence reigns supreme. The dailies take a special delight in alternately giving absurd puffs to electrical inventions and horrifying their readers with imaginary deaths of telegraph linesmen from touching live wires, but not one of them, as far as I have seen, has condescended to mention that last week the north of London, or at any rate a large part of it, was plunged into darkness by the Gas Light and Coke Company. The incident took place about eleven at night, and as at this hour some people are asleep in bed with their gas burners slightly on, far more serious danger was run than would be the case from a temporary extinction of glow lamps.

It is as well that publicity should be given to this fact, for though two blacks do not make a white, still there is no reason why gas companies should not have their blunders exposed as well as electric light purveyors.

Yours, &c.,
R.

Stoke Newington, London, N., 24th January, 1891.

THE SCOTTISH RAILWAY STRIKE.

To the Editor of "Industries."

Sir,—The debate in Parliament bodes no good for the companies, so far as their present attitude is concerned. It evidently foreshadows some legislation in the direction of restricting the hours of labour on railways. The perfectly obstinate attitude of the North British Railway Company in declining to submit to arbitration, in absolutely rejecting all efforts at compromise, in refusing even to say in the vaguest way that administrative reforms would be undertaken to avoid real cause for discontent among its servants and excessive inconvenience to the travelling public, is bound to recoil, not only upon its own head, but upon the whole railway service of the country. Comparison between the returns of the North British Railway as regards the hours of its servants with those of the other Scottish and any of the English lines reveals a state of matters quite sufficiently serious to account for the deplorable situation in which it finds itself.

The conduct of the company throughout this crisis has shown indeed that, while labour combinations may often exercise their power in a rash, selfish, and tyrannical way, a company employing 10,000 or 12,000 men, and controlling nearly half the railway system of Scotland, can put itself in flagrant opposition to the public interest in such a way as to make objections to direct legislation, and, perhaps, even oppressive legislation, almost certain to be unavailing. When a principle is strained to breaking point, as the North British Company has strained the principle that "a man may do what he likes with his own," the swing of the pendulum in the opposite direction is often extreme.

Railway shareholders may have little reason to congratulate themselves upon the battle the North British has been presumed to be fighting for them when they find the railways infested by inspectors to see that a driver does not work more than ten hours or that a signalman has not fallen asleep in his cabin. The people who really cause great, hurried, and sometimes disastrous changes are those who, like the authorities of the North British Railway Company, do not carry on the administration of the large interests with which they have been entrusted with a reasonable amount of tact.

Yours, &c.,
Disappointed Laisser-faire.

Glasgow, 28th January, 1891.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—In reply to the critical letters of your two correspondents, I must preface my reply by an acknowledgement of the courtesy of the one writing over the *nom de plume* of "Cockney," whose communication I will first attempt to answer.

He observes that in all fairness I should have added, to the estimate of cost of the project, the cost of converting, in each house, the existing hearths for gaseous fuel firing. Now I think a little consideration will convince your correspondent that such an estimate, although possible in an approximate degree, is unnecessary. When a gas supply company is floated, it does not include in its capital the cost of supplying complete, or even connecting, services for every house within its lighting area, and the same may be said of electric lighting companies. The service mains are laid all through the district, and the property owners or occupiers must do the rest. There would be no hesitation on the part of the property owners, or even occupiers, once a cheap heating or fuel gas was supplied. They would be ready to convert the hearths for the use of the new fuel, as the change would enhance the value and attractiveness of their property, and if it cost them £5 to effect the alteration there would, I think, be no difficulty in obtaining an extra 7s. 6d. a year rent. This would pay 7½ per cent. on the outlay, and thus be a safe, and profitable, and advisable investment in every way.

For the poorer districts, the project, if carried out, would prove an incalculable blessing, especially if the new 1d. prepayment gas meters were installed along with the fuel gas service. This new prepayment system is certain to become most popular with the less favoured portion of the population, and I believe already that some gas companies will undertake, without any cost to the occupier, and on certain conditions, to provide prepayment meters. The extra difference over the ordinary price charged for the gas (measured by the volume delivered for one penny) pays them to do so. The system also conduces to economy in the use of fuel.

For the poor, one penny dropped into a slot will enable them to obtain sufficient heat for their purpose, and they can economise it to the most extreme limit. It is not so at present; wood has to be bought, and also coal or coke, costing, say, at least 6d., before a single thermic degree can be obtained. And what a wasteful system it is! A few hours of flickering and smoky flame, a few cheery sparks, an ashy grate, and the fire goes out, leaving the surrounding misery in deeper misery than before.

If we estimate the number of houses within the metropolitan area (I am writing from memory) to equal 450,000, and further estimate the average cost of converting each house at £5, this would, therefore, equal a total cost of £2,250,000, an outlay that would be readily borne and hardly be felt (in its minute division) by the property owners of London. That eminent sanitarian, Mr. Chadwick, estimated the annual damage done to London property by smoke to be equal to £2,000,000 sterling, so that about one year's saving in damage would counterbalance the cost of the household services and internal alterations for gas firing.

Respecting the stated difficulty of obtaining satisfactory arrangements and appliances for fuel gas burning, I believe there are now a good many cheap and effective gas heating and cooking appliances in the market, which are practically all that could be desired. What the householder generally complains of is the inadequate pressure and supply of gas, and that the *price* is too high. Remove these two impediments, and I don't think that the modern methods would leave much margin for improvement.

I terminate my remarks on your correspondent's letter by thanking him for the friendly tone of the last paragraph, which if echoed by his co-citizens would enable the project within a comparatively short and measurable period to become an accomplished fact.

Your correspondent "R. S." does not, I think, act justly in blaming me for ignoring the steps that are being taken by others towards the achievement of a similar object—namely, the prevention of smoke. The Committee in Manchester deserve every possible encouragement in their laudable work, and with steady persistence they will, I am sure, succeed in reducing, if not in removing, the evil in Lancashire and Yorkshire. They have a wide and difficult field for their operations in Manchester alone, and I do not know that the project I have described in any way clashes with their remedial proposals.

I thank "R. S." for the practical illustration he gives of the advantages of the employment of fuel gas at the works of Messrs. Brunner, Mond, & Co. It is striking evidence that for manufacturing purposes gaseous fuel may be utilised with economy, besides its evident collateral advantages to our agriculturists and to the hygienic condition of the workpeople.

The suggestion of "R. S." that the lower basements of houses should be made the *locale* of heat generation or combustion of the fuel gas, for distributing heated air to the upper floors, deserves consideration, and is a rational and scientific proposal; but I fear that we shall not readily overcome the insular prejudices of Englishmen in favour of the open and cheery fire, whether of coal or gas.

I cannot, in the contracted space of a letter, describe in detail the appliances that one could recommend for using the fuel gas—for cooking, heating, and for motor purposes; but without mentioning the proved appliances in use in Pennsylvania for natural fuel gas, there are a number of admirable contrivances which have been developed by British manufacturers that leave little to be desired in the way of efficiency and cheapness of first cost. It would be unfair to specify one more than another.

I feel certain, after reading the body of the letter of "R. S.," that he has no serious intention of damning the project with faint praise. He says: "This experiment at Brunner Mond's, together with the employment of natural gas at Pittsburgh, does certainly tend to support the views he has set forth."

Yours, &c.,
B. H. Thwaite.

Liverpool, 26th January, 1891.

To the Editor of "Industries."

Sir,—Every Londoner must wish that some such scheme as that proposed by Mr. Thwaite may soon be realised.

While agreeing with Mr. Thwaite generally, may I be allowed to suggest that his estimate of the future demand for illuminating gas is excessive? Surely it would be much better to do away with hydrocarbon gas as an illuminator altogether, and use the same gas for fuel and lighting, with only one system of pipes. Of course, incandescent burners would have to be used.

A very small reduction of the price of gas would make a great difference in the proportion of gas heating. At present gas stoves are too expensive; moreover, they are not well designed. They are generally fitted with asbestos radiators, which are white, whereas some black substance should be used. Moreover, they cause such a draught that nearly all the hot air produced by them is drawn up the chimney.

Judging by the slow progress of the electric light fraternity, London will have to depend on gas as an illuminant for many a long day, and now that the chief gas engine patent is run out, we will, no doubt, soon have numbers of cheap little engines which can be used for lifts and small power work.

If we had half the push of our American cousins, Mr. Thwaite's scheme would be taken up at once. I beg to enclose my card, and remain

Yours, &c.,
Londoner.

London, 27th January, 1891.

CYANIDE OF POTASSIUM AS A SOLVENT OF GOLD AND SILVER.

To the Editor of "Industries."

Sir,—Chlorine, which was thought to be the best and the most powerful solvent of gold, is considered now as having been superseded by cyanide of potassium, the affinity of which for gold has been discovered, we are told, after three years of researches and experiments, by Messrs. MacArthur and Forrest.

But, is there any discovery in these properties of cyanide of potassium for dissolving gold and silver? Is it a new thing to chemists, metallurgists, and electricians that cyanide of potassium dissolves gold?

As an electrician, I will only make two quotations about the dissolution of gold in a cyanide of potassium solution. I extract the first one from Elkington's specification, No. 8447 of 1840, page 6, l. 24:—

"The third part of our invention, which consists, it has been said, in coating, covering, or plating certain metals with gold by the use of a *solution of gold* in connection with the galvanic current, we perform as follows:—We take oxide of gold, prepared by any of the known methods, or *metallic gold in fine division*, and dissolve the same in a solution of prussiate of potash or soda. To about 2oz. of gold converted into oxide we add 2lb. of prussiate of potash dissolved in 1 gallon of water, and boil the same for about half an hour, and the solution is then ready for use. We prefer to keep the solution as nearly saturated with gold as possible, and for this purpose we keep a portion of oxide or of metallic gold in the solution undissolved. . . . We claim, therefore, the method of coating, covering, or plating the metals above mentioned with gold by the use—first, of an oxide of gold or *metallic gold* in fine division dissolved in prussiate of potash, or any soluble prussiate; and also by the use of *oxide of gold dissolved* in any other analogous salt."

I take from the paper of Messrs. Glassford and Napier my second quotation on the solubility of metallic gold in an aqueous cyanide of potassium solution. It is entited "Cyanide of Gold and Potassium" (*Phil. Mag.*, T. XXV., page 64; July, 1814.):—

"The following process, which we have employed, is *beautifully calculated for obtaining a large quantity of salt* in a few hours and at comparatively little trouble. A solution of cyanide of potassium is prepared, which contains about six times as much cyanide as the quantity of gold to be dissolved. The cyanide may be dissolved in twice, thrice, or four times its weight of distilled water, and carefully filtrated to separate any insoluble matters with which the cyanide is continually contaminated. This solution is then to be gently and carefully raised to the temperature of 100° F. in an earthenware or glass vessel. *Two plates of gold are placed in the solution at the opposite sides of the vessel*, and these are connected by means of copper wires to the poles of a small galvanic battery, composed of two or three pairs of zinc and copper plates and excited with dilute acid. As soon as the circuit is completed the operation commences, *gold is dissolved* from that plate connected with the copper end of the battery, *passes into the solution, and is only partly deposited* upon the opposite plate, while a gentle flow of gas is evolved from the negative plate. *The solution of cyanide of potassium* rapidly consumes the gold, which is *dissolved* at the positive pole, and becomes a *double salt of cyanide of gold and potassium*. The gold which deposits upon the negative plate is in minute grains, occasionally quite *brown*, is beautifully crystalline. The operation is much facilitated by having the positive plate or pole of gold several times larger than the opposite plate. At first the amount of gold deposited is very small compared with that dissolved from the positive pole, the solution retaining the greater proportion, but after some hours, as the solution becomes saturated, the amount deposited increases until there is a perfect balance. In this way ½oz. of gold may be dissolved in a few hours, and nearly 1oz. of the salt obtained."

As a chemist, I would say that in Thompson's "Chemistry," translated into French by J. Riffault, in 1807, prussiate of potash was stated to be the alkaline solvent of gold and silver. I would also refer to the paper by Proust, on "Facts for the History of Prussiates" (1806, Tome LX., pp. 225–249, *Annales de Chimie et de Physique*), which I quote as follows:—

"There are some metals which form simple and triple-prussiate, such as copper, manganese, cobalt, nickels, &c., some others forming only a simple prussiate: for instance, gold, &c."

There are also many other books from which I could extract passages, showing that the affinity of cyanide of potassium for gold has long been known. I will only give you a few names:—Liebig, Himly, Elssner, Prince Bagration, Gmelin, Hahn, Sagg, Wurtz, Lossen, and Birnbaum, &c. Hagen in 1805 (Hagen's "Untersuchungen," Vol. I., p. 655), states in a most emphatic manner that gold does not only dissolve in *aqua regia* or free chlorine, but also in a cyanide of potassium solution. Wahl, in his "Practical Guide for the Gold and Silver Electroplater," Philadelphia, 1883, makes the following statement:—

"It is a phenomenon worthy of remark that the solutions of cyanides even without the action of the electric current rapidly dissolve in the cold, or at a moderate temperature, all the metals except platinum, and that at the boiling point, they have scarcely any action upon the metals."

As a metallurgist, I would say that in a paper read before the Royal Society of New South Wales, August 1st, 1887, by W. E. Dixon, F.G.S., on a method of extracting gold and silver from pyrites, he states that the only salts of gold, besides chlorine, which possess sufficient stability, are bromide of gold (which was used by Figaguière before other patentees), and the auri-cyanides of the alkali metals, and he enters into details with regard to the action of cyanide. He also adds: "A patent was applied for in America in 1868 for the extraction of gold from its ores by cyanide, but I have no particulars of the process. It seems to me, however, that the high price of the salt, its insta-

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bility when exposed to the air and in solution, and its extremely poisonous properties, precluded its use for this purpose."

To these objections, Janin, who had made in 1886 some experiments on the treatment of rebellious argentiferous ores at the Ontario Silver Mine, Utah, gave his views, and it will be interesting to give an extract from his paper on the subject in the *Engineering and Mining Journal*, 29th December, 1888, page 548, in which he says:—"According to Smee, the auri-cyanide of potassium may be easily made by simply placing a piece of pure gold in a solution of cyanide of potassium, but this is a long process. I found that gold leaf is readily soluble in a moderately strong solution. . . . . Cyanide extracts a large percentage of gold from raw and roasted pyrites, and from gold ores where the gold is present in a very finely divided state. But on raw ores the effect is less pronounced than on roasted ores, and therefore the drawback of the great solvent power of cyanide on base metals has very little importance."

Already, in 1867, the powerful dissolving properties of cyanide were patented in America by Dr. Rae (No. 61826), and in his specification he claimed the combined action of a current of electricity and of a suitable liquid such as cyanide, so that, by the action of cyanogen, the metal is reduced, and then can be collected. In 1880 Clark (No. 229586) patented the use of 1lb. of prussiate of potash, 1lb. of alkali, and 5lb. of salt to treat 1 ton of auriferous ores containing 5 per cent. sulphurets, and, as far as I can remember, he said in his claims: "The ore is completely desulphurised and the precious metals are freed." A little after, Faucett (No. 236424 of 1881) patented the use of cyanide of potassium with some other chemicals; he also employed a tumbler, and what he claimed was the separating of metals from refractory ores in subjecting the ores to the action of disintegrating chemicals. Then we find the specification of Sanders (No. 244080 of 1881), which is of minor importance, but in which we see that he employs cyanide, apparently for dissolving the coatings of the auriferous ores, but really to dissolve the gold. Simpson (No. 323222 of 1885) is more explicit; he uses cyanide of potassium with an addition of carbonate of ammonia, and precipitates the gold from the solution by means of zinc.

Where is the difference between Messrs. MacArthur & Forrest's process, patented in 1887, and Mr. Simpson's system, patented in 1885? The only one I find is that, in order to precipitate gold from the solution, Messrs. MacArthur & Forrest employ zinc in a state of fine division, which is neither efficient nor new, since the precipitation of gold by means of zinc in state of fine division was the object of the Price patent, No. 5125 of 1883. I think I have made one point clear—namely, that cyanide of potassium is common property.

Now the next question is: How to apply this solvent of gold? and, when the gold is in solution, how to separate it and how to catch it? It is a very long and tedious work to have to dissolve gold and exhaust its ores; and then, to have to filter the gold solution and to precipitate the precious metal by complicated and not altogether cheap methods, such as the alloy of zinc and sodium, suggested by Mr. Claude Vautin. I have no intention whatever of disparaging this mode of separation of gold any more than I would criticise the use of charcoal, through which Mr. Claude Vautin used to filter and separate the gold. But I confess I do not see the advantages of an alloy of zinc and sodium, while I see in this process many drawbacks which render it prohibitive.

What is wanted in any process for the extraction of gold from its ore, is not only novelty and patentability, but also efficiency, practicability, simplicity, and cheapness. As long as the gold and silver are not dissolved and separated *in one single operation*, the problem of the extraction of the precious metals will not be solved; and my experience in treating refractory or non-refractory auriferous ores is, that there is *nothing like the electric current* to exhaust the ore and to deposit the gold and silver it contains.

Yours, &c.,
E. ANDREOLI.

62, Loughborough Park, London, S.W.,
26th January, 1891.

Legal Proceedings.

PINTO *v.* TROTT.

THE SAME *v.* BADMAN.

THESE two actions were tried in the Queen's Bench Division, before Mr. Justice Day and a special jury. Mr. Aston, Q.C., and Mr. McCall appeared for the plaintiff; Mr. Lane, Q.C., with Mr. Willis Bund and Mr Herbert Reid, for the defendants.

The actions were brought to recover damages and obtain an injunction in respect of the infringement of the plaintiff's trade mark. The plaintiff is a manufacturer and importer of Mexican cigars, which he sells under a registered trade mark and the name "El Destino." The defendant Trott is a cigar merchant, and sells a brand of cigars known as "El Devino." The use of this name and of a label strongly resembling the plaintiff's in design constituted the acts complained of. The plaintiff, beside relying on the obvious resemblances between the two names and labels, called in evidence the designer who had prepared the defendant's label, and who deposed to having been furnished with a specimen of the "El Destino" label which he had copied. During the progress of the case, the jury conveyed an intimation of opinion to the judge, by whom it was communicated to counsel, and, in consequence, the counsel for the defendant did not argue the point as to imitation, but was content to discuss before the jury the question of the amount of the damages to be awarded, and to submit to the Court that the plaintiff had not successfully made out his title to the exclusive use of the trade name said to be infringed. For this purpose he relied on an alleged defect in the instrument under which the plaintiff had acquired the rights of Marcia Brothers & Co.—the original manufacturers of "El Destino" cigars—and on the fact that the name "El Destino" had been previously used by other manufacturers, and so used, as he alleged, as to have become matter of public right, incapable of being afterwards monopolised by any person. It is necessary for this purpose to prove user by three persons, and the user proved by the defendant in this case was a continuous user in the course of a business carried on at first by a firm of which the members were a father and his two sons; after the father's retirement, the two sons in copartnership; and, after the retirement of one of the sons, the other son trading alone. There was a further objection to the registration—that the name was a geographical name, and, as such, a descriptive word when applied to these goods. Mr. Justice Day overruled these objections, and, upon the finding of the jury in favour of the plaintiff, gave judgment for an injunction, damages and costs as asked.

The second action was brought in respect of another infringement by the use of the term "El Destinacion." The defendant in this case was a cigar dealer in Birmingham, in no way interested in the making of the cigars, which are of English manufacture. The case made against him was that his assistant had sold "El Destinacion" cigars for "El Destinos," and evidence was tendered in behalf of the plaintiff that a purchaser at one of his shops upon asking for "El Destino" had been offered cigars from a box labelled "El Destinacion" by an assistant, who held the box in such a way as to conceal with her finger the letters "cion" at the end of the word. This was denied by the incriminated assistant, but the jury, having regard no doubt to other matters—as the conduct of the defendant in taking up the quarrel instead of referring the plaintiff to the manufacturer who had supplied him with the goods, and to the fact that English manufactured goods were being passed off under a Spanish name, and that the label complained of was decorated with what appeared to be drawings of medals, although no prize medals had in fact been awarded to these cigars—found for the plaintiff in this case also, awarding damages to the extent of £50.

This latter case may at first sight appear to be one of some hardship, since the unfortunate retailer was certainly not primarily responsible for the infringement of the trade mark of which the plaintiff complained. It is, however, well that it should be generally known that a vendor of goods sold in derogation of trade-mark rights is equally responsible before the law with the person who commits the original act of piracy, and that the only safety for a person attacked by the owner of a trade mark lies in obtaining from some person who has a substantial interest to defend a sufficient indemnity against the consequences of an action, or a timely submission, which will reduce his damages to a nominal sum, or give him a substantial defence if the plaintiff refuses to acquiesce in a reasonable settlement of the dispute.

THE STANLEY SHOW.

THE fourteenth annual Exhibition of bicycles, tricycles, and accessories, which is being held at the Crystal Palace, and which closes on the 31st inst., differs somewhat from its predecessors from the fact that most of the principal cycle makers are conspicuous by their absence. The show, however, has suffered comparatively little from this, while the smaller makers, who are exhibiting in greater force than previously, are likely to reap a substantial reward. The number of machines exhibited is not quite so large as last year, but there are quite sufficient to satisfy the curiosity of the average spectator. The ruling features of the present Exhibition are undoubtedly the "pneumatic" and "cushion" tyres, by means of which racing cyclists were able last season to beat all previous records made with the old form of tyres.

If the relative numbers of the "safety" and "ordinary" bicycles exhibited may be regarded as any criterion, the latter type would seem to have almost become a thing of the past, except for racing purposes. It is interesting to note the rapid growth in public favour of the inflated tyres. At last year's show the principal novelty was the exhibit of the Pneumatic Tyre Company, whereas at the present Exhibition, owing to the enormous demand for these tyres, every exhibitor has a large proportion of the machines shown fitted with them. Another feature of the show is the absence of regard to mechanical principles. By purely empirical methods designs of superlative excellence have been gradually evolved—frames stiff and light, wheels admirably built, bearings little short of perfection, giving as a result machines through which can probably be transmitted a greater number of foot pounds of energy per pound weight than can be dealt with without injury by any piece of mechanism in any way comparable with them. But this has only been arrived at by the painful process of trial and error, and the adoption of such patterns as have proved successful in practice. Of the principles that are involved in the construction and propulsion of a cycle the average maker appears to know little or nothing, judging from the announcement, made in a catalogue, that the use of a band-brake acting on a drum attached to the hub of a steering wheel "solves the problem of a brake which shall not strain the spokes," the idea latent evidently being that the retarding force not being applied at the rim does not have to pass through the spokes.

A novel form of tyre is shown by the Maxim Company of Birmingham. This consists of a number of projecting studs of rubber placed very close together, instead of the continuous rim. The object of this is to prevent skidding of the wheel. The exhibit of Mr. Vaughan Sherrin, of 37, Tabernacle Street, E.C., is worthy of attention. This gentleman appears to have effectively studied the application of electric motors to cycles, and shows a tricycle so equipped which is capable of travelling at a speed of fifteen miles per hour, and also a Bath chair with a motor applied. Mr. W. E. Roberts, of Bristol, shows some new constructive features in connection with "safeties" for reducing vibration when a rider is passing over obstructions or uneven roads. He provides an oscillating lever or levers, fulcrumed at or upon the driving spindle or crank axle, and carrying at the end of it the axle of the rear or driving wheel, while the other or shorter arm of the lever is connected by means of a spring to the framework. In passing over a rough road the shocks to the back-wheel are thus reduced by the elastic properties of the lever. Mr. Harrison Carter, of London, exhibits a method of protecting and lubricating the pitch chain of safety bicycles and tricycles, which consists of a metal curve containing oil, through which the chain is made to travel. Mr. W. Bown, of Birmingham, exhibits a safety bicycle with a pneumatic tyre on the rear wheel only, the vibrations from the front wheel being absorbed by means of a spring fork. The Cornbrook Cycle Company and Acme Two Speed Gear Company exhibit safety bicycles fitted with their two-speed gear. This only adds about 2½lb. weight to the machine, and the apparatus is thrown in and out of gear by means of a small lever placed near the saddle.

The loan collection of curious and old machines is very interesting.

THE ELMORE COPPER DEPOSITING PROCESS.

THIS often-quoted process has taken practical shape at Leeds, and extensive works in connection with it are in course of construction. In the case of the Tube Making Company vats are already at work and orders are being executed, but the wire works are still incomplete. So much has, however, been done, that our representative paid a visit to the Leeds works on the 27th inst. to inspect the actual state of progress. Although the company was apparently unprepared for a special visit of the kind, much was seen of considerable interest. The most striking feature of the process is, perhaps, its automatic character, the depositing tanks being so arranged that work can go on day and night, the traverse of the burnisher being periodically altered in direction. We had hoped to give an illustrated description of the works at Leeds, but in consequence of the short notice that had been given of the visit adequate drawings and photographs could not be obtained in time. We hope to deal with them in a later issue.

Reviews.

THE METALLURGY OF STEEL. By Henry Marion Howe, A.M. (Harvard), S.B. Vol. I. New York: THE SCIENTIFIC PUBLISHING COMPANY. 1890.

This portly volume is the first instalment of a work which, although professing to be the outcome of a desire on the part of its publishers to give metallurgists an account of American steel works, fulfils a much larger design. The author practically gives an exhaustive account of all that has been done since the appearance of Percy's well-known manual, as he passes on to the various sections in the important departments of steel manufacture and the application of this material to industrial purposes. The term *steel* is used in its modern acceptation, and is made to include mild steel or ingot iron, as well as those alloys of the metal that are capable of being hardened and tempered. The intelligent observer of those mysterious actions to which cutting tools made of steel owe their main value will be pleased to find a well-founded theory that explains

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them, even though we are told that it must be accepted as provisional. The chemical evidence adduced seems to prove conclusively that carbon exists in steel in two states of combination, being in one case called *hardening* carbon, because chiefly found in hardened steel, and in the other *cement* carbon, because chiefly found in cement or blister steel. One form readily passes into the other by changes of temperature. Thus the explanation is easily understood that "the heating which occurs in tempering and annealing relaxes chemical inertia so as to permit the carbon to pass from the hardening state, in which it has been previously imprisoned by sudden cooling, to the cement state, to a degree which, within limits, increases with the temperature reached."

The subject-matter of the book is treated on a methodical plan that must greatly facilitate the labour of reference, more especially to those who may consult the work on any of the many difficult questions bearing on the effect of the presence of various elements in the composition of steel. The chapters in the section that treats on these matters begin in each case with a summary containing the leading facts and conclusions, which are expanded in succeeding paragraphs, and the evidence for or against which is given in detail. In this way the effect of the various metals and metalloids that are usually met with in combination with steel is dealt with, not only from the point of view of the chemist, but also in their most intimate practical relations, so that the manufacturer has here a perfect storehouse of information. Some correspondence that appeared in the pages of *Industries* whilst the work under review was passing through the pages of our American contemporary, *The Engineering and Mining Journal*, is an evidence of the interest that this section of the work has already aroused. The representations made in the letters referred to might be understood to take Mr. Howe to task for the subordinate place he assigns to our knowledge of chemical composition as a means of indicating the physical properties of steel, but the same thing might be said in regard to his views as to the value of mechanical tests. The failures which Mr. Howe chronicles of material that had behaved admirably under test make it clear that there is still a mystery that lies beyond our present knowledge. The fact remains that a judicious combination of chemical and mechanical tests is absolutely indispensable to the manufacturer who wishes to conduct his processes with safety and efficiency.

The steel maker will turn with interest to the chapter on the prevention of "blow holes" and "pipes," a subject intimately connected with the phenomena of the absorption and escape of gases from iron treated of in the antecedent chapter. Various methods of liquid compression to effect the desired purpose have been adopted since Whitworth devised his mould for subjecting the ingots to hydraulic pressure, but none seem to have met with such success as that of S. T. Williams, who employs a mould one of whose inner faces is concave. As soon as the shell of the ingot has solidified, a plano-convex plate is slipped between mould and ingot, and the two sides of the mould are forced together by hydraulic pressure. Mr. Howe states that this process has been in use at Henry Disston & Sons' Tacony works for over two years, and he is informed that during this time not a saw has split on account of "piping." Fifteen presses are now in use, and twelve more are building.

The discovery of Regnard that the fresh fractures of ingots from certain heats of open-hearth steel emitted a sound of escaping gas, with an ammoniacal smell whose intensity seemed proportionate to the quantity of gas escaping, may have unforeseen consequences in regard to the much-sought-for synthesis of ammonia. As Percy only refers to the presence of ammonia in iron rust, the facts ascertained since his time, and brought together in Mr. Howe's work, should not be overlooked by those engaged in the investigation referred to. Chemists on the look-out for useful work to do will find other helpful suggestions in this book, such as the hint that the sulphuric acid, now wholly lost, in the calcination of the ferrous sulphate obtained as a by-product from the pickling liquor used in wire mills, might be recovered. The very interesting section on wire drawing may follow naturally after a discussion on "the rationale of the effects of cold working." So detailed an account, however, certainly comes as a surprise, even though the important and manifold uses to which wire is applied quite justify the introduction of a thoroughly practical description of the process that is sure to be appreciated by many readers. Billings' apparatus is also described, by which previously pickled steel and iron bars (round, square, hexagonal, &c.) are drawn cold through a die, by hydraulic means, to strengthen them, raise their elastic limit, and give them accurately uniform section. Although the division on cold working appears to be complete, we find no mention therein of Dyson and Hall's reeling process, which, although applicable only to round bars, admirably effects a similar purpose to that of Billings' and at less cost. The omission might have been intentional had the original scope of the work been carried out, as the process is a purely English one. In this case it is somewhat difficult to understand why Hadfield's recent labours on manganese steel, and those of Riley on nickel steel, should find so prominent a place in the appendix to this volume, seeing that Britain also must claim the honour of their discoveries, as must also be the case with the classical researches of Sorby on the microscopical structure of iron and steel which are incorporated in this work. In fairness to the author, we must add that he seems throughout most anxious to give credit where it is due, and that also, like Percy, he fearlessly gives expression to his opinions when they differ from the fashionable beliefs, thus greatly adding to the value of the work, which is illustrated with upwards of 200 engravings and diagrams and a like number of original tables. We shall welcome the advent of the next volume.

NOTES ON PERMANENT-WAY MATERIAL, PLATELAYING, AND POINTS AND CROSSINGS. By W. H. Cole, Executive Engineer, P.W.D. India. London: E. & F. N. SPON. 1890.

This little work is evidently written by one who has had practical experience of the matters with which he deals. In the preface the author dedicates his book to "the permanent-way inspector of to-day," "who," he says, "is not merely that vague product, a 'practical man'; he does not necessarily prefer guesswork to certainty; he has *not* a supreme contempt for a simple and intelligible mathematical method; . . . . and he is not one jot less practical than the platelayer of the old school, although he has had the advantage of a better education."

In the first chapter the nature and methods of manufacture of the materials used by the platelayer are first briefly described. The author then deals with the inspection and testing of steel rails, sleepers, fish-plates, and other parts of the permanent way; the construction and component parts of points and crossings; the relative merits of steel and wrought and cast iron, double-headed and other forms of rail, longitudinal and transverse sleepers and metal and wooden sleepers. On the subject of inspection of steel rails, &c., we think the author might with advantage have gone further into details and have described more minutely the character of the faults and flaws to be expected. We are also of opinion that detailed drawings of the forms of steel and pot sleepers most extensively used, and of a few standard rail sections and chairs, would add considerably to the value of the book. The author has, however, to a great extent disarmed criticism of this character by his remark in the preface, that "This little book has been written at scattered intervals of leisure," and that this may be pleaded "as a partial excuse for its unequal treatment of the subject and lack of completeness." Chapter II., on "Platelaying," is devoted to useful information of a distinctly practical character, including such matters as the distribution of workmen in platelaying, duties of permanent-way inspectors and sub-inspectors, "creep" or "travel" of rails, maintenance of wood sleepers, and treatment of metal sleepers. In Chapters III. and IV. the construction of points and crossings is explained, and the rules necessary for laying them out, together with various tables bearing upon the subject. This part of the work is well illustrated by diagrams, and very clearly yet concisely treated. In some cases more than one rule or method of determining certain dimensions is stated, as very frequently a simple approximate formula may with sufficient accuracy replace a mathematically exact but more elaborate expression. In any future edition we would suggest that a working drawing of a set of points and crossings should be added to the purely *diagrammatic* illustrations. Altogether, we are favourably impressed with Mr. Cole's work, and commend it to railway engineers.

STRUCTURAL MECHANICS: A HANDBOOK FOR ENGINEERS, ARCHITECTS, AND STUDENTS. By R. M. Parkinson, Assoc.M.I.C.E. London: GEORGE BELL & SONS. 1890.

This small book will be found very useful, as an intermediate step between treatises on theoretical mechanics and those which treat of applied mechanics or the different departments of engineering. It is evidently the outcome of the wants which the author experienced when he was a student, and, as such, is more likely to meet the difficulties of the majority of those for whom it is intended than if it had formed a systematic treatise. The author complains that such treatises do not take the student direct from the simpler to the more complicated problems which occur in practice. He treats the elementary and theoretical parts of the subject in as short a manner as possible, the chief part of the space being devoted to the solution of problems which can only be gathered from a number of different books, such as the works of Baker, Barlow, Box, and Twisden, and the papers by Bell, Christie, Clarke, and Fidler in the Proceedings of the Institution of Civil Engineers and the American Society of Civil Engineers. The author has freely consulted and used these works, and has selected his examples with reference chiefly to the everyday work of the engineer's and the architect's office, and for the purpose of comparing calculated results with actual experiments, a system which will impress the meaning of the different formulæ on the minds of the students. Like many books which treat of the properties of materials, there is sometimes a tendency to an inexact or double use of some of the terms employed. For instance, the word "strain" should be restricted to the deformations produced by the forces acting on a structure, and not to the accompanying stresses. We have suggested before now that a committee of the Institution of Civil Engineers should draw up an authoritative nomenclature for engineering subjects, in the same way as is being done by the British Association for physical subjects, and we now venture to repeat the suggestion, as almost every new book or paper shows that something of the sort is much wanted.

THE ENGLISH AND AMERICAN MECHANIC. By B. Frank Van Clive. New Edition. Edited by Emory Edwards, M.E. Philadelphia: HENRY CAREY BAIRD & Co. London: E. & F. N. SPON, 125, Strand. 1890.

This book contains within a comparatively small volume an immense amount of information, and is in fact, as its preface says, an Encyclopædia of Useful Technical Knowledge. It will be found useful, not only by the practical manufacturer and mechanic, but also by the amateur workman. It was stated in former editions of the work that it was intended to serve as a handy book of reference for the manufacturer, and to supply the intelligent workman with information required to conduct a process foreign, perhaps, to his habitual labour, but which at the time it might be necessary for him to practice. The new edition has been issued for the purpose of bringing the work up to date, and of otherwise improving it, in the hope that it may be still more useful in the future than it has been in the past. The editor, indeed, seems to have spared no effort at least to deserve success, and to have endeavoured to select only the best processes and recipes, which have been verified by competent authorities. With this end in view the European and American journals and transactions of societies devoted to technical subjects have been carefully searched.

The first part of the book is essentially a handbook for engineers, and contains many useful notes on the various departments of civil and mechanical engineering. We need not enter into any details of these, as they are very voluminous, but we may say that British engineers will find in them many useful hints regarding American practice which they would do well to study. The second part is made up of recipes of all kinds, which will be found most useful both in the actual workshop and by the amateur. Such subjects as alloys, solders, lacquers, varnishes, and cements receive particular attention, and the editor has, in addition, covered a very wide field of subjects. It would be difficult to name a subject in workshop practice on which useful and reliable information is not given. The book is rendered more complete, and its contents more available, by a very copious index, which makes reference to any subject or special recipe prompt and easy. We have no doubt that the success which this book has met with in America will, to a large extent, also attend it in this country, when its merits become more widely known.

THE ELECTRIC LIGHT. By John Urquhart. London: CROSBY LOCKWOOD & SONS. 1890.

This is the fourth edition of a comparatively old work, and is one of the few books on electric lighting extant in 1880, when the first edition appeared. Now it has a rapidly increasing number of competitors, but an attempt has been made to bring the work up to date. The author has not, however, been altogether successful in this. There are far too many descriptions of old and obsolete machines and lamps, and these occupy space that should be devoted to modern practice.

A TREATISE ON ELECTROMETALLURGY. By Walter G. McMillan. London: GRIFFIN & Co. 1890.

This is one of Messrs. Griffin's well-known "Scientific Textbooks." The title is somewhat too comprehensive, as the author deals but in a small way with the larger branches of electrometallurgy, such as copper refining. The work is really a treatise on electro-plating, and contains full and complete directions for depositing every useful metal and alloy. Several receipts are given for each solution, taken from a large number of authorities, so that the worker has a most extensive choice.

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THE "EICKEMEYER" STREET RAILWAY MOTOR.

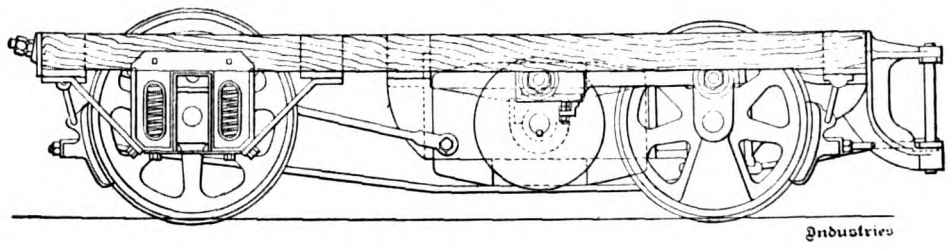


FIG. 1.—SIDE ELEVATION.

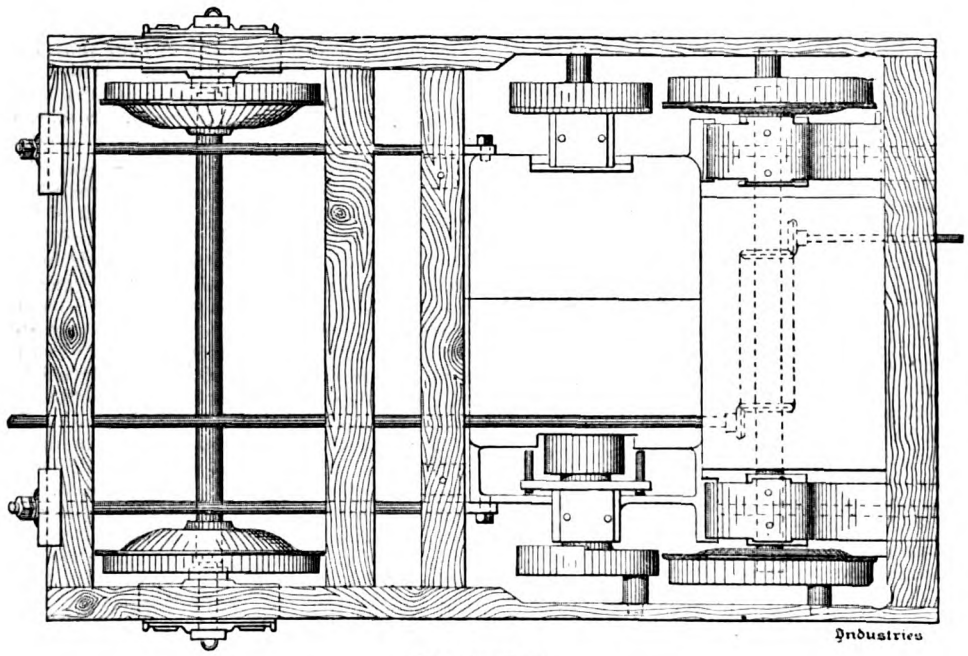


FIG. 2.—PLAN.

THE "EICKEMEYER" STREET RAILWAY MOTOR.

DURING the summer of 1887 Mr. Stephen D. Field worked an electric locomotive on the Thirty-Fourth Street branch of the elevated railroad of New York. The locomotive represented a new departure, the essential



FIG. 3.

feature of which lay in the fact that the machine was designed for a slow speed, and that the armature spindle was provided with a crank geared direct to the driving wheels by a connecting rod. The results obtained were so satisfactory that a street car was constructed on a similar principle, in which the well-known "Eickemeyer" motor was employed. The illustration Fig. 3 represents the car as it stands on the track. The motor is geared direct to the drivers, which are 18in. diameter, and is capable of developing 25 h.p. at 300 volts; it weighs altogether about 2,400lb. The armature is 12in. in diameter and 17½in. long. When the motor is running at a velocity of 150 revolutions per minute, the car attains a speed of 8½ miles an hour. We are informed that for ease of starting, evenness of running, and ability to get along sharp curves and gradients, the motor is very satisfactory. This system is about to be adopted at Lynchburg, Va. Figs. 1 and 2 show a side elevation and plan respectively of one of the trucks which will be employed there. The motor, which is designed to develop 35 h.p at 500 volts, will be geared directly to drivers of 26in. diameter by a 5in. crank, and under these conditions it is expected that a speed of 10 miles an hour will be attainable with only 120 revolutions per minute of the motor. The diameter of the armature is 13¾in., and its length 18½in. As in Mr. Eickemeyer's dynamos, these motors are all supplied with carbon brushes, but, unlike the usual type of solid blocks, a multiplicity of contacts is obtained by securing a series of carbon buttons to a spring plate, which presses them against the commutator and thus provides a number of contacts. We are indebted for our illustrations to the *Electrical Engineer* of New York.

ELECTRICITY IN TRANSITU: FROM PLENUM TO VACUUM.*

(*Continued from page* 89.)

Radiant Matter.—By means of this tube (Fig. 5) I am able to show that a stream of ultra-gaseous particles, or radiant matter, does not carry a current of electricity, but consists of a succession of negatively electrified molecules whose electrostatic repulsion overbalances their electromagnetic attraction, probably because their speed along the tube is less than the velocity of light. The tube has two negative terminals A A¹, close together at one end enabling me to send along the tube two parallel streams of radian matter, rendered visible by impinging them through holes in a mica diaphragm on a screen of phosphorescent substance. It is exhausted to a pressure of 0·1 mm. I connect one of the negative poles A with the induction coil, and the luminous stream darts along the tube from C to D parallel with the axis. I now connect the other negative pole, giving a second parallel stream of radiant matter. If these streams are in the nature of wires carrying a current they will attract each other, but if they are simply two streams of electrified molecules they will repel each

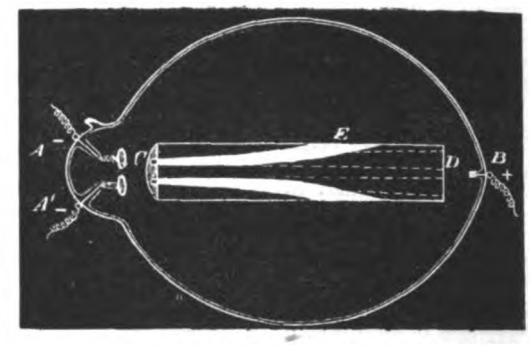


FIG. 5.—P = 0·1 MM.

other. As soon as the second stream is started you see the first stream jump away in the direction C E, showing strong repulsion, proving that they do not act like current carriers, but merely like similarly electrified bodies. It is, however, probable that were the velocity of the streams of molecules greater than that of light, they would behave differently and attract each other, like conductors carrying a current.

The Edison Effect.—An exactly parallel experiment has been made by Mr. Edison, Mr. Preece, F.R.S., and Professor Fleming, using, instead of a vacuum tube, an incandescent lamp. They found that from an idle pole placed between the ends of the filament the electricity always flowed as if the pole were the zinc element of a copper-zinc cell. Having repeated their experiments, I entirely corroborate them. I get a powerful current in one direction from an idle pole placed between the limbs of an incandescent carbon filament, and one in the opposite direction from an idle pole in a highly exhausted vacuum tube. This discrepancy was extremely puzzling, and I tested, with a similar result, very many experimental tubes made in different ways.

Some of the contradictory results are due to the exhaustion not being identical in all cases. In my vacuum tubes the directions of current between the idle pole and the earth changes from negative to positive as the exhaustion rises higher. Testing the current when exhaustion is proceeding, there is a point reached when the galvanometer deflection—hitherto negative—becomes nil, showing that the potential at this point is zero. At this stage the passage of a few more drops of mercury down the pump tube renders the current positive. This change occurs at a pressure of about 2 mm.

After this point is reached, when the induction current is passed through the tube, the walls rapidly become positively electrified, probably by the friction of the molecular stream against the glass, and this electrification extends over the surface of any object placed inside the tube.

Properties of Radiant Matter.—One of the most characteristic attributes of radiant matter—whence its name—is that it moves in approximately straight lines, and in a direction almost normal to the surface of the electrode. If we keep the induction current passing continuously through a vacuum tube in the same direction, we can imagine two ways in which the action proceeds; either the supply of gaseous molecules at the surface of the negative pole must run short, and the phenomena come to an end, or the molecules must find some means of getting back. I will show you an experiment which reveals the molecules in the very act of returning. Here is a tube (Fig. 6) exhausted to a pressure of 0·001 mm., or 1·3 M. In the middle of the tube is a thin glass diaphragm C, pierced with two holes D and E. At one part of the tube a concave pole A¹ is focussed on the upper hole D in the diagram. Behind the upper hole, and in front of the lower one, are movable vanes F and G, capable of rotation by the slightest current of gas through the holes.

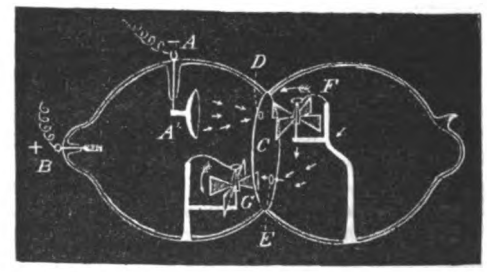


FIG. 6.—P = 0·001 MM.

On passing the current with the concave pole negative, the small vanes rotate in such a manner as to prove that at this high exhaustion a stream of molecules issues from the lower hole in the diaphragm, whilst at the same time a stream of freshly charged molecules is forced by the negative pole through the upper hole.

This view of the ultra-gaseous state of matter is advanced merely as a working hypothesis, which, in the present state of our knowledge, may be regarded as a necessary help, to be retained only so long as it proves useful. In experimental research early hypotheses have necessarily to be modified, or adjusted, or perhaps entirely abandoned, in deference to more accurate observations. Dumas said, truly, that hypotheses were like crutches, which we throw away when we are able to walk without them.

* Abstract of Presidential Address given by Mr. William Crookes, F.R.S., before the Institution of Electrical Engineers on the 15th inst.

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Radiant Matter and "Radiant Electrode Matter."—In recording my investigations on the subject of radiant matter and the state of gaseous residues in high vacua under electrical strain, I must refer to certain attacks on the views I have propounded. Dr. Puluj's paper concerns me most, as the author has set himself vigorously to the task of opposing my conclusions. Dr. Puluj has no authority for linking my theory of a fourth state of matter with the highly-transcendental doctrine of four dimensional space. I could quote numerous passages from my writings to show that what I meant and said was the mean free path as amplified and modified by the electrification. In this view I am supported by Professor Schuster, who distinctly admits that the mean free path of an electrified molecule may differ from that of one in its ordinary state.

The greatest difference between Puluj and myself lies in his statement that "*the matter which fills the dark space consists of mechanically detached particles of the electrodes which are charged with statical negative electricity, and move progressively in a straight direction.*"

To these mechanically detached particles of the electrodes, "of different sizes, often large lumps," Puluj attributes all the phenomena of heat, force, and phosphorence that I from time to time have described in my several papers.

Puluj declares that the phenomena I have described in high vacua are produced by his irregularly shaped lumps of radiant electrode matter. My contention is that they are produced by radiant matter of the residual molecules of gas.

Some metals, when used for the negative electrode in a vacuum tube, volatilise more or less rapidly, coating any object in their neighbourhood with a very even film. Aluminium, however, seems exempt from this volatility. Hence, and for other reasons, it is generally used for electrodes.

If, then, the phenomena in a high vacuum are due to the "electrode matter," the more volatile the metal used the greater should be the effect.

Here is a tube, Fig. 7 (P = 0·00068 mm., or 0·9 M.), with two negative electrodes A A^1, so placed as to project two luminous spots on the phosphorescent glass of the tube. One electrode (A^1) is of pure silver, a volatile metal, the other (A) is of aluminium, practically non-volatile. A quantity of "electrode matter" will be shot off from the silver pole and practically none from the aluminium pole; but in each case the phosphorescence (C C^1) is identical. Had the radiant electrode matter been the active agent the more intense phosphorescence would proceed from the more volatile pole.

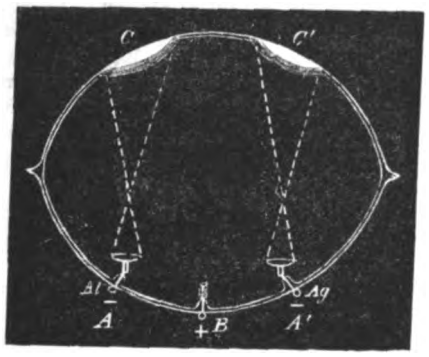


FIG. 7.—P = 0·00068 MM.

The identity of action of silver and aluminium in the first case, and the non-projection of silver in this second instance, in themselves are sufficient to condemn Dr. Puluj's hypothesis, since they prove that phosphorescence is independent of the material of the negative electrode. In front of me is a set of tubes that to my mind puts the matter wholly beyond doubt. The tubes contain no inside electrodes with the residual gaseous molecules, and with them I will proceed to give some of the most striking radiant matter experiments without any inner metallic poles at all.

In all these tubes the electrodes, which are of silver, are on the outside, the current acting through the body of the glass. The first tube contains gas only slightly rarefied and at the stratification stage. It is simply a closed glass cylinder, with a coat of silver deposited outside at each end, and exhausted to a pressure of 2 mm. The outline of the tube is shown in Fig. 8. I pass a current, and, as you see, the stratifications, though faint, are perfectly formed.

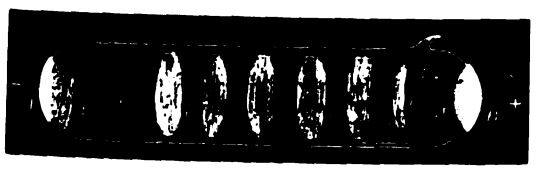


FIG. 8.—P = 2 MM.

The next stage, dealing with more rarefied matter, is that of phosphorescence. Here is an egg-shaped bulb, shown in Fig. 9, containing some pure yttria and a few rough rubies. The positive electrode B is on the bottom of the tube under the phosphorescent material, the negative A is on the upper part of the tube.

A shadow of an object inside a bulb can also be projected on to the opposite wall of the bulb by means of an outside pole.

Passing to the next phenomenon, I proceed to show the production of mechanical energy in a tube without internal poles. It is shown in Fig. 10 (P.=0·001 mm., or 1·3 M.). It contains a light wheel of aluminium, carrying vanes of transparent mica, the poles A B being in such a position outside that the molecular focus falls upon the vanes on one side only. The wheel rotates rapidly, reversing in direction as I reverse the current.

All the old "radiant matter" effects can be produced in tubes containing no metallic electrodes to volatilise. It may be suggested that the sides of the tube in contact with the outside poles become electrodes in this case, and that particles of the glass itself may be torn off and projected across and so produce the effects. This is a strong argument, which fortunately can be tested by experiment. In the case of this tube, Fig. 11 (P. = 0·00068 mm., or 0·9 M.), the bulb is made of lead glass phosphorescing blue under molecular bombardment. Inside the bulb, completely covering the part that would form the negative pole A, I have painted a substantial coat of yttria so as to interpose a layer of this earth between the glass and the inside of the tube. The negative and positive poles are silver discs on the outside of the bulb, A being the negative and B the positive pole. If, therefore, particles are torn off and projected across the tube to cause phosphorescence, these particles will not be particles of glass, but yttria, and the spot of phosphorescent light C on the opposite side of the bulb will not be the dull blue of lead glass, but the golden yellow of yttria. You see there is no such indication; the glass phosphoresces with its usual blue glow, and there is no evidence that a single particle of yttria is striking it.

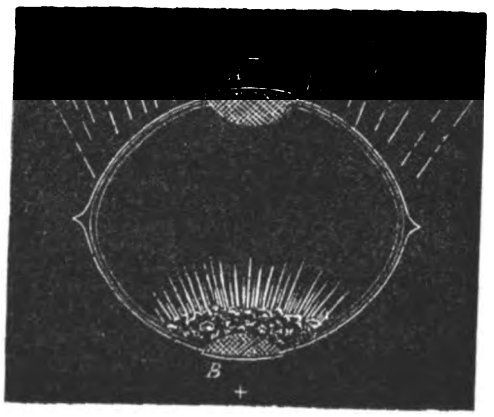


FIG. 9.—P = 0·00068 MM.

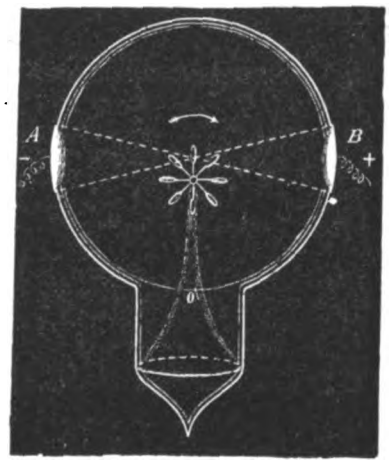


FIG. 10.—P = 0·001 MM.

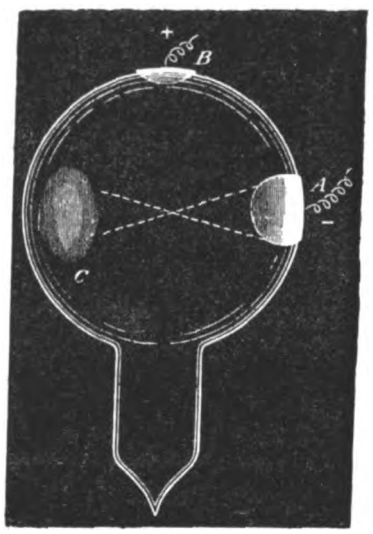


FIG. 11.—P = 0·00068 MM.

Witnessing these effects I think you will agree I am justified in adhering to my original theory that the phenomena are caused by the radiant matter of the residual gaseous molecules, and certainly not by the torn-off particles of the negative electrode.

(To be continued.)

ORGANIC ANTISEPTIC COMPOUNDS.

THE late Dr. Carnelly contributed to the Chemical Society, just before his death, the results of an investigation to determine the influence of atomic arrangement on the antiseptic properties of organic compounds. It is well known that within recent years many organic compounds have been proposed and are actually in use in antiseptic treatment, and as good preservatives and from an economical point of view, as well as of theoretical interest, it is important to ascertain what factors determine the antiseptic nature of the bodies referred to. Most of the physical properties of organic compounds have been shown to be determined by the orientation or relative position of the various elements or groups in the molecule, and there can be no doubt that the "germ-destroying" property will also bear some definite relation to the constitution of the compound. In Professor Carnelly's experiments sterilised peptogelatine, containing a known weight of the antiseptic, was inoculated by exposure in a dusty room for fifteen minutes, and, after the lapse of some days, the surface of the jelly was examined for growths or colonies of micro-organisms. By varying the amount of antiseptic it was quite easy to hit the point so that a milligram more or less of the substance was sufficient to reverse the result, and in this way it would be possible to arrive at what may be called the fatal dose, or limit of safety, in employing any given antiseptic as a food preservative. So far as the investigation has at present been conducted, it has been proved that among the di-derivatives of benzene, the *para*, or most symmetrical compounds, are usually more powerfully antiseptic than the corresponding *ortho* and *meta* compounds. The oxy-benzoic acids are, however, an important exception to this rule, the *ortho* acid (salicylic) being far more powerful in its action than its two isomers. The phenols and nitro-compounds appear to have a relatively high antiseptic power, so that among the above derivatives of benzene this property culminates in para-nitrophenol.

LUBRICATING OILS AND GREASES.

AT the meeting of the associates of the Insurance Institute of Manchester, held on the 14th inst., a paper on the above subject was read by the county analyst, Mr. J. Carter Bell, A.R.S.M. For the purpose of making the paper thoroughly practical Mr. Bell divided the subject into the following queries, which he then proceeded to answer, viz.:—(1) What are mineral oils made from? (2) With what are they mixed or blended for lubricants? (3) If not mixed, are they more dangerous than mixed or blended? (4) What are the flashing points of oils at present in use? (5) Are any "low flash" oils now used? (6) Will mineral oils on waste cause spontaneous combustion? If not, why? (7) State any danger of fire from "friction" in the use of these oils. (8) From what are lubricating greases made, and which kind are dangerous?

With regard to question (1) Mr. Bell stated that mineral oils are made from natural oil and shale. The natural oil is obtained from America and Baku (in Russia); the shale oil is obtained from the distillation of shale in Scotland. The Russian oil supply is increasing at an enormous rate, and in the future bids fair to supplant America and Scotland. Thus, in the first five months of 1890, Russia exported 828 million pounds, being an excess of 270 million pounds over the same period of 1889. (2) In the preparation of lubricants for textile machinery mineral oils are commonly blended in various proportions with animal oils, such as neatsfoot oil, lard oil, tallow oil, and occasionally sperm oil, and not unfrequently with olive oil. (3) As the "flashing points" of the leading animal and vegetable oils range from 100° to 150° Fahr. above those of ordinary mineral lubricating oils, and as the addition of any considerable percentage of fatty oil to mineral oil produces an oil having its flash point proportionately above that of the pure mineral oil, it seems reasonable to suppose that a well-blended oil is safer than a pure mineral oil, and not only on account of its greater power in reducing friction and in preventing increase in temperature, but on account of its higher flash point. (4) The flashing points of oils in use are on an average over 350° Fahr., and oils obtained from first-class manufacturers are from 360° to 370°, and therefore insurance companies should lay down a hard and fast rule that no lubricating oil should be used in any mill that has a lower flash point than 350° Fahr., and that lost more than 5 per cent. in twelve hours at 140° Fahr. The first-class oil manufacturers would be glad, he said, to hear that such was the decision of the Insurance Institute. (5) Very few low flash oils are now in use; from an examination of about 170 oils, only 14 per cent. flashed under 350° Fahr. (6) Mineral oils on waste will not

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cause spontaneous combustion, because, being hydrocarbons, they are not liable to oxidation, and a mixture of mineral and animal oil is also not liable to spontaneous combustion, unless the animal oil is in very large excess, and even then the danger would be very small. (7) It is difficult, if not impossible, to establish any graduated ratio of danger in relation to the flashing points of oil, but it must be evident that in the event of a journal or bearing becoming heated to a temperature approaching that of the flashing points of ordinary lubricating oils, the lower the flashing point of the oil in use on that bearing, the sooner will it produce an atmosphere of inflammable and explosive gas ready to be ignited by any spark from the heated machinery, and to communicate flame to any material in the neighbourhood. (8) Lubricating greases should be made from mixtures of tallow and palm oil mixed with other oils, the flash points of which should be high. The most dangerous greases are those which are made from the refuse of coal tar products, such as anthracene oil, dead oils, creosote mixed with lime, steatite, plumbago, sulphur, &c. The grease which was in use at a cotton mill near Manchester, recently destroyed by fire, was made from tar oils and anthracene. This was highly inflammable, and the grease, when once fired, was not easily put out. Snch a compound should never be allowed to be used in any mill.

An interesting discussion followed the reading of this paper, and many important points were raised, which were fully answered by Mr. Bell, after which a vote of thanks was accorded him for his valuable paper.

THE "JUBILEE" OF THE CHEMICAL SOCIETY.

The Chemical Society of London is the eldest among chemical societies, and, having been founded in 1841, it is now in the fiftieth year of its existence. Arrangements have been made to celebrate this important occurrence in the history of the Society. The first meeting of the Society was held on February 23rd, 1841, in the house of the Society of Arts, John Street, Adelphi, and in the report of this meeting we find the well-known names of Andrews, Brande, Daniell, De La Rue, Fownes, Graham, Grove, Lyon Playfair, Stenhouse, Warington, and others among the list of original members. A provisional committee was appointed to draw up a report for the government of the Society, and at the second meeting this report was presented and adopted, and Professor T. Graham was elected the first President of the Society. On April 13th of the same year the Society commenced work by the reading of a paper "On the Preparation and Formation of Yellow Prussiate of Potash," by Professor Liebig. After publishing memoirs for a few years at irregular intervals, the council changed the publication of the Society to a quarterly journal, and finally this was supplanted by the present well-known journal of the Society issued monthly, which now not only publishes the transactions of the Society, but gives a monthly digest of foreign chemical literature. Within the last few years the Society has published proceedings as soon after the reading of papers as possible, containing an abstract or preliminary notice of the author's communications to the Society. The "Jubilee" celebrations include a meeting on February 24th, at 3 to 5 o'clock, at the Society of Arts, where the original meeting took place on February 23rd, 1841, at which the formation of the Society was decided on. At this meeting various addresses will be delivered, and delegates from other societies will be received. On the evening of the same day the President and Council will hold a reception at the Goldsmiths' Hall, which has been placed at the disposal of the Society for the purpose by the Worshipful Company of Goldsmiths. On the evening of February 25th the Fellows and their friends will dine together at the Hôtel Métropole.

Notes.

PERUVIAN RAILWAYS.

The new Verrugas Bridge on the Lima and Oroya Railway in Peru has recently been completed. This bridge replaces the famous viaduct over the Verrugas Gorge, which was built in 1871 by the Baltimore Bridge Company (illustrated in *Industries*, Vol. II., page 38), and destroyed by a flood in March, 1889. The new bridge will be secure against such an accident, inasmuch as there are no piers in the centre of the ravine which it crosses, the undermining of which was the cause of the failure of the old viaduct. The new bridge is of the cantilever type, 575ft. long, and is supported on two iron piers. The cantilever arms are each 235ft. long, and the suspended span is 105ft. At the centre it is 250ft. above the bottom of the valley. The new bridge was designed by Mr. L. L. Buck, M.Am.Soc.C.E., and was constructed by Messrs. Cooper, Hewitt, & Co., Trenton, N.J. The Oroya Railway has its present terminus at Chicla, eighty-seven miles from Callao, and 12,300ft. above the sea level. Arrangements are being made to complete the road from that point to the Cerro di Pasco Mines, and thence to a point on the upper waters of the Amazon.

ELECTRIC TRACTION.

It is reported by the London correspondent of the *Elektrotechnische Zeitschrift* that the Barking line of accumulator cars is being run at a heavy loss. The depreciation of the accumulators is stated to cost at least 2d. per car mile, and at the contract price of 4½d. per car mile the General Electric Power and Traction Company, Limited, are said to be losing 1d. per car mile. In the interests of electric traction in this country it would be well if this assertion were either confirmed or corrected.

FLEXIBLE MOULDINGS FOR ELECTRIC LIGHTING PURPOSES.

For ingenious practical contrivances we must generally turn to America. Mr. John A. Seely, of New York, has, according to our American contemporary, the *Electrical Engineer*, brought out a flexible moulding. The wires, already well insulated, are imbedded in a flexible insulating material, which is moulded so as to have the same appearance as the usual wooden cases. This moulding has the advantage, however, that it can be bent round corners if they are not too sharp.

SURFACE LEAKAGE IN ELECTRIC LIGHTING.

Now that electrical supply companies demand a very high standard of insulation before they will connect a house to their systems, the surface leakage question comes to the front. In many cases there will be as much leakage in one lamp holder exposed to the weather as a door light or gate light as in all the rest of the installation. All fittings exposed to vapour condensation from fogs and moist air should be made perfectly water-tight by some elastic packing, so that condensation cannot give rise to surface leakage.

VACUUM TUBES.

Mr. Crookes' presidential address to the Institution of Electrical Engineers was of unusual interest, owing to the large number of experiments shown. Engineers are a little apt to look upon vacuum tubes as of interest only from a purely research point of view. Is it unlikely, however, that the light of the future, which is to take little power and develop little heat, will be some sort of vacuum discharge? Vacuum tube lamps have already been used or proposed by Trouvé and others, but so far have not been successful.

RAILWAY CONSTRUCTION IN THE UNITED STATES IN 1890.

During the past year there were constructed in the United States 6,080 miles of railway, which is somewhat below the average of the previous ten years, although slightly greater than that of 1889. The Eastern States are pretty well supplied with railways, and therefore the greater part of the construction has taken place in the Southern, South-Western, and North-Western States. The latter has had the most rapid rate of growth, many important extensions having been made, the Great Northern having pushed its way nearly to the Rocky Mountains. With these exceptions, however, the greater part of last year's additions consist of branch and supplementary lines, rendered necessary by increased population and traffic.

NEW ZEALAND RAILWAY CARRIAGES.

The *N. Z. Railway Review* states that an improved railway carriage has been placed upon the Wellington-Taranaki line. Two sets of carriages, each comprising one first-class and one second-class vehicle, have just been turned out of the Petone Government workshops, and reserve sets are also being manufactured, and expected to be completed shortly. Each first-class carriage is mounted on a double-bogie frame. Exterior balcony runs along one side of the carriage for half its length, to enable passengers to indulge in a promenade, the danger of falling off being obviated by an iron railing and lattice-work. Abreast of this balcony there are three separate compartments, viz., a smoking recess luxuriously fitted up, a well-appointed lavatory, and a comfortable cushioned and padded section available by engagement by private parties. It is seated for six persons. The remaining half of the carriage is fitted along one side with reversible double cross seats, which are of the American pattern, but with wooden arm-rests. Along the other side there is a comfortable couch running longitudinally. Another important feature is that the two smaller compartments can be readily provided with beds for the accommodation of invalid passengers. The second-class carriages have been furnished with lavatories, and in other respects improved as compared with those used on other lines. New Zealand timber and other material have been used throughout in construction. These carriages were made at the Addington workshops, and mounted and decorated at the Petone shops under the superintendence of Mr. Beatty.

ELECTRICAL HEATERS.

In the United States quite a large business is done in electrical heaters. At first sight this method appears an expensive way of heating, but on further consideration this is seen to be hardly the case. A fire sends most of its heat up the chimney—that is to say, it has a very much lower efficiency than a central station. In addition to this, it causes dirt in the house, and cannot be turned on or off just when wanted. It is not likely that we will use electric stoves instead of fire, but electric heaters are so very much more convenient that they will probably come into very general use. For instance, if a person is writing, his feet often get cold, and it is almost impossible to arrange a fire to keep them warm, especially during such weather as has been experienced lately. An electric heater, taking about twenty watts, and costing less than a farthing an hour, will do. To boil a kettle containing a couple of pints of cold water needs, theoretically, 125 watt hours, or a penny-worth of energy. If the kettle is coated with felt, and is heated from the inside quickly, this amount of energy should be nearly enough. In 1885 Mr. J. S. Sellon exhibited electrical foot-warmers at the Inventions Exhibition, and since then various engineers, such as Messrs. Ferranti, Madgen, Gay, and Hall, have been working in the same direction. For such purposes as keeping sleeping children warm at night, of course nothing can compete with electric heaters. In the United States it is said that instead of hot-water tins vessels containing fused acetate of soda are used. The latent heat of fusion is great, so they keep at one temperature a long time. Even they can hardly compete with electrical heating when once introduced.

NEW GRAVING DOCK AT BOMBAY.

The new graving dock, which the shipping interests of the port of Bombay have so long demanded, is so far advanced that it is likely to be ready for use in the course of next month. The dimensions of the new dock are as follows:—Length of floor, 500ft.; extreme length available for docking purposes, 530ft.; width at coping, 90ft.; width at floor, 62ft.; depth of dock at head, 33ft.; depth of stern, 34ft.; available depth for docking at H.W.O.S.T., 27ft. 3in.; width of entrance, 65ft. 6in. The work is very substantial, states the *Indian Engineer*, no less than 140,000 cubic feet of dressed stone and 32,000 cubic yards of rubble masonry having been utilised in the construction. The dock will hold about 7,000,000 gallons of water, which will be filled through culverts placed on either side of the entrance, and with the three powerful 36in. centrifugal pumps, which have been supplied by Messrs. James Watt & Co., Birmingham, it will be possible to empty the dock within the space of three hours, which means that the pumps will have to deal with not less than 40,000 gallons per minute. It may here be stated that the caisson was built by Messrs. J. & G. Rennie, and put together in Bombay in the early part of last year. All, therefore, that now remains to finish the dock is the erection of the engine-house, and this is being pushed forward as speedily as possible. This portion of the work, which could not, for many reasons, be proceeded with while the other work was in progress, is now well in hand, and there is not the least doubt but that everything will be quite ready for the opening of the dock in the course of next month.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

12th January, 1891.

541. Hamilton, J. ..... Steam engine governors.
547. Fowler, A. B. ..... Buffing, sand papering, or heel scouring machines.
552. Burrell, F. J. ..... Pneumatic guns.
561. Briercliffe, J. R. G. ..... Speed regulators of motive power engines.
571. Halsey, T. P. C. ..... Jury shafts for propellers.
574. Riedinger, A. (of the Kommandit-gesellschaft für Popp'sche Druckluftanlagon, August Riedinger & Co.) ..... Engine governor.
578. Bourgoin & Decorce ..... Gas making apparatus.
579. Saville, A. ..... Boring machine and self-centreing chuck for same.

13th January, 1891.

603. Ineson, B. ..... Gear shaft for weaving purposes.
610. Cauthebley, H. ..... Motive power engines.
615. Allison, H. J. ..... Type-writing machines (*The Transatlantic Machine Company*).
619. Hutchison, R. ..... Jacquard machines.
624. American Elevator Company ..... Electrical elevator apparatus (*Otis Brothers & Co.*).
626. Anderson, R. W. ..... Sewing machines.
634. Kingston, Swallow, & Jeffrey ..... Railway chairs and wedges.
636. Jones, W. ..... Sewing machines.
637. Wells, C. ..... Steam engines.
640. Milnes & Elgar ..... Wire netting machine.
645. Greenamyer, C. V. ..... Wrenches and similar tools.
651. Newton, H. E. ..... Direct-acting duplex engines (*Worthington*).
670. Myers & Wells ..... Screw propellers.
672. Thompson, W. P. ..... Matrix-making machines (*Landsberg & Köhler*).
677. Imray, O. ..... Bolt heading machines (*Seaton & Seaton*).
682. McNeil, M. ..... Steam pressure gauges.

14th January, 1891.

694. Taylor, R., Jun. (of the Firm of Asa Lees & Co., Ld.) ..... Machines for opening and clearing cotton and other fibres.
695. Taylor, R., Jun. (of the Firm of Asa Lees & Co., Ld.) ..... Grinding the flats of carding engines.
696. Macqueen, J. ..... Spindles used in spinning or doubling fibrous materials.
708. Griffin, S. ..... Hydrocarbon motors.
710. Sheldon, J. ..... Differential pulley blocks.
719. Downing, G. C. ..... Lubricators (*Mense*).
724. Nield, J. ..... Receptacle for the rollers of mules or other spinning frames.
730. Bolze, H. A. ..... Double-acting injector apparatus.
734. Bunch, W. S. ..... Wrenches. (3rd September, 1890.)
736. McCool, W. A. ..... Metal bar, &c., polishing machines.

15th January, 1891.

741. Adams, M. J. ..... Engines and motors.
742. Stoner, W. ..... Pulley for regulating and insuring uniform speed in gas, steam, or other engines and machinery.
751. Stuart, D. ..... Fibre-cleaning machines.
770. Horton, J. ..... Apparatus for preventing the greasing of fabrics in tentering machines.
771. Binns, G. A. ..... Reed stripper for carding engines.
775. Richards, L. H. ..... Typewriting machines.
782. Ainsworth, I. N. ..... Loom pickers.
784. Jameson, J. ..... Automatic governor for steam engines (*Tuckfield*).
788. Wrigley, T. ..... Spindles and bobbins for ring and traveller spinning and doubling frames.
791. Brewin, A. ..... Warp lace machines.
798. Mottershall & Macey ... Typewriting machines.

16th January, 1891.

815. Wilson, A. ..... Steering gear.
816. MacCallum, P. F. ..... Caloric engines.
825. Sutcliffe, W. ..... Looms.
826. Brown & Mackay ..... Paper-making machines.
834. Miller, A. ..... Gas, hydrocarbon, and other explosive power engines.
835. Dunn & Dunn ..... Water gauges of steam boilers.
841. Von Blinsdorf & Adler Railway signalling apparatus.
842. Kämmerer, P. ..... Automatic measure-testing machines.
851. Davis & Taylor ..... Railway fog signalling apparatus.
856. Stalker, J. J. ..... Steam engines.

17th January, 1891.

862. Turton, W. H. ..... Locomotive boiler.
863. Walker & Walker ..... Lubricator.
870. Tweedale, J. T. ..... Stop motions for cotton preparing machinery.
879. Hargreaves, R. H. ..... Water tube steam boiler.
882. Atkinson, J. ..... Fluid pumps, meters, and motors.
883. Ramsey & Croasdell ..... Rock drilling.
888. Weiss, R. ..... Weaving apparatus
889. Woodhouse & Rawson United, Ld. ..... Apparatus for manufacturing corrugated lead boxes for electric accumulators (*Steanes*).
894. Lindley, H. ..... Valve operating mechanism of steam engines.
898. Barton, J. B. ..... Water gauges for steam boilers.

ELECTRICITY.

12th January, 1891.

584. Hautin & Leblanc ..... Alternate current dynamo electric motors.
587. Berlyn, F. H. P. ..... Incandescent lamps.
593. Coad, T. ..... Primary batteries.

13th January, 1891.

608. Parker, T. ..... Conduits for street electric conductors.
616. Allison, H. J. ..... Carbon pencils for arc lamps (*Ward*).
617. Allison, H. J. ..... Arc lamps (*Ward*).
647. Lake, H. H. ..... Electrical measuring instruments (*Weston*).
649. Lake, H. H. ..... Electric elevators (*Eickemeyer*).
657. Lake, H. H. ..... Conduits for electric conductors (*Lord*).
667. Thompson, W. P. ..... Electrodes for voltaic accumulators (*The Hess Electric Storage Battery Company*).
668. Thompson, W. P. ..... Voltaic accumulators (*The Hess Electric Storage Battery Company*).
669. Puluj, J. ..... Cut-outs.
675. Ball, R. E. ..... Electric regulator.

15th January, 1891.

743. Rooper, W. O. ..... Application of electricity for mining purposes.

16th January, 1891.

846. Morten, W. V. ..... Electrical cables.

17th January, 1891.

871. Bennett & Hides ..... Telephone transmitters.
884. Wells, C. ..... Apparatus for the production of electricity.
899. Eager & Milburn ..... Electric cells or batteries.
908. Ross, F. A. ..... Insulators for electric wires.
910. Clark, A. M. ..... Electromagnetic mechanism for controlling the transmission of power (*Kilbourn*).

CHEMISTRY.

12th January, 1891.

551. Dawson & Hirsch ..... Colouring matters.
583. Durand, Huguenin, & D'Andiran (trading as La Société L. Durand, Huguenin, & Cie.) ... Colouring matters. (13th June, 1890.)

13th January, 1891.

684. Astrop & Parker ..... Manufacture of carbonate of lead or white lead and apparatus therefor.

16th January, 1891.

843. André & Curtis ..... Manufacture of gunpowder and apparatus therefor.
857. Pitt, S. ..... Colouring matters from triphenylmethane (*L. Cassella & Co.*).

17th January, 1891.

891. Imray, O. ..... Obtaining pure nitric acid (*The Farbwerke Greisheim-on-Main*).

MISCELLANEOUS.

12th January, 1891.

549. Noble, K. D. ..... Driving of screw propellers.
557. Tucker & Harbord ..... Removal of scale from iron or steel sheets, plates, &c., and apparatus therefor.
566. Drake, H. ..... Aërial and submarine propellers.
595. Wise, W. L. ..... Process of dyeing or treating fibres (*Schniter*).

14th January, 1891.

707. Sinnette, F. J. ..... Rivets, bolts, and nuts.

16th January, 1891.

823. Williams & Morris ..... Piston rings.

17th January, 1891.

892. Haddan, H. J. ..... Rivet and bolt cutter (*Helwig*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

17471. Budd. 18294. Flint & Michell.
20486. Britchett & Low.

1890.

498. Vialet-Chabrand.
865. Lorrain.
905. Coad.
993. John Wigham Edmundson & Margaret Clarke (Executrix of the late William Clarke).
1198. O'Donnell & Timmis.
1337. Charles Burgon & Mary Ann Marshall (Executrix of the late Edward Marshall).
1566. Toller & Mabbs.
1821. Phillips & Lewis.
2002. Shenton (*Berg*).
2083. Thuby.
2206. Reeve.
2274. Wickstead.
2284. Higginbottom.
2343. Wrigley.
2406. Strange & McMahon.
2482. Adair.
2491. Gritten & Parmley.
2502. Renshaw.
2556. Easton.
2623. Brennan.
2655. Kingsbury (*Western Electric Company*).
2845. Mackrill.
2903. Thomson & Rogers.
2997. Atkins.
3230. Tillett.
3315. Wedlake.
3391. Pohl.
3545. Bradford.
3613. Nutter.
3676. Lever, Holland, & Todd.
3774. Abel (*The Gas Motoren Fabrik Deutz*).
3809. Keith.
3869. Calvert & Hunt.
3876. Middleton.
3885. Cade.
3906. Nobes & Jackson.
3927. Griffiths.
3976. Herries.
4012. Douse.
4052. Harrison & Harrison.
4098. Read.
4132. Dunlop.
4159. Steiger-Meyer.
4161. Steiger-Meyer.
4206. Willoughby & Lynde.
4213. Tyndale.
4365. Bolden.
4594. Jones.
4723. Milnes.
4908. Fry.
4971. Blyth.
5221. Mee & Hand.
5383. Hamilton & Young.
5695. Gill.
6289. Gregson.
7146. Stuart & Binney.
7586. Lake (*Löbell*).
12144. O'Connor. (6th January, 1890.)
12420. Jensen (*Isaac Blum*).
12904. Elliott.
13017. Lake (*Ferreira*).
13557. Dixon. (6th February, 1890.)
14823. White.
15286. Horn (*Lennox*).
15380. Morton.
16283. Battye.
16433. Wall.
16724. Renshaw.
16740. Baird.
17012. Anders & Elliot.
17617. Mitchell.
17752. Webb.
17780. Barker (*Rodwell & Moore*).
17846. Pratt.
18027. Gunesch.
18128. Bateman, McKee, & Butler.
18263. Jollye.
608. Becker.
876. Darling & Darling.
911. Pitt (*Atherton*).
1023. Lennox.
1072. Binswanger.
1100. Paterson.
1101. Paterson.
1197. John Patrick O'Donnell, William Smith, & Illius Augustus Timmis.
1535. Wilkinson.
1551. Watson & Watson.
1736. Hall & Whitfield.
1913. Thompson (*Carez*).
2016. Marsh.
2153. Dewar.
2218. Marshall & Fitzgerald.
2334. Robson.
2384. De la Touche.
2423. Wylie.
2490. Edwards (*Wehmann & Muller*).
2512. Walker.
2582. Moss & Moss.
2654. Kingsbury (*Western Electric Company*).
2664. Embrey & Parry.
2869. Boult (*Eichbaum*).
2990. Stephenson.
3146. Wood & Davies.
3302. McDougall, McDougall, & Sugden.
3508. Helliwell.
3573. Parsons.
3664. Marks.
3677. Lever, Holland, & Todd.
3779. Edwards (*Ahrens*).
3806. Mackay.
3849. Smith & Cooper.
3874. Williams.
3877. Challenor.
3887. Thompson (*Prichard*).
3913. Kapp, Johnson, & Phillips.
3999. Dawson.
4014. Banks.
4067. Heath, Tillam, & Harrison.
4142. Verity.
4160. Steiger-Meyer.
4164. Abel (*The Gas Motoren Fabrik Deutz*).
4292. Bennet.
4554. Shoveller.
4669. Tyer.
4892. Allen, Wright, & Allen.
5164. Hargreaves.
5357. Schatz.
5531. Imray (*English*).
6056. Bradley.
6400. Von Langer & Cooper (*Pietzka*).
7949. Bartle, Evans, & Smith.
12266. Attock.
12884. Gladstone.
12959. Hunt.
13429. Riley.
14346. Oldroyd.
14769. Hartmann.
15269. Jordan & Wallis.
15379. Platt.
15755. Rateau.
16337. Wesson.
16484. Lucas. (17th March, 1890.)
16960. Cooper & Hillman.
17370. Andres.
17740. Cox, Robinson, & Gritton.
17798. Gillott.
17806. Browne (*Remus*).
17932. Calantarients.
18117. McIntire.
18136. Wylie.
18171. Thompson (*Coomes & Hyde*).

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18808. Hamilton.
18654. The Bottle Seal Company, Ld. (*Painter*).
18989. Wittkowsky.
19110. Morrell.
19148. Thompson & Husbands.
19153. Norton & Adcock.
19157. Koch & Peto.
19198. Hirschler.
19265. Browne (*Butter*).
19372. Kernaghan.
19420. Green. (1st August, 1890.)
19665. Dewey.
19781. Knoop.
20019. Sabold.
20077. Boult (*Hair*).
20241. Benson.
20308. Meili.
20327. Oldroyd & Oldroyd.
20362. Grant & Rumsay.
20531. Brennan.
20606. Regnault.
18688. Hartmann & Braun.
18915. Thompson (*Land*).
18972. Lee.
19077. Allison (*Cary*).
19139. Thompson (*Faulhaber*).
19152. Lyman.
19155. Lake (*Hatch*).
19174. Newton (*The Essex Universal Typewriter Company*).
19404. Amsden.
19569. Boult (*Outhet*).
19617. Rothwell & Rothwell.
19889. McLaren.
20072. Little.
20225. Klein.
20301. Carter. (12th May, 1890.)
20330. Fox.
20403. Ficker & Hentschel.
20532. Brennan.
20612. White.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Stop Valves.—*G. M. Marchant, Huddersfield.*—The invention relates to expanding plugs for parallel screw valves. Fig. 1 in the illustrations is a vertical section, and Figs. 2 and 3 cross sections of a valve embracing the principle of this invention. On each side of the nut A are two halves of a plug or block B and C divided vertically in an angular direction, as shown in plan view (Fig. 2). These plugs B and C are each provided with a wedged or inclined side piece D, and are arranged to come into contact with inclined or wedge-shaped surfaces E formed within the valve casing F, so that when the spindle G is operated in a downward direction the side pieces D are forced down the inclined surfaces E in such a manner as to force the plugs B and

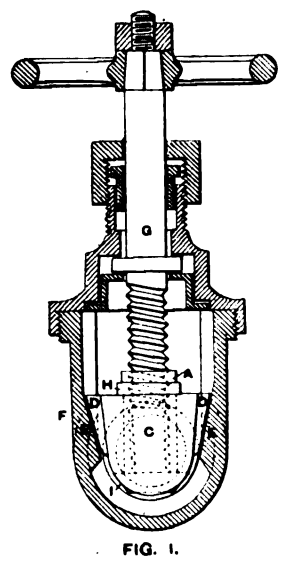


FIG. 1.

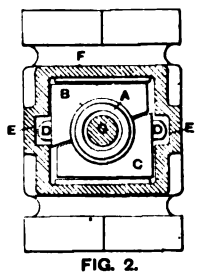


FIG. 2.

FIG. 3.

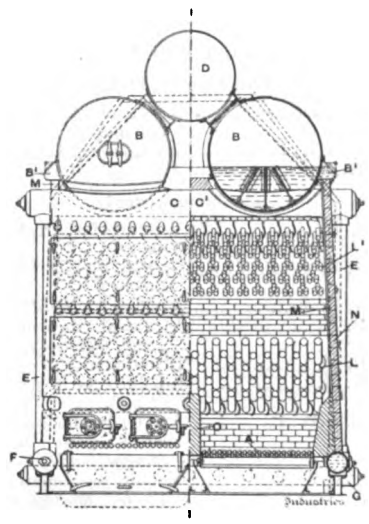
C sideways laterally, which brings the two halves of the divided plug into position, shown in Fig. 3, the effect of which is to widen the two plugs, forcing them apart in the direction indicated by arrows, whereby the outer face of each plug is thrust with considerable pressure against the interual face of the valve. On the screwed spindle G being reversed and the side pieces D made to slide upwards vertically, the parts B and C are slackened to permit of the valve being opened. The two halves of the plug B and C surround the nut A between the upper collar H and the lower collar or flange I of Fig. 1. The inventor also describes other methods of effecting the above. Claims: (1) In parallel screw-faced valves, the use of a divided plug or block having inclined or wedge-shaped surfaces operated so as to be forced against the valve seating in manner substantially as described; (2) the combination therewith of plugs expanded laterally by cam, wedge, or scroll-shaped surfaces; (3) the combination therewith of oscillating discs or expansion plugs widened laterally by cam or screwed surfaces; (4) the combination therewith of oscillating discs or expansion plugs operated in combination with intermediate plates; (5) the combination of a screwed nut and one expanding surface, operated laterally by cam, wedge, or scroll-shaped surface.—No. 1718. February 1st, 1890. 8*d*.

Looms.—*I. Kirkbridge, Colne, Lancashire.*—The invention relates to an arrangement of springs as a substitute for the weights now used to impart drag or friction to the warp beam. The chains or ropes are wound in the usual manner round the collars or necks of the warp roller, but instead of attaching such chains or ropes to the weighted levers, they are each attached to spiral springs, one at each end of the loom, connected to a cross-bar extending from spring to spring. A screw bolt, acting in a chased bracket at the centre of the bar, is employed to impart more or less tension on the springs as may be required, and a pointer moving over a fixed dial is employed to indicate the amount of pressure or tension placed upon the springs. Claims: The combination of said parts for applying friction or drag to warp beams and the employment of an indicator for giving the amount of tension applied to warp beams, substantially as described.—No. 2911. February 24th, 1890. 6*d*.

Pipe Couplings.—*R. Curry, G. Mackie, T. Souter, & G. B. Hughes, all of Newcastle-on-Tyne.*—The invention is intended to dispense with solder and screwing the ends of pipes, to accomplish which the inventors use a male and female coupling outside the pipe to force it upon a double-coned tube inside the pipe, maintaining thereby the full area of the pipe and a clear way without any resisting shoulders. In the case of joining lead or soft pipes to iron or hard pipes, the inventors use one-half of the coned tube before mentioned, with a recess in it to receive the iron pipe. This is placed inside the lead pipe, and on the iron pipe is placed a piece of lead or soft tube. The external and internal couplings are then screwed together, forcing the lead pipe on to the single cone, and the short piece of lead pipe is forced by an internal cone turned in the coupling on to the iron pipe and against the end of the single cone. Claims: Four claims are made, embracing the arrangement of pipe couplings as described, with modifications to suit the junctions of taps and cocks to pipes, &c.—No. 11346. July 21st, 1890. 6*d*.

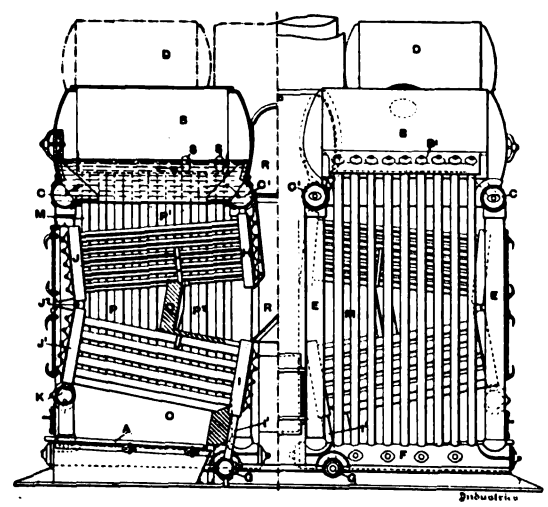
Sectional Steam Boilers.—*W. Fairweather, Glasgow.* (*N. W. Pratt, & the Babcock & Wilcox Company, New York, U.S.A.*)—A front elevation partially in section is shown in Fig. 1 of the accompanying illustrations, and Fig. 2 is a side part sectional

FIG. 1.



elevation, the fire bricks between the vertical tubes being omitted, of a double sectional steam boiler constructed according to this invention. A are the separate fire-grates. The two steam drums B placed side by side are connected together by pipes C C¹, and through the common steam drums D. E are the vertical downflow pipes supporting C and C¹ and forming a communication therewith and the longitudinal distributors F, which are connected together by transverse pipes G. The headers H are supported by and communicate with the tubes C¹. The headers I are supported by and communicate through pipes I¹ with pipes G. The headers J J¹ connected together by nipples J² are supported by transverse tubes K connected to tubes E. The headers are serpentine in form, and are connected together by water tubes L L¹ as shown. Connection is made between drums B and pipes F by means of connecting boxes B¹ and tubes M, which pipes form the side work of the furnaces, being filled in with firebrick sections N. The dividing wall O separates the fuel spaces, but after passing above the same the hot gases mingle in the common combustion spaces P P¹ passing thence through tubes L¹ into space P² separated by wall Q and thence to common flue R. In operation, the circulation is passed upward from the transverse distributors G, through the uptake tubes I¹ and

FIG. 2.



generating tubes L first, the same body of water thence circulating a second time under exposure to the hot gases through the tubes L¹, where the heating surface is furthermore increased. The opposite inclinations of the successive groups of tubes promotes the reverse circulation, the steam and water being finally delivered through the transverse pipe C¹ to the drums A. The water also circulating upwards from the pipes F, through the wall tubes M, and discharging through the openings S, at the water level in the drums, throws the currents forward in a common direction into the cross pipe C, thence downward through the downtake pipes E, chiefly at the fronts of the boilers. Nine claims are made.—No. 17673. November 4th, 1890. 8*d*.

Apparatus for Repairing Spinning Rings.—*F. M. Marcy, Worcester, Massachusetts, U.S.A.*—The apparatus for the above purpose consists of two horizontal metal plates held at a suitable distance apart by means of distance pieces. Running in a step-bearing in about the centre of the lower plate, and in a bearing in the upper plate is a vertical shaft carrying on its upper end, which projects above the upper surface of the upper plate, a cup-shaped socket to receive the spinning ring to be repaired, and which is held therein by means of a set-screw. Between the two plates this vertical spindle carries a bevel gear-wheel, which gears with a bevel pinion on one end of a horizontal shaft running in a suitable bearing formed on the under side of the upper plate. The latter carries at its other end a pulley, by means of which the power for operating the apparatus is applied. Fixed on the upper surface at one end of the upper plate is a vertical arm, to which is fixed a horizontal arm, having formed on its outer end a suitable head. This head is provided with a vertical groove, in which slides the track expanding die, and which is forced down upon the upper surface of the flanged track of the spinning ring by means of a screw passing through the upper part of the head and pressing against the end of the die. Hinged to the upper part of the head on the horizontal arm are two steel bars forming the side dies. The lower ends of these side dies are turned inwardly to form lips which extend beneath the flanged track of the spinning ring and press against the waist of the said ring. Upon the inner sides of these side dies are formed scraping lips, which in the operation of the machine are brought against the edges of the flanged track of the spinning ring. Pressure is applied to these side dies, so as to press them towards one another, by means of set screws carried in one end of swing arms, the other ends of which are attached to a rocking shaft journaled in the horizontal arm carrying the block. Eight claims are made, embracing the general construction of an apparatus as and for the purpose described, together with modifications.—No. 17706. November 4th, 1890. 8*d*.

Grinding, Milling, and Burnishing Machines.—*W. J. Hands, Harborne, Staffordshire, & A. Price, Sparkbrook, Birmingham.*—Fig. 1 in the accompanying illustrations is a front elevation, Fig. 2 an end view, and Fig. 3 a plan of an apparatus constructed according to the invention and for the purpose of dressing stamped, cast, or pressed articles. The grinding tool A is fixed on the end of a spindle B rotating in bearings C carried by a pair of triangular-shaped frames D that are mounted to turn upon a driving shaft E, so allowing the cutter to be raised or lowered. The shaft E is mounted to run in bearings F carried by standards G on a base-plate H, and carries fast and loose pulleys as shown. To the cutter spindle B is fixed a toothed wheel I that gears with another toothed wheel J fixed to

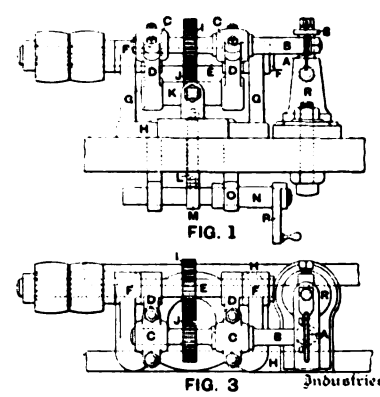


FIG. 1.

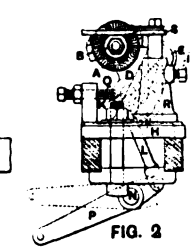

FIG. 2.

FIG. 3.

the driving shaft E, and by which the cutter spindle is driven. To enable the frames to be readily raised and lowered to suit the work to be done, they are connected by a rod K to which is jointed one end of a connecting rod L, the other end of which is jointed to a lever arm M fixed on a shaft N working in bearings O and operated by a lever handle P that may be actuated either by hand or foot. By these means the rotary cutter can be readily raised and lowered to any required position while the machine is in motion. Q is an adjustable stop screw to limit the upward movement of the frames D. R is a hollow support for a vertically adjustable rest S upon which the work to be dressed is placed. This rest is formed with a slot for the passage of the rotary cutter or burnisher, and is provided with suitable pegs and with a holding-down gauge to hold an article in position. Claims: (1) A grinding, milling, and burnishing machine constructed with a rotary cutter spindle carried in pivoted frames and capable of being raised and lowered whilst it is rotating about its axis, and mechanism capable of being actuated by hand or foot power for raising and lowering the said cutter spindle as described; (2) in a machine of the kind above referred to, a slotted rest adapted to support the article to be dressed, and provided with suitable gauge or stop pegs.—No. 18072. November 10th, 1890. 6*d*.

Cropping Machine.—*J. Beever, Huddersfield.*—The invention relates to cropping machines or "perpetuals" employed for shearing hearthrugs, carpets, and other like fabrics, the object being to prevent the end of the rug being sheared from being lifted, and so damaged by the revolving cutter used in such machines. The inventor, to accomplish this object, places close to the underside of the helical cutting edge of the revolving cutter a number of thin copper, steel, or other metal wires, arranged transversely or at an angle to the axis of the cutter. The carpet or rug to be operated upon travels underneath these wires, which prevents the edge of the fabric being drawn up by the cutter, but as the wires are fine they form no impediment to the proper shearing of the fabric. Each wire is attached to a thumbscrew arranged in suitable framework, so that the tension of the wires can be regulated. Claims: (1) In machines for cropping or shearing hearthrugs and other similar fabrics, the combination therewith of cross-wires, forks, or fingers employed in the manner and for the purpose set forth; (2) in machines for cropping fabrics, the combination of cross-wires together with means of adjusting the tension thereof in a manner substantially as described.—No. 2929. February 24th, 1890. 6*d*.

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PULLEYS.—*H. H. Lake, London.* (*F. B. West, San Francisco, California, U.S.A.*)—Sheaves or pulleys are constructed as follows according to this invention:—The outer periphery is made in two sections firmly bolted or otherwise secured together. The radial arms or spokes are each provided at their outer ends with a head or flange bevelled on its outer edge. The sections of the rims are provided, on their inner edges, with recesses, the inner walls of which are bevelled to receive the bevelled heads of the radial arms or spokes. These spokes are provided on one side with a projection or stop, so that, when the grooved rim is forced into place on the radial arms, the said rim will abut against this projection, and thus ensure the rims being fixed centrally on the radial arms. The grooved rim is secured to the radial arms by bolts passing through them and each of the bevelled heads. The pulley is divided into sections through two of the radial arms, which are provided with suitable bosses or flanges by means of which the two parts may be secured together. Three claims embrace the construction of sheaves or pulleys substantially as described.—No. 13005. August 19th, 1890. 8*d.*

CONDENSING APPARATUS FOR STEAM ENGINES.—*J. Y. Johnson, London.* (*J. A. Damey, Paris, France.*)—In the annexed illustrations Fig. 1 is a side elevation, and Fig. 2 an end elevation of

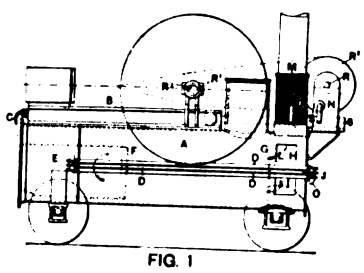


FIG. 1

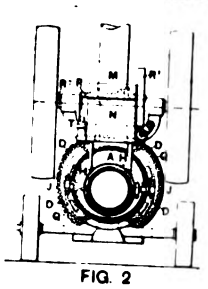


FIG. 2

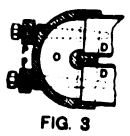


FIG. 3

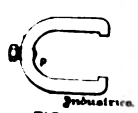


FIG. 4

a portable engine with a condensing apparatus constructed according to this invention, Figs. 3 and 4 being enlarged details thereof, and Fig. 5 a horizontal section of the air pumps. A is the boiler, the feed-water pipes of which are heated by the exhaust steam in the hollow bed-plate of the engine B, as described in a prior patent, No. 19418 of 1889, and are connected by a pipe C to the superheating pipes D arranged in the side flues and heated by the products of combustion from the fire-box E, which pass from F to G in the boiler tubes and flow under a plate H through an opening I back to the front under a horizontal partition at J, finally returning through K to the opening L leading into the upper part of the smoke-box and passing into the chimney M. The tubes D are connected together at their ends by U-shaped junction pieces O secured by bails P (Figs. 3 and 4), and are covered with a non-conducting jacket Q. N is the condenser worked by a crank R driven at a lower speed than the engines by means of pulleys R^1 R^2 (Fig. 1). With this condenser is combined an injector S in connection with a condensation indicator and a feed pump T driven from R. The two air pump pistons U (Fig. 5) are operated by connecting rods consisting of two rods V attached at their upper ends to a block V^1, with bearings working on the cranks, and formed with an eye V^2 for connecting them to the piston U of the pump. The pistons U are perforated and carry a disc U^1 of flexible material

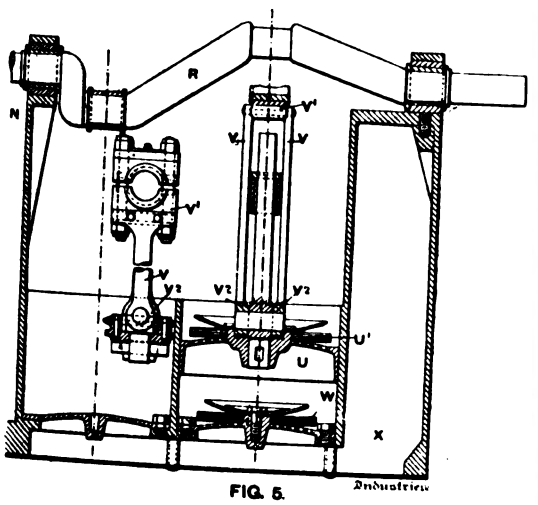


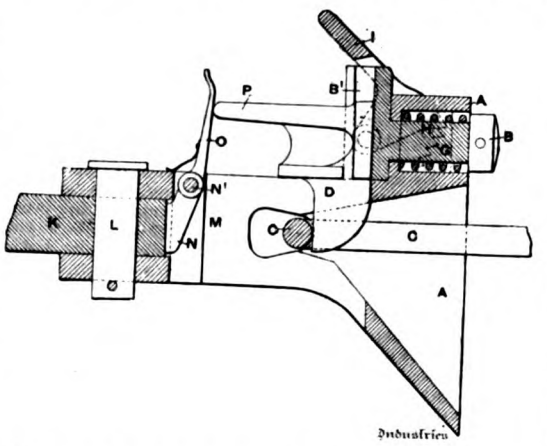
FIG. 5.

for closing such perforations. The suction valves W leading to the chamber X, in which the injection takes place, are of the usual construction. Four claims are made.—No. 19494. December 4th, 1889. 8*d.*

ELEVATORS.—*M. J. Paul, London.*—The invention relates to apparatus for coaling ships or for conveying coal or other such cargo in bulk to wharves or other places of discharge. In carrying out the invention the inventor employs a barge or "lighter" provided with a travelling bed in the form of an endless chain arranged centrally, and which, after running the complete length of the "lighter," is then inclined upwards and passes over the extremity of a structure resembling the arm of a derrick. The outer end of this derrick arm may be raised or lowered by suitable means within certain limits to suit the level at which the cargo is to be discharged. The chain constituting the travelling bed is composed of links having formed on one edge of them projections in the form of teeth which are slightly inclined in the direction in which the chain travels, so preventing the material constituting the cargo to be discharged from the "lighter" falling back when ascending the inclined derrick-arm. The material of which the cargo consists is disposed in the lighter along each side of the horizontal portion of the travelling bed, and may be rapidly transferred thereunto by manual labour. Or the floors of the coal bunkers may be inclined towards the centre of the lighter, and may be provided with sliding doors which, upon lifting, release the coal or other cargo, and permit it to fall upon the travelling bed. Two claims are made, embracing the arrangement substantially as described.—No. 2140. February 10th, 1890. 6*d.*

WHEEL VALVES.—*J. S. Smith, Nottingham.*—The invention consists of improvements in screw or wheel valves, but is also applicable to retention and other valves, in which the passage through them is closed by a plate or disc being pressed upon a seat. In applying the invention to small valves the inventor makes the seat solid with the valve casting, and it is designed to give a double bearing to the valve or disc. In section it somewhat resembles the letter L with a semi-circle described upon the horizontal line, and a quarter of a circle described tangentially to the top of the vertical line. The valve is made of a composite metal, copper and lead being used as ingredients, and its shape is a flat disc with the outer edge inclined at about 20° with the spindle, the smallest diameter being at the bottom. This valve or disc is attached by screws to a circular plate, so as to be easily replaced when worn, and the plate is carried by the spindle, and is free to rotate thereon. For "junction valves" the inventor forms the seating of a ring of brass or gun-metal fitted into the casing, the valve being made of a ring or disc of composite metal. Claims: The use in valves and other similar articles of a double seat constructed substantially as described, in combination with a disc of compressible metal or mixture of metals designed to bear upon both seats at the same time.—No. 11143. July 17th, 1890. 6*d.*

CAR COUPLINGS.—*A. E. Schurr, Romford, Essex.*—The invention refers to automatic central buffer couplings, in which the slack is automatically gathered, and at the same time the couplings are released from a clutch holding them in a central position, and allowing them to radiate to suit the curves on the railway. The annexed illustration is a sectional side elevation of such a coupling. B is the auxiliary buffer fitted to the coupling, and carrying at the rear the detent in vertical slides B^1 formed with the said buffer head B; after the coupling links C have engaged the detents D (by the lifting and falling of the said detents in the slides B^1), the said buffer or buffers B come in contact, are driven



back and carry with them the said detents D, thus gathering the slack. Each detent is held in position after the slack is gathered by a cam H (shown dotted) with lever I, which device H falls into position in toothed part G, formed on buffer head A, thereby effectually preventing the return of the detent D, and at the same time the auxiliary buffer is held withdrawn, thus allowing the main heads A to meet. The driving in of the auxiliary buffers at the same time causes the dog P to withdraw a clutch N by striking its lever arm O, which clutch has hitherto secured the draw-bar K and buffer head A in axial line with each other, and the said dog P prevents the clutch N from again gripping the draw bar and thus bringing it to, and securing it in a central position. The inventor also describes two modifications in which the auxiliary buffer is dispensed with, and the coupling link is utilised for operating the detent to take up the slack. Five claims are made, embracing the coupling as described, with modifications.—No. 2295. February 12th, 1890. 8*d.*

BALL GRINDING MACHINES.—*W. H. Wright, Buffalo, U.S.A.*—The machine for the above purpose, and constructed according to this invention, consists of following parts:—A framework, consisting of a vertical beam, on the lower end of which is formed an arm projecting outwards at right angles thereto, and the upper surface of which is of a circular shape. At its upper end or head, this beam is inclined forward in the same direction as the horizontal arm, so as to bring its end exactly over the centre of such arm. Centrally in the lower arm and in the upper end or head are formed bearings, in which runs the vertical driving shaft. At an equal distance from and on each side of this shaft are fixed two vertical rods, the upper ends of which are fixed in auxiliary arms on the head of the framework, and the lower ends being fixed on each side of the disc on the lower arm. Sliding on these two rods are two slides fixed to the periphery of an upper disc carrying on its under-side the upper grinding ring. This upper disc has an internally screwed boss in its centre, in which works a hollow screw embracing the vertical driving spindle and free to revolve, but prevented from moving longitudinally by the upper end, having a collar formed on it, which is embraced by suitable lugs fixed to the under-side of the head of the framework. Fixed below the upper grinding ring is the lower grinding ring, fixed to and carried on a disc revolved by the vertical driving spindle. In the opposite faces of the upper and lower grinding rings semicircular annular grooves are formed concentrically with the driving shaft and opposite one another, in which grooves are placed the balls to be ground. The grooves in the lower grinding ring have supplementary grooves formed in their lower sides to allow for wear. At diametrically opposite positions around the screwed boss on the upper disc are formed funnel-shaped openings leading into the interior of the upper and lower grinding rings, and in which funnels the grinding material and water, or other lubricant, is placed. This grinding material and water is so fed into the interior of the upper and lower grinding rings, and is, by centrifugal force, caused to escape between the opposite grooved faces of the rings, which are held slightly apart by the balls being ground. Three claims are made.—No. 17723. November 4th, 1890. 6*d.*

PUMPING ENGINES.—*J. Wright, London.*—Referring to the annexed illustrations, Fig. 1 is a front elevation, Fig. 2 a side elevation, Fig. 4 a vertical section, and Fig. 5 a horizontal section of an apparatus constructed according to this invention. A A^1 are the motor cylinders and B B^1 the pumping cylinders, the piston rods of the pistons of which are connected to the

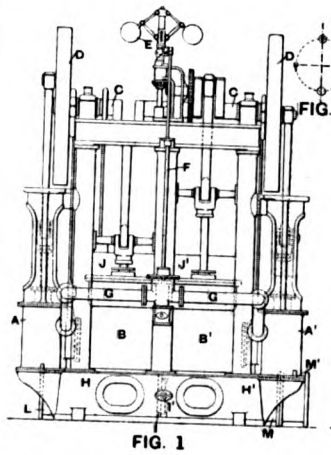


FIG. 1

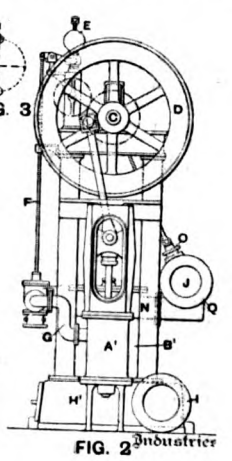


FIG. 2

crank-shaft C carrying the fly-wheels D as shown. E is an ordinary governor fixed as shown, and actuated by a gear-wheel on C, and acts by a rod F upon the throttle valve in the steam supply pipe G. The pump cylinders B B^1 at their lower ends communicate with the double chamber H H^1 divided by the partition I, and having an opening capable of being closed and opened by the valve L^1. The pump cylinders at the top communicate with a double chamber J J^1 also divided by a partition K, with an opening therein which can be closed or opened by the valve K^1. The pipe L leads from the condenser, and the pipe M leads to a water supply, which can be closed by the valve M^1. The pumps deliver by the pipes N into the chamber J provided with a pump O operated by an eccentric from the crank-shaft. This pump delivers feed-water through the pipe P from J into the boiler through a feed-water heater. The other end of J is provided with a pipe Q communicating with

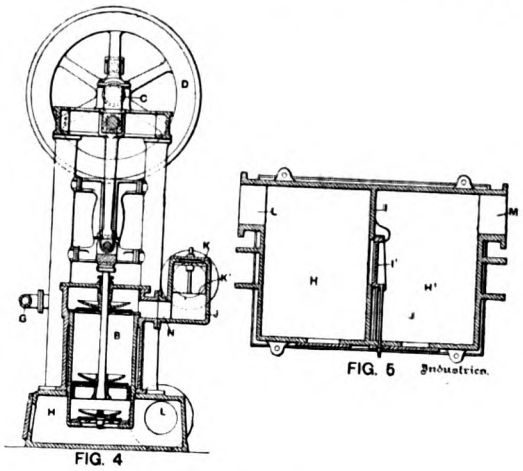


FIG. 4

FIG. 5

the water space of the condenser and operated by valve R. The apparatus may be used for pumping for any number of engines and boilers put into connection with it. Three claims are made.—No. 17859. November 6th, 1890. 6*d.*

LUBRICATORS.—*R. B. Helliwell, Liverpool.*—The lubricator constructed according to this invention is for use with lubricants of the solid class, and is intended for use on pulleys and other revolving parts of machinery, and is constructed as follows:—A cup of a shape similar to the ordinary cylindrical lubricator is used, the same having its inside turned truly cylindrical and having one hole in the centre of the bottom, passing through the stub-end and one or two holes communicating with the outer air also through the bottom. Within this cylinder a piston is fitted to move freely up and down therein, and from the centre of the piston projects downwards a tube of a size to fit easily the hole in the stub-end in which it is intended to slide, the tube being of such a length that if the piston be lifted up until it touches the cap screwed into the top of the cup, the said tube will still be within the hole. The action is as follows:—The lubricator being fixed to the boss of the pulley so that it is vertical to the axis of revolution, the piston is inserted, the cup above the top of the piston filled with lubricant, and the cap screwed on. As the whole revolves, the piston, by the action of centrifugal force, tends to force the lubricant upward, so causing it to escape through the tube in the centre of the piston to the bearing being lubricated. Above the top of the tube fixed to the piston a radial arm is pivoted on a screw screwed into the surface of the piston, which may be moved as desired to regulate the flow of the lubricant. Five claims are made, embracing the apparatus substantially as described.—No. 1124. January 22nd, 1890. 8*d.*

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COMPOUND STEAM ENGINES.—*J. Klein, Frankenthal, Germany.*—The invention refers to engines in which the high and low pressure cylinders are placed side by side, a single slide-valve being used. The valve-box is placed on the opposite side of the low-pressure cylinder to the high-pressure cylinder, channels being formed around the exterior of the low-pressure cylinder leading to each end of the high-pressure cylinder. The valve-box face has five port holes in it, three in a row, the outer two of which lead to the low-pressure cylinder, and the central one to the exhaust and two other ports placed opposite to the two outer ones of the three, and leading to each end of the high-pressure cylinders. The valve is of a U shape, having in each arm and also between said arms indentations, which, when the valve is, say, in its uppermost position, opens a passage for steam from the lower end of the high-pressure cylinder to the higher end of the low-pressure, and admits steam from the valve-box to the higher end of the high pressure cylinder and forms a connection between the lower end of the low-pressure cylinder and the exhaust, as will be readily understood. The inventor claims in two claims the arrangement as described.—No. 17447. October 31st, 1890. 6*d.*

RING SPINNING AND DOUBLING MACHINES.—*G. Walker & W. Parker, Rochdale, Lancashire.*—The invention refers to the anti-ballooning wires which extend from end to end behind the spindles. These wires are carried upon and moved with the ring rail. At each end of the ring rail a bracket is secured which is slotted horizontally in a direction at right angles to the axis of the ring rail. Through each slot a screw bolt passes, and one end of the anti-ballooning wire is attached to an eye in the end of one screw bolt at one extremity of the ring rail, and the other end to the eye in the screw bolt at the other extremity of the ring rail. There is a screw nut upon each bolt to stretch the wire, but, in order that the wire may be kept in correct position without stretching it at too great a tension, there are brackets formed on the ring rail at intervals to sustain the wire in the required position and prevent vibration. Claims: (1) The combination of a wire, eye bolt, and slotted stands, or their equivalents (the wire being capable of being moved back for doffing), with the ring rail substantially as and for the purpose set forth; (2) the combination of a wire, eye bolt, slotted stands, intermediate supports for the wire, with the ring rail as and for the purpose described.—No. 3815. March 11th, 1890. 8*d.*

ELECTRICITY.

ARC LAMPS.—*H. Harper, London.*—The invention relates to means of regulating the feed of the carbon and of a method of constructing the solenoid-core so as to render it specially adapted for use with alternating currents. In the annexed illustrations Fig. 1 is a sectional elevation of an arc lamp embracing these improvements, Fig. 2 being enlarged details thereof. The solenoidal tube A, fixed as shown, has wound in layers around it between the gills B coils of coarse wire (not shown) connected

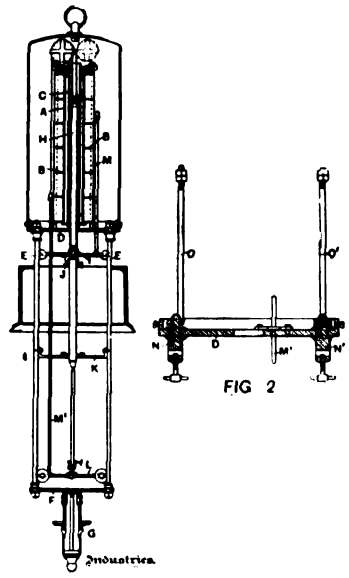


FIG. 1

FIG 2

in series with the lamp circuit. An inner coil of fine wire in a shunt to the lamp circuit is wound around the tube C inside A. The tube A and gills B are split longitudinally to prevent heating. Fixed to the plate D carrying A and C are two rods E, slotted longitudinally, the slots being on the inner and opposite sides, and connected together at their lower ends by cross-piece F carrying a gallery G for supporting a globe. The core H working in C consists of a number of insulated iron wires placed in a longitudinally slotted brass tube, the lower end of which is fixed to a cross-piece I, on the ends of which are rollers running in the slots in rods E, the cross-piece I carrying the upper carbon-holder J fixed to it by means of a ball-joint to allow of adjustment. The lower end of the upper carbon passes through a guide in a cross-piece K fixed to rods E. The lower carbon-holder is fixed by means of a ball-joint to a second cross-piece L also carrying rollers, in this case of an insulating material, running in E. Fixed to the top of core H are two cords passing over rollers, fixed as shown to the top of A, the other ends of the cords being fixed to rods M M^1 projecting from the cross-pieces I and L respectively. The positive wire from the generator is connected to the binding post N (Fig. 2), whence the current flows to the outer coil of the solenoid. From the latter it passes into the base of the rod O and along that rod, the top of which is electrically connected by a flexible wire with the rod M carried by the cross-piece I. From the rod M the current flows into the upper carbon, thence into the lower carbon, along the rod M^1, and through a flexible wire to the binding rod O^1, and thus to the binding post N^1 leading to the generator. Five claims are made, embracing the principal features of an arc lamp as described.—No. 17425. November 2nd, 1889. 8*d.*

TELEPHONE TRANSMITTERS.—*C. L. W. FitzGerald, London.*—The invention relates to transmitters in which granulated carbon is used. Fixed in a suitable holder are two carbon discs placed at a suitable distance apart and concentrically with one another. These discs are insulated from one another by means of a ring of indiarubber or other insulating material placed at their edges, and have connected to them the respective wires. In the space between the two discs a division of a curved or angular form is placed, which passes across the centre of the discs or thereabouts, and extends from side to side so as to divide the area between said plates into two spaces, in the upper of which the inventor places the granulated carbon. Claims: A telephone transmitter with the area between the two discs or plates divided by the partition as described into two spaces, so that the granulated carbon is contained in one of the said spaces, substantially as described.—No. 4028. March 14th, 1890. 6*d.*

INCANDESCENT LAMPS.—*A. M. Clark, London.* (*A. Bornholdt & J. Glatz, both of Brooklyn, U.S.A.*)—This invention relates to the manufacture of incandescent lamps and other vessels that are more or less exhausted of air, and to the mode of exhausting and sealing same. The bulb of the incandescent lamp to be exhausted is fitted with the ordinary hermetically sealed stopper, which on its inner end supports the filament, and on its outer end carries the connecting wires. Formed in this stopper is a small passage passing completely through it, the upper end containing a gravity valve. This valve is of a conical shape, so that it can be fitted firmly into the passage in the lamp stopper, the bottom thereof, on which the gravity valve rests, being finely perforated. These lamps, when so fitted, are placed in an inverted position in a suitable cylindrical vessel, and this vessel is then hermetically sealed and the air exhausted by means of a suitable vacuum pump. The air in the lamp bulbs is so also exhausted owing to the gravity valves being open by the bulb being placed in an inverted position. The cylindrical vessel containing these bulbs is then turned over, it being carried upon suitable trunnions for that purpose, and the gravity valves in the lamp stoppers so closed, and will be so held by the external atmospheric pressure when taken out of the cylindrical vessel, as will be well understood. Three claims are made, embracing the arrangement and method of exhausting incandescent bulbs and the like, substantially as described.—No. 19097. November 25th, 1890. 6*d.*

ARC LAMPS.—*W. P. Thompson, London.* (*R. H. Beach, St. Paul's, Ramsey County, Minnesota State, U.S.A.*)—The arc lamp embracing the principle of this invention is constructed in the following manner:—A cylindrical metallic casing is used, in the top of which two binding screws are placed, one being insulated from the casing, which two screws may be connected when the lamp is not required by means of a radiating arm pivoted on an extension of one screw and sliding on an extension on the other screw. Passing through the sides and bottom of the casing are the tubular carbon-holders, one being fixed and the other pivoted in the bottom of the casing to allow its lower end to be adjusted to the end of the other holder. Inside these tubular holders are placed the carbons, the same being pressed downwards by means of a following weight sliding in the tubes and pressing against the top of the carbons, the movement of the carbons being, however, somewhat retarded by means of springs, one end of which is fixed to the lower end of the holder, and the other end of which presses against the lower end of the carbon. Fixed in the upper part of the casing are two solenoids, the core openings of which are placed opposite one another and in the same horizontal plane. One of these solenoids is wound with coarse wire, one end being connected to the fixed and insulated carbon-holder and the other end to the insulated binding screw. The other solenoid is wound with fine wire, the ends being connected respectively to each of the binding screws. Working in these solenoids is a common core, in the centre of which is fixed a cross-piece, having one extremity connected to a helical spring, a second end being fixed to the casing, and the other end is connected by a hinged arm to the upper end of the pivoted carbon-holder. The action is as follows:—The current flows from the insulated binding screw through the coarse wire of one solenoid, so attracting the common core and moving the lower end of the pivoted carbon-holder from that of the fixed holder, so forming an arc. The resistance of the arc shunts a portion of the current through the finely-wound solenoid, which acts in opposition to the first solenoid, and checks the movement of the core, as will be understood. Six claims are made, embracing the arrangement of arc lamps as described, with modifications.—No. 19057. November 24th, 1890. 6*d.*

CHEMISTRY.

COLOURING MATTERS.—*H. H. Lake, London.* (*Wirth & Co., Frankfort-on-the-Main, agents for A. Leonhardt & Co., Frankfort-on-the-Main, Germany.*)—Dioxynaphthalene (melting point 216° C., obtained by melting β-naphthalenedisulpho acid or Schäffer's β-naphtholmonosulpho acid with alkalies) when heated with ammonia or primary amines, especially in the presence of a salt of such, can be converted into naphthylenediamine and its corresponding derivatives. These derivatives when treated with salts of nitroso-derivatives of aromatic amines (such as nitrosodimethylaniline or the like) yield green basic dyestuffs, which are very fast against the action of light and soap. The production of these colouring matters takes place in the usual manner by heating the two components in the presence of some dissolving and distributing agent such as spirit, acetic acid, &c. Examples:—1st. 10 kilos of diphenylnaphthylenediamine are heated with 200 litres of spirit, up to, say, 70° C., and about 10 kilos of chinondichlorimide gradually added, care being taken that the reaction does not become too violent by a too quick addition of the chlorimide. The fluid is then kept boiling at the reflux cooler for some time, diluted with hot water, the liquid filtered, and after cooling down the dyestuff precipitated out of the filtrate by means of common salt. 2nd. 20 kilos. of orthoditolylnaphthalenediamine, about 30 kilos. of the chlorhydrate of nitrosodimethylaniline, and 200 litres of methylic alcohol are heated at the reflux cooler, until all nitrosodimethylaniline has disappeared. The whole mass is then diluted with, say, 800 litres of water and filtered, and the colouring matter is precipitated out of the filtrate by means of common salt. By employing diphenylnaphthylenediamine instead of orthoditolylnaphthylenediamine, a part of the colouring matter crystallises out of the alcoholic solution on cooling and can be separated by filtering. Instead of the chlorhydrate of nitrosodimethylaniline, other salts of this base, as for instance the sulphate or nitrate, can be used. The nitrosodimethylaniline can further be substituted by an equivalent quantity of nitrosodiethylaniline. Four claims are made.—No. 3098. February 26th, 1890. 6*d.*

MISCELLANEOUS.

SUGAR BEETS SLICING APPARATUS.—*R. Bergreen, Roitsch, near Bitterfeld, Germany.*—The object of the present invention is to slice sugar beets, sugar canes, and the like in a uniform manner, and so that they do not lose their juicy properties, and also to so construct the knife edge that it will be more durable.

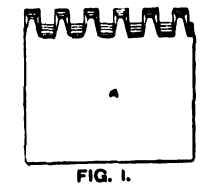


FIG. 1.

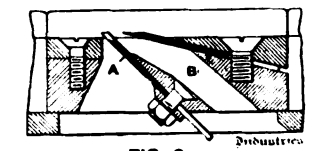
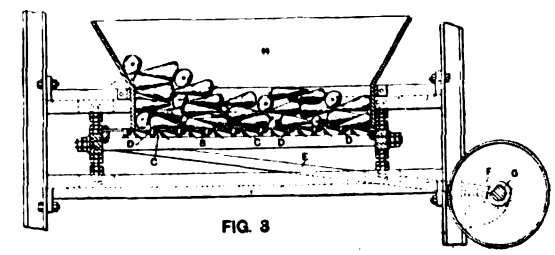
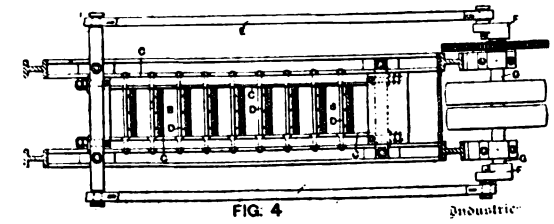


FIG. 2.

The knife A is formed with a zig-zag cutting edge, as shown in Fig. 1, and can be used alone or in conjunction with a second and plain knife B as shown in Fig. 2. Figs. 3 and 4 show a plan and side section of an apparatus constructed for the purpose of slicing sugar beets. The numerous knives A and B are fixed in a frame C, the knives B being adjustable in clamps D. The levers E attached to the knife frame C gives the latter a reciprocating motion under the hopper H, in which are the beets, and is actuated in the usual manner from crank F and eccentric G. The inventor also describes a modified apparatus for effecting the slicing of


FIG. 3


FIG. 4

sugar cane. Claims: (1) A knife for producing slices of beet, sugar cane, and the like, consisting essentially of a solid metal plate, the edge of which is cut in zig-zag fashion, producing points and indents (Fig. 1), such knives being attached to cutting frames of machines either singly or in combination with plain knives, all substantially as described and shown in the illustrations.—No. 20573. December 21st, 1889. 8*d.*

PIPE COUPLINGS.—*J. E. Matthewson, Sheffield.*—In securing indiarubber or other flexible pipes to steam pipe or nozzles, a metal clip is employed, which the inventor constructs in the following manner:—A strip of thin sheet steel or other suitable metal, of suitable length and width, is placed around the junction of the pipes, and the ends of this strip are flexibly connected to guide blocks or nuts by lapping the ends thereof round the front and top sides and connecting to the back. Through each block or nut a hole is made to receive a close fitting bolt for drawing the blocks together. Underneath the ends of the clip a short thin piece of sheet metal is placed (of the same width as the clip band), to prevent friction on the soft material of which the flexible tube is composed. The blocks being flexibly connected to the ends of the strip of metal will slip readily on the surface of the tube and no angles will be presented when tightening up to cut into the flexible tube. Claims: (1) The improvement in metal clips as described, and consisting of the combination with a flexible strap of blocks round or partially round which the ends of the straps are lapped, a bolt to be passed through the blocks and straps, and a nut for drawing the blocks together on the bolt as and for the purpose described; (2) in a metal clip, the ends of which are secured together and tightened up by a bolt and nut, the use of blocks, the undersides of which are free or not, attached to the strap, as and for the purpose described.—No. 5580. April 12th, 1890. 6*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., ***Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every*** 10***d. or fraction of*** 10***d. Remittances exceeding one shilling must be made by Post Office Order.***

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DEEP WELL PUMPING.

We had recently an opportunity of inspecting a method of obtaining water from deep wells, which has been devised by Messrs. Kilner & Matthews, West Gorton, near Manchester. The difficulty in raising water from great depths has generally been that of creating sufficient vacuum to induce the water to rise into the pump. In most cases the pump is put in the well at about the level of the top of the bore-hole, and it is necessary for the water to rise to the level of the pump before it can be raised to the surface. In many cases this plan has been practically impossible, and the quantity of water got has only been a fraction of the amount absolutely available. Messrs. Kilner & Matthews adopt the plan of forming the pipe lining the bore-hole into the barrel of the pump, in which they fit the bucket. Instead of placing the latter above the top of the bore-hole they carry it down to a sufficient distance to ensure that it shall always be covered with water, in many cases, indeed, placing it almost at the bottom of the bore-hole. In the well which we inspected this arrangement was carried out. The well is about 60ft. deep, the bore-hole extending downwards beyond that another 80ft. Near the bottom of this bore-hole the bucket is placed. The clack valve is fixed above instead of below the bucket, and the result of this arrangement is that the amount of water lifted is considerably increased. Instead of it being necessary to lift the water out of the bore-hole before pumping it, the bucket, being always immersed and working in the water, is simply required to pass it on its downward stroke and lift it on its upward stroke. This apparently simple alteration has had remarkable results in the plant we saw. When the old style of pump was fixed the yield was only 1,600 gallons per hour, while at the present time the well easily yields 5,600 gallons per hour. The extreme ease with which the pump works is well shown when it is stated that the pump rod only protrudes above the top of the bore-hole 1ft. or 2ft., and is then coupled directly to the crank by a connecting rod about 48ft. long, which works entirely without slides. Ordinarily this arrangement would give a large amount of vibration in the pump rod, and it is scarcely likely that it would work with sufficient steadiness to be practicable, but in this case the vibration was practically nil. The makers have carried out a number of similar arrangements, and all have resulted in a great benefit to the persons using them. For dyers, bleachers, brewers, and many other trades, the advantage of a supply of water of uniform temperature and composition is undoubted, and only the difficulty of obtaining a sufficient volume has hitherto prevented pumping being largely resorted to. In many places, by the arrangement now described, this difficulty could be entirely obviated.

THE CHIGNECTO SHIP RAILWAY.

II.

(*Concluded from page* 98.)

The gridiron of the lift, which is similar to a double-track bridge floor, and is really a movable section of the railway, has placed upon it the cradle, made up of flat cars of peculiar design, running on four lines of wheels. At the London offices of the company in Dashwood House there is on view a working model of the ship-lift, made under the direction of the engineers, which illustrates the extremely simple process by which the ship is transferred from the water to the rails or the reverse. The accompanying illustrations, Figs. 4, 5, and 6, represent this model as seen at three different stages of operation—viz., Fig. 4 shows the vessel floating over the cradle and gridiron ready to be raised, Fig. 5 shows the vessel blocked on its cradle and on the line of railway, and Fig. 6 shows the vessel on the cradle and gridiron in position ready to be lowered into the water again. When a ship is in the dock awaiting transportation, the gridiron, with the cradle resting upon it, is lowered to the bottom of the water in the lift. The ship is then floated into the lifting dock, and placed precisely over the cradle (Fig. 4), which is then raised to the level of the keel, when the supporting blocks are fitted accurately to the bottom and bilges. When thus in position, the pumps are started, and in about ten minutes the gridiron reaches the level of the track, with which its own rails exactly coincide, and to which it is firmly locked, as well as to the sides of the quays, so that it becomes an integral part of the railroad. A hydraulic gear draws the cradle from the gridiron to land, two locomotives are attached, and in less than two hours it will have reached the other end of the line. Here the lifting process is reversed, and when the gridiron has been lowered into the water the ship sails or steams away on her voyage. In order to use the line in both directions at the same time,

THE CHIGNECTO SHIP RAILWAY.

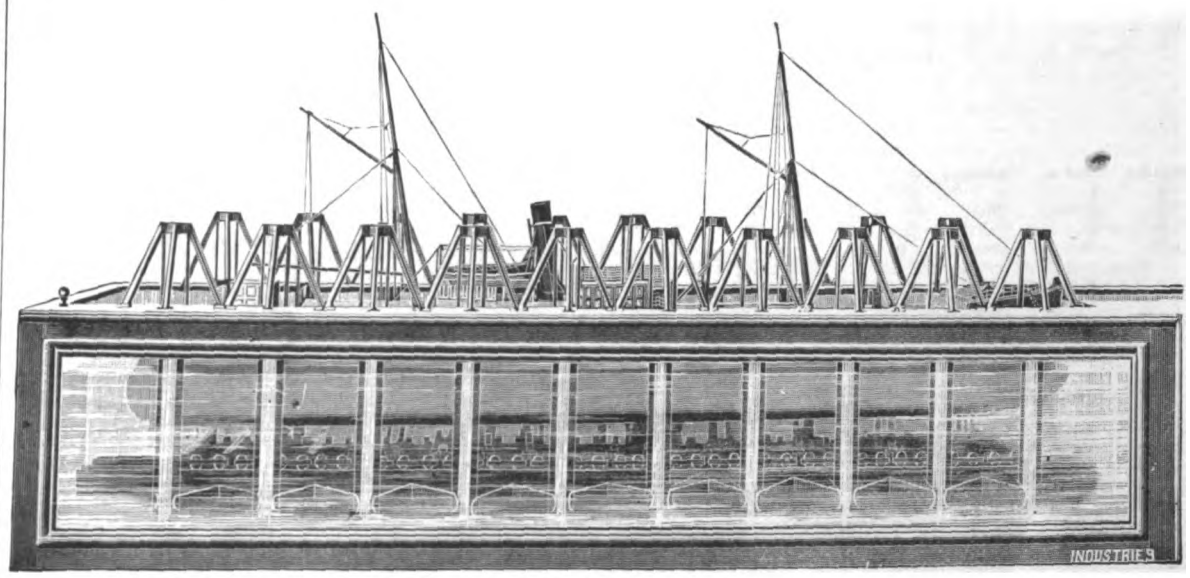


Fig. 4.—Model Vessel Floating over Railroad Cradle.

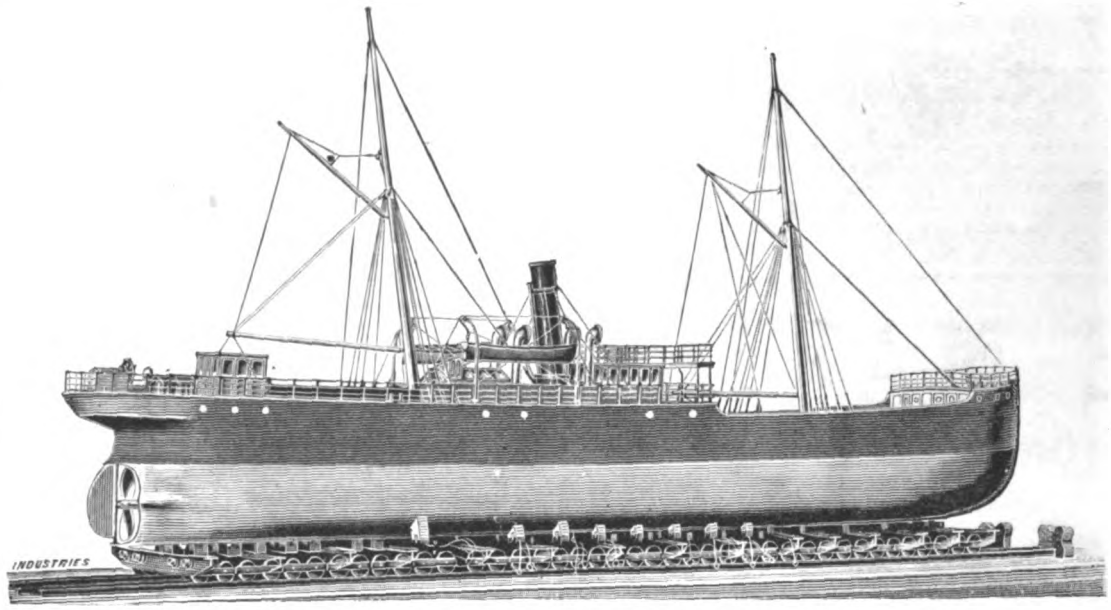


Fig. 5.—Model Vessel Ready for Land Transport.

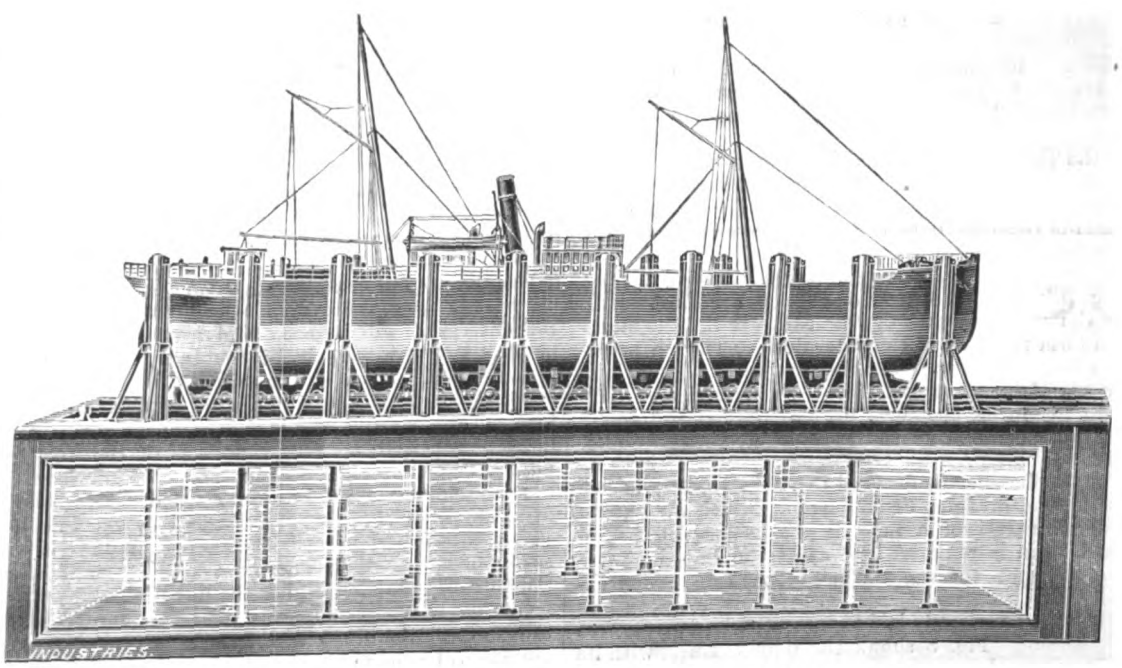


Fig. 6.—Model Vessel in Position for Refloating.

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THE CHIGNECTO SHIP RAILWAY.

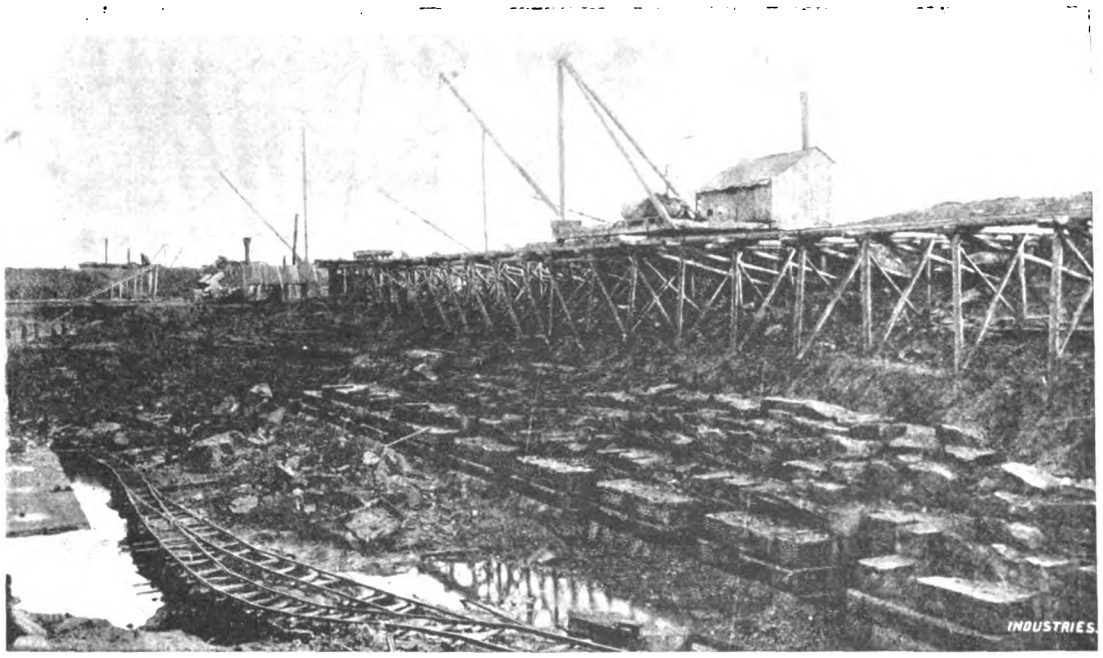


Fig. 7.—Interior of Cofferdam showing the Masonry of Lifting Dock.

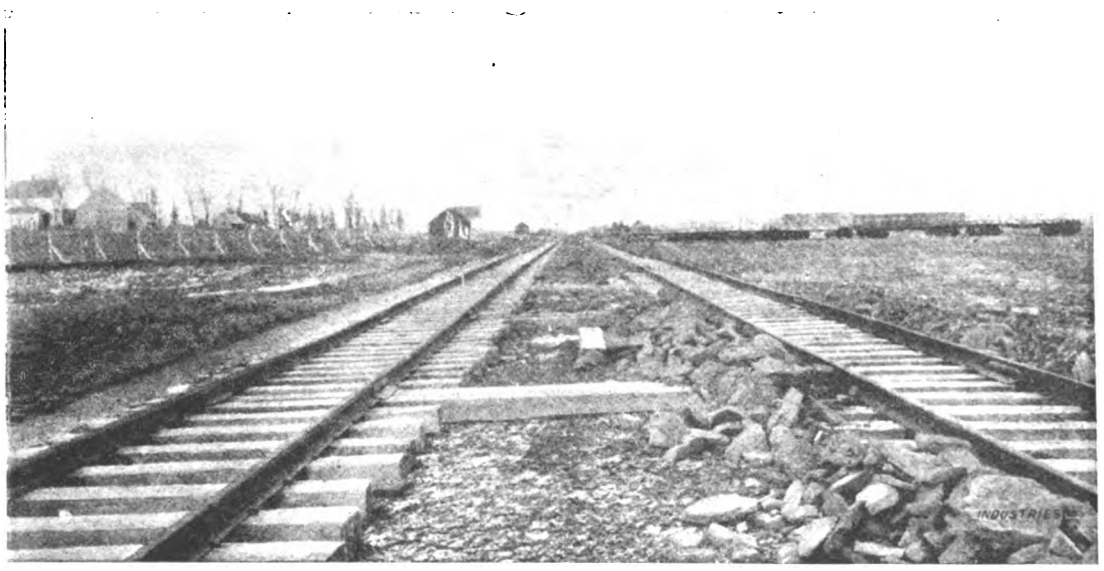


Fig. 8.—View showing the Double Railway Track Ready for Ballasting.

traversers will be used, so that ships may pass each other. By means of a division of the cradles it will be possible to haul two or three small vessels at one trip. The cradles to be used are being manufactured by Messrs. Handyside & Co., Limited, Britannia Iron Works, Derby.

At the Tidnish terminus on the Gulf of St. Lawrence it was found necessary to construct a cofferdam for laying the masonry of the lifting dock. Fig. 11 (see page 132) represents this cofferdam before the water was pumped out, with the moles of the outer dock behind. Fig. 7 is a view within the cofferdam showing the masonry of the lifting dock, and Fig. 3, given on page 99 of our last week's issue, shows the recent progress of the work. The moles which form the sides of the outer dock at Tidnish are of round timber cribs to the level of low water, above which they are of hewn spruce. They are divided into 10ft. square weighting chambers by longitudinal and transverse bulkheads, filled with rock, and surrounded by 12in. by 12in. square piles.

The basin is being dredged to a depth of 20ft. at low water. The dredging of the channel, which will extend about a quarter of a mile, is nearly completed. No locked basin is required here as at the Bay of Fundy terminus, since the rise and fall of the tide seldom exceeds 7ft.

The rails are already laid for one track half-way across the isthmus. Fig. 8 shows the double track, with its heavy rails and sleepers prepared for ballasting. Fig. 9 represents the closing of the last embankment on the line, together with the 30ft. arch culvert for the diversion of the Tidnish River.

Fig. 10 shows the great cutting at Tidnish, now completed. It is two miles long, and as the road bed has a uniform width of 40ft. for the whole line, half a million cubic yards were excavated from this cutting. The view shows also the side drains and bottom ballast. The progress of the hydraulic lifting dock at Amherst is shown in Fig. 12 (see page 132), together with the engine and boiler houses and accumulator.

From what has been said, it will be seen that the expectation of the company of having the work finished by October next, has every chance of fulfilment. That the enterprise will be successful from an engineering point of view can scarcely be doubted. All the operations are such as are in common use, the only novelty being in their application on a larger scale than heretofore. That it will be a commercial success may as fairly be anticipated. The whole cost of the work will be £1,100,000 sterling, a much smaller sum than was ever estimated as the cost of a canal. The running expenses of the railway, as estimated by Sir Benjamin Baker, should not exceed £30,000 per annum. A very small percentage of the enormous coasting trade of the Canadian waters would give the line profitable employment, and the easier access to markets afforded by the railway will doubtless add greatly to existing trade. No one will grudge the largest success to the spirited engineers and capitalists who have so resolutely faced the difficulties of the undertaking.

THE INSTITUTION OF CIVIL ENGINEERS.

At a meeting, held on the 27th ult., Sir John Coode, K.C.M.G., President, being in the chair, a paper was read on "Machine Stoking," by Mr. John Frederick Spencer, M.Inst.C.E.

Steam engineering, he said, included three processes—namely, the combustion of fuel and production of heat, the generation of steam, and the utilisation of steam. The paper was limited to the first of these. Experience had shown that with hand-firing sometimes a quantity of oxygen, sufficient for the complete combustion of the fuel, was found in the waste gases leaving the boiler flues, this excess of the air supply being due to the difficulty of mixing the carbon and the oxygen perfectly. The inequalities of hand-firing were twofold. First, air was admitted at the wrong time and place; and, secondly, the fuel was added according to the pressure gauge, the imperfect human feeding machine being thus the direct cause of a great waste of fuel, and of a large portion of the smoke produced. Steamship owners paid heavily for their human stokers, especially at the present time, when an Atlantic steamship might require from ten to fifteen tons of coal per hour.

James Watt patented a machine stoker in 1785. It was worked by hand, and consisted of two sets of bars, one behind the other, the fuel being fed at the front, and pushed towards the back as it ceased to smoke, the smoke from the fresh fuel passing over and through the more advanced combustion at the back end of the grate. A brief reference was then made to the principal steps in the development of machine stoking since that time, and one of the most successful machines of each type was selected for illustration—namely, the "coking" stoker of Messrs. T & T. Vicars, of Liverpool and Earlstown, and the "sprinkler" machine stoker of Mr. E. Bennis, of Bolton. There were two distinct types of machine, which were called coking and sprinkler stokers, and were both fed with coal from a hopper. In the coking stoker fuel was pushed slowly on to the dead-plate, movable bars being provided for carrying it forward at a speed intended to be proportionate to the rate of combustion required. In the sprinkling system the fuel was more or less evenly distributed over the grate by fans, beaters, or shovels, with or without movable bars. In both systems it was claimed that when it arrived at the farther end of the furnace there was nothing left but ash and clinkers, which dropped into a space provided, and from which, as required, they were removed through the ash-pit. In many cases a supply of steam was provided underneath and in front of the dead-plate, by means of a ¼in. or ⅜in. pipe, perforated with holes about $\frac{1}{32}$in. in diameter, and so drilled that jets of steam and air were blown along and between the line of the fire-bars, the effect of this minute expenditure of steam being to prevent the adhesion of clinker to the bars, and to act as an aid to combustion. Machine stokers of all kinds being fitted with hoppers which were filled by hand, in lieu of the coal being thrown direct into the furnace, there was no saving of labour, except as regarded slicing and raking the fires; but where there were several boilers in a range, the coal could be raised with a Jacob's ladder or elevator from the coal stock, and then conveyed in an overhead trough by a screw or tray chain to each hopper as required. The elevators and conveying screw were driven from a revolving shaft, which might be the one used for driving the machine stokers. Messrs. Coates, of Paisley, Messrs. Campbell of Perth, and other steam users in this country and in the colonies, who had adopted machine stoking, were also working these power conveyers with great success. In some cases this conveying plant was also employed to remove the ashes and clinkers. Machine stokers were generally worked by a small engine, a 6in. cylinder engine being ample for a range of twelve Lancashire boilers. The advantages claimed for machine stoking were:—

1. *Prevention of Smoke.*—The efficiency of a machine stoker as a smoke preventer was due to its "uniform careful firing." It was always working under Mr. C. Wye Williams' essential conditions of a "green" and a bright fire on the same grate, and much better localised than with "alternate-side firing," when it was possible for the gases to escape on the green side without combining with the oxygen on the hot side. With movable bars, machine stoking was at the least a greatly improved system of combustion, tending to smoke prevention. And, finally, one great cause of smoke was entirely absent—viz., the frequent use of the slice and poker to rouse the fire and clean the bars. An observer outside a mill where the boilers were hand-fired could count the firing and stoking times by the emission of smoke from the shaft. In machine stoking it was only at long intervals that the door was opened, and then for a much shorter time.

2. *Economy of Fuel.*—In the case of machine stoking this might result from two distinct causes. First, the

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use of a cheaper coal, either too dirty for, or the heat units of which could not be fully utilised by, hand-firing. Secondly, the more perfect combustion due to a uniform supply of fuel, and the automatic and progressive manufacture of carbonic acid. With reference to the economy from the use of a cheaper coal than was possible with hand-firing, the testimony was overwhelming, and was rarely contested; but it was not so generally known that, owing to the more perfect combustion in machine stoking, the cheaper coal realised also a higher evaporative duty per pound of fuel.

3. *Machine Stoking.*—This gave an increased and more uniform evaporative duty; of this there was a large amount of evidence available. There were good reasons for anticipating a greater evaporative power with sprinkler than with coking stokers in certain cases. The automatic supply and progression of the fuel gave great uniformity of evaporation, while the mechanism employed afforded facilities for varying it as might be required.

4. *Economy of Labour.*—This might be and was realised by machine stoking, as the system permitted the automatic supply of fuel to the hoppers. In the mercantile steam navy machine stoking was hardly known, only a few vessels being fitted with Henderson's movable self-cleansing fire-bars. It would be an efficient remedy for many sea troubles, it would save the loss in cleaning the fires, and would give a larger increase of evaporation duty than forced combustion by fans, with much less inconvenience. An increased duty of at least 10 per cent. would be obtained from the fuel, and less skilled labour would be required. In addition to these advantages, all classes of cheap coal would be available for steamships, and smoke would be prevented.

The approximate number of furnaces fitted, and now working, with machine stokers was as followed:—

Coking.		
Juckes and others, old style	300	
Vicars.....	2,500	
Sinclair, McDougall, and others	600	
Frisbie, Beely, and others	200	
		3,600
Sprinklers.		
Stanley, beater, or fan machines	20	
Dillwyn, Smith, and Henderson	1,500	
Whittaker, Hodgkinson, Carver, Newton, Rye, Leech, and others	1,000	
		2,520
Spring Machines.		
Bennis	5,000	
Proctor	4,000	
		9,000
Total.....		15,120

This would represent about 8,000 boilers, out of an estimated total, in the United Kingdom, at the present time, of 140,000, or only 5·7 per cent. fitted with machine stokers, and it had taken nearly seventy years to achieve this limited success. It was estimated that, of the 140,000 boilers in the United Kingdom, about one-half were to be found in the three counties, Lancashire, Yorkshire, and Cheshire, and about the same number (70,000) were under inspection by the Manchester Steam Users' Association and the several boiler insurance companies. In two large boiler guarantee and insurance associations there were approximately 1,010 boilers fitted with machine stokers, or about 8 per cent. of the total number under the inspection of these associations.

CONSTRUCTIONS IN EARTHQUAKE COUNTRIES.

In one of our early numbers (see *Industries*, Vol. I., page 254) we directed the attention of our readers at considerable length to the conclusions arrived at by Professor John Milne, of Tokio, and given in a paper read before the Institution of Civil Engineers, regarding the conditions which should be attended to in constructions in earthquake countries. Professor Milne has for many years been a most diligent student of the phenomena of earthquakes and their effects, and is now one of the greatest, if not the greatest authority on the subject, and his writings contain a vast amount of information regarding it. He has carefully studied it in what may be considered its purely scientific aspects, but he has gone much beyond that and shown what lessons are to be derived with regard to construction in earthquake countries. In one of the recent volumes of the Transactions of the Institution of Civil Engineers (Vol. C., page 326) there is a paper by Professor Milne which may be looked upon as a continuation of the previous one, and it may be of use to some of our readers if we note a few of Professor Milne's chief conclusions. British enterprise extends to all parts of the world, and earthquake countries such as those of South America are receiving a considerable share of it, and the results of Professor Milne's observations and study will be found deserving the attention of all engaged in architectural or engineering construction in such countries.

The selection of a suitable site is the most important matter in connection with such construction, and in order to mitigate the effects of earthquakes the general conclusion at which Professor Milne arrives is that it is essential to select a site where it is known that the ground suffers but slight motion. This is generally hard, high ground. Soft ground, slopes, and scarps should be avoided. A site being selected, one of two general systems of construction can be followed, namely, either to give so much rigidity to a structure that it may be likened to a steel box; or to erect a light building, which has so much flexibility that it may be compared to a wicker basket. Both those structures should be light, especially their upper parts. Buildings of the former class, which are generally of stone or brick (by preference hollow bricks) should rise from a deep foundation, have a free basement, walls of unusual thickness, and be well bonded and tied together. The roofs should be light, and the precautions respecting the position and form of the openings, the arrangement of floors, roof trusses, and top weight should be carefully attended to. In buildings of this kind, their strength more than outweighs the ill effects due to their weight. Such buildings are durable and relatively safe against fire. They are suitable for all climates, but they are in respect to all other buildings exceedingly expensive, and therefore can only be employed for buildings of importance. Light buildings are nearly all constructed of wood or iron. The former, however, are neither durable, safe against fire, nor impervious to heat and cold, but these objections may be practically overcome. They have, however, the advantage of being cheap. Iron buildings are relatively expensive, and, without special arrangements, they are too hot in summer and too cold in winter. Framed buildings of iron or wood, filled in with hollow bricks or cement, such as are so strongly recommended in Italy, have many advantages, and modifications of them are much used in Japan. In buildings of all kinds the roof must be light, openings must be in proper positions, walls must be of moderate height, while floors, trusses, balconies, and the like must be well supported. Ordinary structures of brick or stone are usually bad, while timber structures with a masonry front are worse. To resist earthquake motion, lightness and strength are essential, and so is a certain elasticity. Weight, unless

THE CHIGNECTO SHIP RAILWAY.

(*For description see page* 121.)

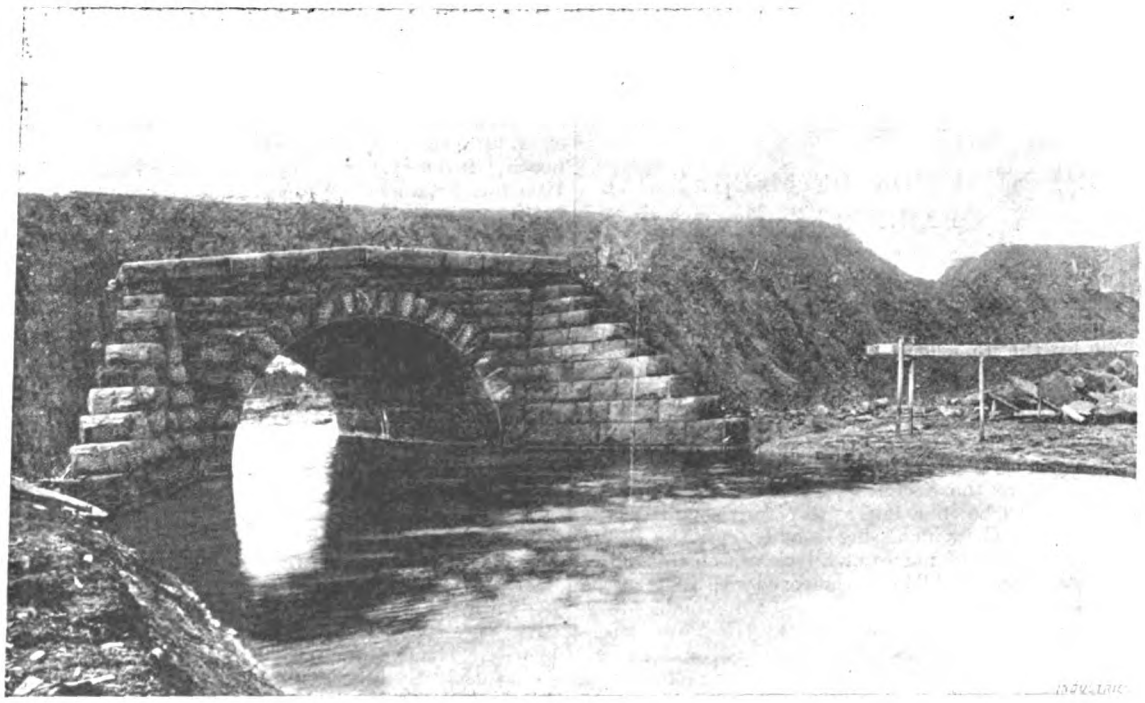


Fig. 9.—Showing the Culvert for the Tidnish River Diversion.

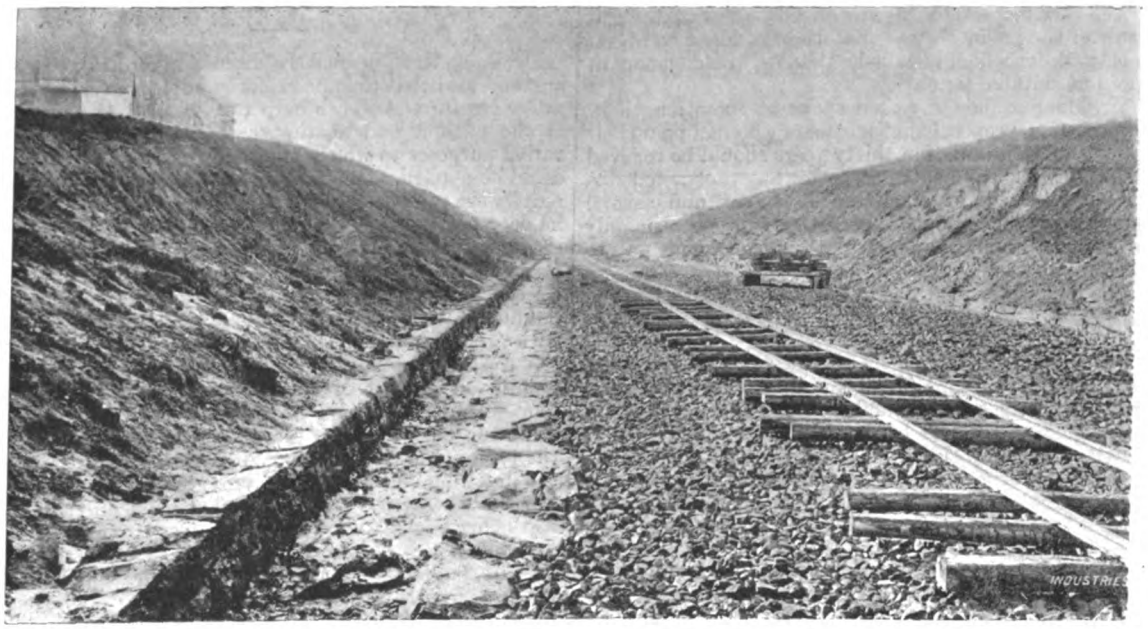


Fig. 10.—The Completed Cutting at Tidnish.

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it is accompanied by great strength, is a quality to be avoided.

For buildings of importance Professor Milne suggests the use of brick, and as regards this opinion considerable experience in earthquake countries enables us to corroborate his suggestion. The buildings should be in good situations, the brickwork well bonded and unusually thick, and rise from deep foundations. For ordinary buildings he suggests that, for a country like Japan, frame buildings should continue to be used. To improve them, they require more diagonal bracing, lighter roofs, and some protecting covering against fire.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The forty-fourth annual general meeting of this Institution was held on Thursday evening, the 29th ult., and continued on Friday evening. The chair was taken by the President, Mr. Joseph Tomlinson. On Thursday evening, after reading the minutes of the previous meeting, the Secretary announced that the summer meeting would be held in Liverpool at the end of July. The usual annual report of the Council was presented to the members, a brief verbal abstract of the same being given by the Secretary. This report shows the Institution to be in a fairly prosperous condition, the number of members increasing steadily. At the end of 1890 the number of names of all classes on the roll of the Institution was 1,945, as compared with 1,858 at the end of the previous year, showing a net gain of 87. Among the new members is included His Royal Highness the Prince of Wales, who was elected an honorary life member at the spring meeting. The Institution lost by death during the past year eighteen members. The receipts during the year amounted to £6,784 16s. 5d., and the expenditure to £5,738 6s. 2d., leaving a balance of £1,046 10s. 3d. After allowing for accounts owing but not yet rendered, the capital of the Institution stands at the very respectable figure of £33,708 4s. 9d. The result of the ballot showed that the President had been re-elected, for which honour he thanked the members in brief but suitable terms.

Mr. MacFarlane Gray then spoke at some length in support of a proposal that members who had paid their annual subscriptions for thirty years should be relieved of all further payments. A somewhat protracted discussion followed, in which the President and several members of Council opposed Mr. Gray's proposal, mainly on financial grounds, and, on the question being put to the vote, it was negatived.

The first paper read was by Mr. Bernard Dawson,

"On Some Different Kinds of Gas Furnaces."

This paper was of a generally descriptive character, accompanied by a large number of diagrams. The author stated that the greater number of gas furnaces in which crude heating gas had been successfully employed were of the kind now universally known as reversing regenerative furnaces. There were, however, many processes, in which temperatures below that which could be maintained only by "Siemens regenerators" were required, for which gas furnaces could be employed with some success, both as regards economy in quantity and quality of fuel, speed of work, saving in wear and tear, labour, abolition of smoke, and certainty in maintaining an atmosphere or flame of a given character. It was often, also, an advantage in large works to concentrate in one place the manipulation of all the fuel required in the various furnaces scattered throughout the establishment, and avoid the cleaning of fires and removal of ashes. There was thus often a distinct advantage in using gas for heating furnaces apart from economy in fuel. Reversing regenerators were only economical and advisable for high temperatures, but there was some diversity of opinion as to the exact point at which such regenerators could be advantageously dispensed with. Whatever system of regenerator might be adopted, care must always be taken to ensure that the escaping gases should pass into the chimney flues at a sufficiently high temperature to secure the draught requisite to work the furnace advantageously. Gas furnaces might be divided into four classes—(*a*) With reversing regeneration, (*b*) with continuous regeneration, (*c*) non-regenerative, and (*d*) with blow-pipe or forced blast.

The author then proceeded to describe, with the aid of numerous diagrams, types of furnaces belonging to each class. The well-known ordinary Siemens furnace is representative of the first class (*a*), which also includes the Batho or Hilton furnace, with regenerators encased in cylindrical wrought-iron vessels above ground; furnaces in which the air only is regenerated; and the furnace recently described by Mr. Head (*Iron and Steel Institute Journal*, 1889, II., page 256), in which a portion of the waste heat is taken back to the gas producer. In furnaces with continuous regeneration the air, before admission to the interior of the furnace, is heated by radiation or conduction from the bottom of the furnace, and through thin walls separating the air flues from the flues carrying the waste heat to the chimney. In non-regenerative furnaces the air is admitted to the furnace at its natural or atmospheric temperature. In forced blast or blow-pipe furnaces the air is either supplied at atmospheric temperature by a fan or blower, or air thus supplied is heated by the waste heat from the furnace, as in the Radcliffe furnace.

Among the varieties of gas furnaces referred to by the author the following may be mentioned:—Crucible steel furnaces, basic and ordinary steel furnaces, reheating furnaces, bar and tire heating furnaces, glass tank furnace, annealing furnaces, sand-drying or calcining furnace, core and mould stoves, gas-fired oil boiler or still, gas-fired brewer's copper, and gas-fired Babcock & Wilcox and Lancashire boilers. The author also dealt with the construction of reversing valves for regenerative furnaces. The butterfly valve was being superseded by "pot" or double-beat mushroom or pan valves, and also by the hydraulic slide valves of Mr. Le Neve Foster, water-seated valves, and Mr. John Ramsbottom's revolving valve. A brief notice of the application of water gas to heating purposes, and a description of the Smith Casson open-hearth steel-melting furnace were included in the paper. We have alluded to these in particular, because they were afterwards referred to in the discussion.

Mr. J. A. F. Aspinall, in opening the discussion on Mr. Dawson's paper, referred to the gas furnaces at Horwich Works. The gas furnaces used there for brass melting had been, he said, generally successful, but in the application of gas fuel to steam boilers the results varied greatly. His experience went to show that where boilers were sufficiently large for their work gas firing gave satisfactory results.

Mr. J. M. Dobson inquired whether the conveyance of gas for a long distance was a drawback to its use.

At the termination of Mr. Dobson's remarks the discussion was adjourned till the following evening.

Mr. John Head opened the discussion on Friday evening, and said that the numerous examples of the regenerative gas furnace shown bore testimony to the activity of the author, and at the same time illustrated the varied purposes to which the Siemens form of furnace could be applied. According to his experience, gas furnaces were rarely erected except for economy in fuel, and he deprecated passing waste heat into the chimney for creating a draught. For securing sufficient draught for a furnace, the height of the chimney should be raised. A furnace with a bed supported on girders could be built without having recourse to the forms shown with regenerators built in boxes either at the sides or on the top of the bed. The latter were defective from a philosophical point of view, inasmuch as heat always tended to rise to the top of the chamber in which it was confined; hence regenerators should be vertical, so that the top of each chamber should be the hottest part, and the inflowing currents should enter at the bottom to be gradually heated as they reached the top on their way to the heating chamber. Fireclay pipes for regenerators are objectionable, as they may break, in which case the current that is being heated will pass up the chimney without reaching the furnace. All regenerative gas furnaces should be constructed so as fully to utilise the waste heat escaping from the heating chamber. In an open-hearth steel melting furnace of the ordinary Siemens type, making charges of twenty tons, the weight of the gases passing through the furnace in five minutes' time amounted to one ton; those gases deposited heat in the regenerators according to their temperature and their weight, and the inflowing gases must be of the same weight, and at a temperature not exceeding the waste gases, as they leave the reversing valves, in order to be able to take up the heat deposited. The only exception which could be allowed to this rule was in the case of the new Siemens furnace (of which diagrams were exhibited), wherein the gas producer utilised—in another manner—the heat that would otherwise be deposited in the gas regenerators. Mr. Head explained how heat was utilised in converting carbonic acid into carbonic oxide, thus, he said, saving one-half the carbon in the coal. The final result showed a saving of, say, one-third the coal used, to which should be added a further saving of the sensible heat of the gases amounting to 30 per cent., making together a saving of above 60 per cent. in fuel in favour of the new, over the old, Siemens furnace. In practice these results had been fully realised, so that now from fifty to sixty furnaces were either working or in course of construction. Beyond the results shown, he would only add the results of working of a large heating furnace, as ascertained during thirty-six hours' continuous work; in that time 210 tons of steel were heated, being at the rate of 70 tons per shift, and the consumption of fuel was only 1 cwt. of coal per ton of steel heated. The late Mr. Holley, the eminent American engineer, strongly advocated the use of the Siemens furnace, but the cost of the original form was sometimes found to be an objection to its introduction in many works. The new form of Siemens furnace was well suited to fulfil Mr. Holley's prophecy, referred to in the paper under discussion, as it effects a saving of 50 per cent. in cost of construction; also a saving of 50 per cent. of fuel, in working, over the original form.

Mr. Smith Casson stated that he would not go so far as to say that he preferred overhead to underground regenerators; the construction to be adopted was to a great extent a matter of convenience. Their practical success had, however, proved that overhead regenerators were not to be objected to. With his 6-ton furnace an average production of 65 tons per week was obtained, and no extraordinary difficulty experienced with the overhead regenerators. The number of casts per week was from twelve to fourteen, and about 11 cwt. of screened fuel was required per ton of steel. Where space was of value overhead regulators were to be recommended. With a small furnace producing only 2 tons per week satisfactory results had been obtained. In this case a great advantage was secured by placing the boilers overhead and utilising the waste heat to work them. In reply to a supplementary inquiry by Mr. John Head, as to whether the steel was made by decarburising pig iron with iron ore, or was simply an alloy of pig with wrought iron, Mr. Casson stated that he did not use iron ore.

Mr. Alfred Slater said that at the works with which he was connected a new Siemens heating surface had been erected only within the last two months, and, consequently, his experience was as yet very limited. Owing to a mistake on his own part the furnace had been under repair during some portion of this time, and, therefore, he could not give statistics. He had, however, no hesitation in saying that very appreciable comparative economy had been obtained by the adoption of the new furnace. For some reason, which he was unable to explain, after successfully employing for some time a certain kind of coal from the Forest of Dean, it had been suddenly found necessary to change the quality of the fuel.

Mr. Oakman remarked that his special work related to water gas and the other gases obtained in its manufacture. Since reading his paper in July, he had made good progress in the Sheffield district, and subsequent experience had more than confirmed his previous statements. By the application of water gas to welding an economy of about 40 per cent., as compared with coke firing, had been obtained. For continuous firing with producer gas, the gas was supplied under a pressure of about 3in. of water. Perfect control was secured, and the heat with producer gas alone could be varied from 800° to 2,000°. Arrangements had at one time been made for working with mixed water and producer gas, but had not been used, as it had been found that the mixing of the gases was not economical. Water gas should be employed where great heat was required, and producer gas for lower temperatures. On the Continent and in the United States water gas was being used for open-hearth furnaces with success. In a 6-ton furnace a ton of steel could be produced with 6 cwt. of fuel, while the cost of the furnace did not exceed £120. If he might venture to prophesy, he would say that the time was not far distant when both gas and air would be used under pressure.

Mr. Reed inquired whether the author could give the temperatures reached in gas furnaces, and what pyrometers he had found to give the best results. With respect to the gas firing of boilers, he was interested in an arrangement, invented in the United States and now at work in this country, which was characterised by great simplicity. The gas generators consisted of two cast-iron retorts behind a brick arch; steam was supplied to the retorts through a small pipe from the steam dome. The ashpit was closed, except to the injector carrying in gas and air. This arrangement had only been at work a short time, but the results shown by a week's trial had been very astonishing, the saving effected amounting to 38 per cent. In reply to a question by Mr. Druitt Halpin as to the previous performance of the boiler referred to, more especially the quantity of water evaporated per pound of fuel, the speaker said that he was unable to state this; the comparison was of a purely practical character.

Mr. MacFarlane Gray pointed out that, by means of the device described by Mr. Reed, steam was dissociated into its constituent gases, which were reunited afterwards by combustion in the furnace.

Mr. Drew described a stationary boiler installation at Glasgow, in which the air supplied by a fan was heated by the waste gases before entering the furnace, the result being a reduction of 30 per cent. in the consumption of fuel. This was simply an application to a stationary boiler of Mr. Howden's system of forced draught, hitherto

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adopted only for marine boilers, and he (the speaker) mentioned it simply to show what scope there was for saving.

Mr. Schönheyder wished to know what was the temperature of the waste gases in the boiler in question; it must have been enormous to make a saving of 30 per cent. possible.

Mr. Drew was unable to give this information off-hand, but promised to furnish it subsequently.

Mr. H. Marten stated that he had considerable experience with boilers fired by the waste gases from blast furnaces, but not with such in which the gas was made for the purpose. The first speaker had said that gas firing damaged boilers when they were worked hard. He would like to know to what this was due. Was it owing to the nature of the gases or some other cause? The difficulty he had found with blast furnace gases was the extreme variation in their temperature and excessive local heating of the boilers, one part being very hot, while another was comparatively quite cool. His boilers were very long ones.

Mr. Collier asked the author for further information on the application of gas to the heating of brewers' coppers, more especially in regard to economy. His experience was that, unless the lower part of the copper was well protected at the edges, it was soon burned away. He would also be glad to learn what saving was effected by the use of gas in connection with Babcock and Wilcox, and Lancashire boilers, as shown in two of the diagrams, Nos. 19 and 20.

Professor A. B. Kennedy remarked that it was an interesting feature of the new Siemens furnaces that the gas for them was supplied hot. He was under the impression that formerly, in the older types of furnace, it was always thought desirable to allow carbonic oxide gas to cool before entering the furnace. He thought it desirable to draw attention to the fact that the successful use of gaseous fuel in furnaces had no bearing on its employment in ordinary boilers, as the conditions were so different in the two cases. In furnaces it was necessary to obtain a very high temperature, and for this purpose it was necessary that the gases should escape at a high temperature. In consequence of this a regenerator was essential to economy. In steam boilers the case was just the opposite; the temperature required was comparatively low, and in good boilers efficiencies of over 80 per cent. had been achieved without the use of regenerators. If heating furnaces were employed without regenerators, the efficiency would be absurdly low. Success in one case was no proof of success in the other, and he believed that the failure to appreciate this fact had resulted and would result in disappointment.

Mr. H. Marten remarked that the interest on the cost of plant necessary for burning gas in boilers neutralised the saving in fuel.

Mr. Snelus said that one of the valves mentioned in the paper was designed by his pupil, Mr. Foster; this was a slide valve. Butterfly valves gave much trouble; they leaked, were liable to warp, and could not be easily inspected. To Mr. Foster's valve he had added a cooling device to prevent warping. There was only one small objection to it, and that was a slight deposit of tar when the valve was not in use; when in operation no trouble was experienced. Double beat valves were fairly good, but it was difficult to make certain of their being fully down on their seats; in this respect slide valves were better if properly cooled. Mr. Snelus noticed that the author had not mentioned in his paper the American Lash furnace. This was worked in the United States with natural gas. The regenerators were placed at right angles to the furnace on the way to the flues, an arrangement which to him was novel. At Mr. Carnegie's works he had seen such furnaces in operation, and they gave very satisfactory results.

Mr. Halpin inquired whether reversing regenerators had been tried for steam boilers.

Mr. Bernard Dawson, in reply to the discussion, stated, with regard to the remarks of Mr. Aspinall and Mr. Dobson, that in practice he had not found that the conveyance of gas for some distance was any drawback to its use. For supplying producers with steam it was the best plan to employ a small separate boiler in order to avoid the irregularities caused by fluctuations in the main boilers. He had never before heard the objection raised that a boiler could not be forced when fired with gas. Such a state of things could only be due to defective arrangements. In some dyeworks in London with which he was acquainted, in which gaseous fuel was burned, the boilers were frequently forced. He thought there was conclusive evidence that gas fired boilers gave better results than those burning solid fuel. Respecting Mr. John Head's criticisms, the author said that he considered a record of failures was particularly instructive to engineers, and often more was to be learnt from them than from successes. All Siemens furnaces, he believed, had not been uniformly successful. There were many cases in which it was worth while to adopt gas firing even when it was not more economical than other methods, for reasons to which he had referred in his paper. The Radcliffe furnace, he had been assured by the authorities at Woolwich, gave no trouble on account of the leakage of brick tubes. As regards Mr. Smith Casson's remarks, all regenerators placed below the furnaces were liable to become silted up with lime in basic furnaces and with slag in ordinary Siemens furnaces, but this could not occur with overhead regenerators. Replying to Mr. Reed, the author said that he had never yet found a satisfactory pyrometer. All of which he had experience could be "cooked" to indicate whatever was desired; they never returned to zero, and required continual correction of the constants. Gas firing for boilers was not such a novelty as Mr. Marten seemed to suppose; there were hundreds of such boilers in use. With reference to Mr. Halpin's inquiry, he (the author) had carried out some experiments on coal and gas firing with a boiler of the locomotive type, with and without the brick arch. With small common South Wales coal the best result observed was an evaporation of 8¾lb. of steam per pound of fuel. In a "Roots" boiler he had found an advantage of 17 per cent. with gas over coal firing. The best result he had ever obtained with gas firing was 11½lb. of steam per pound of coal. When boilers were fired with gas specially made for the purpose and with proper arrangements, there were no irregularities in the heat, such as those complained of by Mr. Marten. These irregularities were probably partly due to the length of the boilers. Those brewers' coppers which had been heated by gas and furnished with regenerators had been quite successful. To Professor Kennedy his thanks were due for pointing out in such a lucid manner the distinction between heating and boiler furnaces. As to the Lash furnace mentioned by Mr. Snelus, he had been unable to get information about it from the United States. The use of horizontal regenerators, as described by Mr. Snelus, was not new; such regenerators he had seen in connection with the horse-shoe type of furnace. The expense of adopting reversing regenerators for boilers, as suggested by Mr. Halpin, was not justified by the results.

The next and final paper read was by Mr. Walter Bagshaw, of Batley,

"On the Mechanical Treatment of Moulding Sand."

After some brief introductory remarks, the author commenced by describing the qualifications necessary for good moulding sand. This part of his subject he illustrated by diagrams, showing samples of sand, mixed sand and coal dust, and old and burnt moulding sand, magnified 500 diameters. Generally stated, good sand should be composed of 94 parts silica, 5 parts alumina, and traces of magnesia and oxide of iron. For facing sand various mixtures were employed. Plumbago was effective in preventing the destruction of sand, but should not be dusted on the moulds in such quantities as to close the pores and prevent free exit of the gases. The most primitive method of treating moulding sand was by hand riddling and treading. No doubt tough sand could be obtained in this manner, but the process was tedious and, on a large scale, expensive. Other things being equal, the chief characteristics of good moulding sand were toughness and porosity. Power riddling was a decided advance on hand riddling, but presented the objection of not opening out the grains. For hard sand treatment by means of the roller mill was said to answer very well, but the author's experience with soft sand had not been favourable to rolling, the castings made with sand so treated showing a tendency to scab. Schütze's centrifugal mixer, of which the author exhibited illustrations, combined the advantages of all the other plans, besides yielding a greater output. It consisted of a revolving table mounted on the top of a vertical spindle, and carrying on its upper face a number of vertical pins or beaters fixed alternately in a series of concentric circles. The table has a hinged cover, which can be opened for the purpose of removing pieces of metal or other foreign substances. The sand falls upon the centre of the table, which revolves at a speed of 1,200 revolutions per minute, from a hopper above, and is projected with great velocity from one row of pins to the next, until all had been combed out. At a moderate estimate, such a machine would mix 30 tons of sand per diem. One in use in Devonport Dockyard required 1 horse-power when mixing 2 tons per hour. The cost was about 2d. per ton of sand. Messrs. Marshall, Sons, & Co., of Gainsborough, employed three men on one machine to mix sand for 150 moulders and fourteen moulding machines, but expected eventually to reduce this to one man's work. With hand-riddling and treading, the average cost was about 2s. 1d. per ton for wages alone, and, with machine riddling, 1s. 3d. per ton. After working for two years with the mixer, no expense of any kind had been incurred for repairs.

Mr. Schönheyder opened the discussion by suggesting that it would add to the value of the paper if the magnified illustrations of moulding sand, when published in the "Proceedings," were coloured.

Mr. Mair said that in the old days they had only hand mixing. He had found that ordinary roller mills made the sand too dense, and had substituted serrated rollers for plain ones with good results. One point in favour of plumbago for facing had been omitted by the author, which was that it enabled castings to be more readily cleaned. In the United States he had seen very long cores made without wires, a very strong core gum being used to secure adhesion. The grains of the sand employed for such cores were nearly $\frac{1}{16}$in. diameter.

Mr. Brown inquired whether, with the aid of a mixing machine, a large proportion of floor sand could be used for facing.

Mr. Wilson stated that he had seen one of Schütze's mixers in operation at Mr. Cochrane's works; it had given great satisfaction, but it had been found that, contrary to the author's experience, the wear was very considerable and irregular.

The Secretary then read a letter from Mr. Cochrane (who was unable to attend the meeting), in which he wrote that he had had a Schütze machine in use for many months, and it gave unqualified satisfaction. The output was as high as one ton in five minutes. Previous to the introduction of the machine four men, at a cost of 11s. 6d. per diem, had been required to supply fifty moulders, but now the whole of these, and the coremakers as well, were supplied for 6s. per diem. This reduction in expenditure was accompanied by an improvement in the quality of the work. The expenses of the machine were insignificant. On one point he disagreed with the author; there was no prospect whatever of the wrought-iron pins or beaters standing for two years—in fact, some of them were reduced to $\frac{1}{2}$in. in three weeks working only half time. The manner in which the wear took place was very curious, certain pins being worn much more rapidly than the rest, as though the sand followed certain relative courses in preference to any other. In his machine the arrangement of the beaters was not exactly as described by the author, in concentric circles, but apparently quite unsystematic. There was one drawback to the machine, and this was, that it could not be stopped quickly; in this respect, he thought, there was room for improvement by the addition of a brake. Otherwise, the apparatus could be generally recommended.

In replying to the discussion, Mr. Bagshaw confirmed the statements made in his paper with reference to the wear of the pins or beaters. The pin exhibited to the meeting, which was very slightly worn, was the worst he could find after the machine had been at work for three years. As to stopping quickly, he could only say that the man in charge of his machine preferred to run it without a brake, as, when the latter was applied, the driving belt flew off.

THE INSTITUTE OF MARINE ENGINEERS.

A meeting of this Institute was held on the 27th ult., Mr. F. W. Wymer presiding. The paper read by Mr. F. W. Shorey at the previous meeting was further discussed. The chief point of novelty in the paper was a proposed system of "profit sharing," and the leading feature of the arrangement was one to ensure that each man should do his best for the success of the business in which he was engaged, if this could be done without cumbrous inspection.

Previous to the discussion on the above paper, a conference was held by the members of Council and a deputation of members from the Bristol and South Wales, consisting of Professor Elliot and others. Professor Elliot explained the purpose of the meeting, and hoped for an opportunity to welcome the members to Cardiff. Mr. MacFarlane Gray reported that he had heard some flattering remarks regarding the Institute of Marine Engineers as a whole, and on the discussions on the various papers which had been reported in the technical journals.

The annual general meeting of the Institute will take place on the 3rd April, when some important matters will be discussed.

ELECTRIC LIGHTING IN JAPAN.

The first electric light company in Japan was formed at Tokio in 1886. With the lighting of the Imperial Palace an important advance was made in the industry, and since then other companies have been formed at Osaka, Kioto, Nagoya, and Kobe. It is estimated that there are now 11,000,000 electric lamps in the country, and of this number 8,000,000 are at Tokio alone. The capacity of the present five companies is rated at double the above number. No less than ten further electric light companies, says the *Railroad Gazette*, are at present being organised. They will have a combined capacity of 16,000,000 lamps, of which 5,000,000 will be placed at Yohohama.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 3rd February, 1891.

Iron.—The depression in the iron market still continues, but there is an inclination to greater activity. The prices at which business has been transacted remain the same as those of last week—namely, 128s. 6d. a ton for bars and 136s. 6d. a ton for joists. Sheets command from 152s. 6d. to 160s. a ton according to quality, but the demand has been very limited during the past week for all descriptions of iron. The Town Council (*le Conseil Municipal*) have authorised the Orleans Railway Company to prolong the line running to Sceaux and Limours into Paris as far as the Place de Medicis, near the Luxembourg. The station at this point has been commenced, and will be in many respects similar to the London Metropolitan stations, all this extension being underground, The same company contemplate a further prolongation of this line under Paris as far as the terminus of the Orleans main line near the Jardin des Plantes. The Western Railway Company are about to construct a line connecting Havre with Dieppe.

Copper, Tin, Lead, Zinc.—The situation remains unchanged in the copper market, though with a slightly weaker tendency. The tin market shows a rise in Billiton and Banca brands, which have gone up 10s. a ton. Leads of all classes have fallen off 4s. a ton, and generally throughout France business is very dull in this article. Zinc continues firm, with a tendency to a rise in price.

French Commerce.—The following statistics are taken from the report of the Customs Administration (*L'Administration des Douanes*) for the year 1890. The total imports between the 1st of January and the 31st of December are put down at 4,423,255,000fr., and the exports at 3,720,121,000fr. In nearly all sections the figures show a marked increase on the year 1889, but the exportation of raw material is more than 65,000,000fr. below that of the preceding year, while the importation of the same shows an increase of nearly 29,000,000fr., from which it may be inferred that French industries are rapidly growing.

BERLIN, 2nd February, 1891.

Electrical Exhibition in Frankfort.—At a recent meeting of the Frankfort Electrical Association, it was stated by Herr O. von Miller that the proposed Exhibition is to be strictly divided into separate sections. The section which is to be devoted to electrical railways and signalling will be chiefly occupied by four electrical railways, worked either by accumulators, or by overhead or underground conductors. In the section devoted to telephony and telegraphy, Messrs. Siemens & Halske exhibit an exchange instrument for the sending of telegrams from a central office by means of type recording instruments in the houses of customers. In the section of electrolysis, there is to be a complete collection of aluminium articles made by the Neuhausen Company, including a petroleum launch made of aluminium. With regard to the electrical transmission of power, the Exhibition will receive 100 h.p. from the palm garden, 100 h.p. from Offenbach, and 100 h.p. from Lauffen-on-the-Neckar. Messrs. Siemens Brothers are laying down a cable which is said to be for a current of 20,000 volts.

The McKinley Bill.—To give a clear idea of the effect of the McKinley Bill concerning the export of woven goods from Chemnitz to the United States, the following synopsis for the last quarter of 1890 and 1889 will be useful. The export amounted in the fourth quarter in—

	1889.		1890.
Cotton gloves	$163,610	...	$115,533
Silk gloves	271,264	...	136,855
Woollen gloves	47,464	...	11,268
Cotton hosiery	1,757,436	...	1,169,890
Silk hosiery	74,036	...	34,617
Woollen hosiery	19,783	...	11,932
Jersey material	15,801	...	—
Tricot goods	25,435	...	32,109

German Wood Trade in 1890.—According to the annual report of the Union of German Wood and Wood-Floating, the wood trade of the year 1890 was exceedingly brisk. Into the harbour of safety, Brakemünde, there were floated, from the Vistula, 925,000 running metre rafts, 4 metres wide, as compared with 928,345 in the year 1889, 815,045 in 1888, and 619,512 in 1887. Through the Canal of Bromberg were floated in 1890 957,624 m., as compared with 849,217 in 1889, 741,174 in 1888, and 669,368 in 1887.

Trial Trip.—The new fish steamer "Fock and Hubert," which has been built in the shipbuilding yard of Chr. Jürgens & Co., Steinwärder, by order of the Fish Steamer Company in Cranz, has recently made its maiden trip, which was very successful. The "Fock and Hubert" is the first steamer for high sea fishing built in Hamburg. Only German steel has been used for its construction. The engines are built on the compound system, and provided with surface condensation. They indicate 300 horse-power.

VIENNA, 2nd February, 1891.

The Iron Market.—The expectation of a good building season next spring has caused a brisker tendency in the iron market. Important orders have been given for bar iron and thick plates, which will help to maintain prices. The interruption of the railway traffic has caused stagnation in business with regard to hardware and machinery. The Kaschau-Oderberg Railway has given an order for 500,000kgr. of Bessemer steel rails, and for a large quantity of other iron materials.

The Coal Market.—The Vienna coal market has recently been in a miserable condition. The stagnation of the railway traffic has hindered the forwarding of coal from the snow-covered districts. The Northern Railway had great difficulty in dealing with 200,000 cwt., though the usual traffic is from 1,300,000 cwt. to 1,400,000 cwt. The demands of the various coal consuming industries were, therefore, only partially satisfied. On the 29th ult. the stagnation of the traffic was relieved, and the trade of the Vienna coal market became normal. In the Bohemian coal region also the weather has caused much difficulty, but during the past few days the traffic has again become regular. The regularity of railway traffic is the more important, since traffic by water is at a standstill.

Electrical Engineering.—The electrical machinery which is being installed in the new residence of the Empress at Corfu by the International Electricity Company consists of an electric light installation, of a condenser for the production of fresh water, of a refrigerating machine, and of a telephone installation. For the purposes of the electric lighting installation there are three steam boilers, which have been obtained from the manufactory of Messrs. Sigl in Vienna Neustadt, a steam engine from the same makers, and two dynamos of the type Δ 3, constructed by Messrs. Ganz & Co., of Budapest. The telephones are supplied by the Vienna Private Telephone Company. The whole of the plant is to be in working order in the autumn of this year.—The General Austrian Electricity Company has been formed during the past week. Hofrath von Hauffe, the President of the Association of Engineers and Architects, has been chosen as the President of the administration. The other members are the representatives of the Anglo-Austrian Bank and of the firm of Messrs. Siemens & Halske.—A short time ago the "Kleinmünchner" spinning factory began to be driven by the electrical transmission of power supplied by its own water power. The electrical installation was provided by the Oërlikon Company.—The Innsbruck Central Station of Messrs. Ganz & Co. has been considerably enlarged. The largest installation which is supplied from this station is the Jesuits' Church, which is lighted with 1,000 lamps of 16 candle-power.

DÜSSELDORF, 3rd February, 1891.

Iron and Steel Market.—The pig iron market is fairly quiet. The steel works generally are in full operation, but plate and wire makers are seeking orders. Siegen sheets are at from 130 to 145 marks. The builders of railway waggons are hopeful for the future, as the rolling stock of the Prussian State Railways is not sufficient for the existing heavy traffic.

Coal Market.—The production of coal in the Oberbergamts district, Dortmund, was, in the first quarter, 9,032,158 metrical tons; second quarter, 8,526,636; third quarter, 8,977,021; and fourth quarter, 9,032,773—total, 35,568,588 metrical tons. As the production in the same period of the previous year was 33,851,190 tons, the increase is 1,717,898 tons, or 5 per cent. The number of miners at the close of 1890 was 132,038, against 121,200 in 1889, or 10,838 more men, an increase of about 9 per cent. These figures prove that the tonnage produced by each man has diminished. There is still a great deficiency in coal waggons, and in the Ruhr district this deficiency amounted on several days to upwards of 4,000 waggons. Prices are strong in spite of the mild weather, which commenced a week ago, as the severe weather continued longer on the Upper Rhine than on the lower part. The ice, which at some places had a thickness of 15ft. to 20ft., has done less damage than was expected. The Upper Rhine from Loreley to Bacharach is still frozen.

English and Westphalian Coal in Hamburg.—The coal consumption of Hamburg in the past nine years is shown in the following table, in which the tons = 1,000kg.:—

	Westphalian Coal. Tons.		English Coal. Tons.
1882	494,994	...	1,015,400
1883	530,720	...	1,043,800
1884	562,673	...	1,025,500
1885	553,970	...	1,138,700
1886	572,945	...	1,206,700
1887	613,110	...	1,227,820
1888	715,720	...	1,365,000
1889	817,836	...	1,585,531
1890	885,882	...	1,582,900

Though the import of English coal has grown steadily, the Westphalian coal shows an increasing percentage of the whole consumption.

Cement Market.—The prospects of this branch of business are not bright. In the Silesian manufactories the price which is now asked for each keg of 175 kilogrammes is 5·40 marks, whereas in the past year the price was from 6·60 to 6·80 marks. During the present season the shipment of cement is of course small. It is expected that there will be a demand for cement for the building of fortifications, and that a supply of 40,000 tons will be needed for the Nordostsee Canal.

Dr. Otto.—On the 26th ult. there died at Cologne, after a brief illness, a man of considerable eminence, Dr. Nicol August Otto, the inventor and patentee of the well-known "Otto" gas engines. Some twenty-five years ago his attention was drawn to gas engines, and in connection with Mr. Eugene Langen he brought out an engine, called "Langen and Otto's atmospheric gas engine," which attracted considerable attention for some years. This engine was open to many objections, but was highly economical and extremely ingenious. Subsequently he invented the "Otto" gas engine, which found such great favour that in a short time he was enabled to appoint makers all over the world, from whom he derived very large royalties. As an inventor, Dr. Otto possessed inexhaustible patience and considerable fertility of resource. Though he was not brought up as an engineer, he soon became one, as he had great mechanical talent and theoretical knowledge.

AMSTERDAM, 2nd February, 1891.

The North Sea Canal.—An important discussion has taken place in the Town Hall, under the auspices of the Society for the Promotion of Shipping Interests in Holland. The subject was the recent closing of the port of this city by the freezing of the North Sea Canal, and the report was read of the special committee appointed to remedy the ice blockade and to devise means for preventing a similar predicament, so disastrous to shipping and trade, in the future. The report says that it is not impossible to keep the North Sea Canal open at all times of the year, but such an expensive effort should not be undertaken by the trading community alone. The State, the province, and the town of Amsterdam should each be asked to contribute their quota. In the course of an interesting discussion which followed the reading of the report, it was pointed out that the port and town authorities in other places consider it part of their duty to ensure free access even in the severest of winters to all vessels, whilst in Amsterdam the task is left to private enterprise. It was also contended that the State should take some action, in the interest both of the country's trade and navigation, and also in that of the national defence. The meeting finally adopted resolutions in favour of the committee's report. This involves an expenditure of nearly £4,000, spent in clearing the North Sea Canal of ice during the late frost, and authorises the committee to open up negotiations with the State, the province of North Holland, the town of Amsterdam, and the leading houses interested, for obtaining a fund of half a million guilders. The interest thereon, computed at £5,000 per annum, is to be devoted to the maintenance of an efficient ice service upon the North Sea Canal.

Navigation at Amsterdam.—Unofficial statistics show that 1,675 vessels, with a capacity of 4,200,409 cubic metres, entered the port of Amsterdam in 1890, against 1,642 vessels, with a capacity of 3,964,112 cubic metres, in 1889.

The Zone System in Holland.—The State Railways Company will introduce the zone system in Holland, by way of experiment, when the summer train service comes into force on the 1st of May next.

Telegraphs.—The State Telegraphs Administration in Holland has practically decided upon adopting the English system of opening accounts current with the press, well-known firms, and other customers, thus obviating payments at the time of telegraphing and frequent delays.

STOCKHOLM, 31st January, 1891.

Railway Construction in the Past Year.—During 1890 the building of railways has proceeded rapidly in many parts of Sweden. Of the important Mora-Venern Railway a distance of 50 kilometres was opened for traffic between Aforsen and Vansbro. Of the Falun-Rattvik-Mora line, a length of 24 kilometres was opened between Slättberg and Rattvik. The Stockholm-Rimbo-Rjursholm line has been opened for traffic, with a length of 35 kilometres. On the Norrland Main State Railway about 90 kilometres, between Aunsidsjö and Nyoker, have been levelled and partly railed, and the works have been extended some 9 kilometres to the north of Nyoker, as far as Högbränna. The large bridges over the Ore and Usne rivers have been commenced, and several smaller works in connection with the diversion of rivers have been advanced. It is expected that the traffic will be opened as far as Värmös during the present year. While the works on the North Main State line are being pushed on with energy, those on the Lulea-Gellivara-Ofoten line of the Swedish-Norwegian Railway Company have been entirely discontinued. The State is continuing its negotiations with the company for the purchase of the railway, and a decision will probably soon be arrived at. The Skymnös-Munkfors Railway, which is a continuation of the Nordmark-Klacelfoen Railway, has been opened for traffic (length, 24 kilometres), and a railway of 23 kilometres has been opened between Vettsjö and Hessleholm.

Concessions for New Railways.—During last year concessions were granted for new lines of an aggregate length of 333 kilometres, with a calculated cost of 11,028,200kr. Applications for concessions are still pending for further railways, with an aggregate length of nearly 300 kilometres, at an estimated cost of 21,134,400kr.

The Agricultural Society's Meeting at Gothenburg.—The preparations for the Royal Swedish Agricultural Society's meeting, which is held at intervals of five years, are being proceeded with in various directions, and the meeting is likely to be an interesting one. The principal Swedish makers will be fully represented, and foreign makers will have large exhibits. The exhibition of scientific dairy appliances will probably be specially attractive.

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THE ADELFORS GOLD MINE.—This old mine, which has not been worked for about a hundred and fifty years, passed some time ago into the possession of a German syndicate. It would seem that this property is likely to turn out a very valuable one. The modern improvements for extracting the gold from comparatively poor ores increase the prospects of the undertaking.

WORKMEN'S SHARE IN PROFITS.—The proprietors of the Ruben tobacco manufactory in Carlscrana have informed their employés that they are to share in the net profits of the works in accordance with a fixed scale. This arrangement benefits the travellers, the clerks, and the workmen.

CHRISTIANIA, 31st JANUARY, 1891.

SILVER MINING.—The old Kongsberg Silver Works have during their last working year produced about 5,523 kilogrammes of pure silver, which is not a satisfactory output. The prospects are not bright, for, although the rise in the price of silver has helped to improve the result, prices are much lower than they were ten years ago; moreover, some of the old mines show signs of exhaustion. This more especially applies to the "Kongens Grube," which is looked upon as the main mine. The above quantity of silver was sold for a sum of 631,339kr., averaging 117kr. 28 öre per kilo. The aggregate receipts of the works amounted to the sum of 819,073kr., with an expenditure of 700,874kr., leaving net profits of 118,199kr. The smallness of the net profits must be attributed to heavy and extraordinary expenses. The best yield during the last year has been from the Armen mine and the "Gottes Hülfe in der Noth" mine. A couple of English companies are working, in an experimental way, the Kinoren (Christiania) and the Triangel mines. Some rather promising findings are understood to have been made, but the work has been suspended for the present pending the formation of a larger company. The Jacob Kuntsen Mining Company are short of capital, and are endeavouring to make arrangements with an English syndicate, but so far without success. In other places experimental workings have been made with a view of obtaining some negotiable property.

GOLD MINING.—The gold findings at the Bömmelö have been worked by three companies, the Oscar Gold Company, the Hongsmid Gold Syndicate, and the "Bömmelö Bergverkaselskab." The Hongsmid concern has during the year met with some promising findings, and although the quartz, when accompanied with visible gold, appears to be poor, the prospects for this syndicate are looked upon as fairly hopeful. The Oscar Company works with much perseverance, and the results so far obtained, although not yet remunerative, warrant expectations of better times.

MADRID, 2ND FEBRUARY, 1891.

CURE FOR VINE DISEASE.—Senor Don Rosendo Bonfill, an engineer of Barcelona, states that he has discovered an effective and cheap cure for phylloxera, the cost not exceeding £4 per acre. He applies the ingredient to each vine plant, and prevents the attack of the disease, or cures the plant if it has been already attacked. He has been making some experiments on vineyards, where the disease had already done much damage, in order to try the efficacy of his remedy.

NEW MUNICIPAL PALACE.—The Madrid Municipal Corporation have officially announced their intention of building a new set of offices. The site which has been chosen is a garden called "El Buen Retiro," which adjoins the fine park, El Retiro. The building will stand at one corner of an entrance to the Prado, the other corners being occupied by the War Office, the Bank of Spain, and the palace of the Marquis of Linares. As these are large and fine buildings the new buildings of the Corporation ought to be of an equally fine architectural character. A Bill will probably be presented at an early sitting of the Cortes, in order that the Corporation may be enabled to take possession of the land.

MINING EXHIBITION AT BILBAO.—It is proposed to hold a Mining Exhibition on a large scale at Bilbao in 1892. The building which is to be erected for the purpose will be of a permanent character, and will be afterwards used as a museum and technical laboratory for the training of workmen in mining and metallurgy. The management of the Exhibition will be in the hands of the provincial authorities. The future of the metallurgical and engineering industries in Bilbao seems very promising, and the proposed Exhibition is likely to aid their progress.

MERCURY MINES.—The Almaden mine, during 1890, produced 50,035 flasks, against 49,477 flasks in 1889. The yield of the ore last year was nearly as much as in 1889, being just under 9·30 per cent. Other mines in Asturias, belonging to the "El Porvenir" Company, produced 1,450 flasks. The yield of this ore, though only about 1 per cent. on an average, gives a profit.

ROME, 2ND FEBRUARY, 1891.

GROWTH OF MECHANICAL INDUSTRIES.—The largest and almost the only buyers of the machinery made in Italy, excluding the shipbuilding trade, are the Italian railway companies, and, in fact, the history of the mechanical industries of this country coincides with the development of the railways. When, in 1839, the first eight kilometres of railway were made, there were no works in Italy that could supply rails, engines, and waggons, or build iron bridges. The first works erected in Italy were the Officine di Pietrarsa e Granili, which were maintained on behalf of the Government mostly for repairs, and it was only after the year 1879 that a large number of private works were started. Thus, in 1879, Messrs. Gio Ansaldo & Co., of Sampierdarena, were the only firm that manufactured locomotives in Italy, whilst now there are Messrs. E. Breda, the Maschinenfabrik of Saronna, Messrs. Miani Silvestri & Co., the Officine di Pietrarsa e Granili, and other smaller works. In 1879 there were very few firms manufacturing cars and waggons, whilst now there are the extensive works of the Impresa Industriale Italiana, Fratelli Diatto, the Officine di Savigliano, Fratelli Invitti, Società Veneta Officine di St. Elena, Messrs. Miani Silvestri & Co., Felice Grondona, and the Officine di Pietrarsa e Granili. Then, again, twenty years ago there were only two or three firms building iron bridges, whilst now there are from fifty to sixty, including both large and small works.

CRISIS IN THE ENGINEERING TRADE.—The engineering trade of Italy is at present suffering severely from the evil effects of excessive competition and over-production. Various remedies have been suggested by competent authorities in order to effect a remedy for this state of affairs, and restore the engineering trade to a satisfactory condition.

CAUSES OF THE CRISIS.—With the plants now existing for the manufacture of locomotives and waggons and the like, the estimated total production of such works would amount to £1,510,000 per annum. On the other hand, the requirements of the Italian railway companies only amount to from £1,000,000 to £1,200,000. The manufacturers of iron bridges and similar works, with the present low prices due to the excessive competition, ought to have a production of from 80,000 tons to 100,000 tons per annum in order to make an average fair profit, whilst the requirements do not exceed 40,000 tons per annum. The production being thus largely in excess of the requirements has caused the present crisis. The reason for this excessive development is to be found in the fact that some of the works assumed larger contracts than they were able to turn out. They were therefore obliged to enlarge their plants in order to carry out these contracts, and afterwards found themselves with a plant too large for the normal requirements.

REMEDIES FOR THE PRESENT CRISIS.—The question as to the remedies to be adopted is now being discussed in the Italian Parliament. It has been proposed that the Government and the railway companies should now place their orders for all their requirements during a period of the next ten years, which the manufacturers should execute during that period at a reasonable price. Others propose to extend the market, which is actually too small for the production of our industries, and that manufacturers should receive from the Government a premium on exportation, as is done in Germany. A further proposal has been made that all the work of our Government and railway companies should be distributed among the manufacturers proportionately to their respective capacity, thus guaranteeing to all the works a minimum of orders for a certain length of time to come. This latter plan is the one which will most probably be adopted, and, in fact, the Minister of Public Works has now named a commission of experts to carefully study the matter and report as to the real capacity of each of the Italian mechanical works.

NEW YORK, 24TH JANUARY, 1891.

SUGAR MAKING PLANT.—The Fort Scott Foundry and Machine Works Company, of Fort Scott, Kan., has received a large order for sugar making machinery from Edinburgh, Scotland. The order is for a large sugar manufacturing concern in Honolulu, Sandwich Islands. The machinery ordered consists of a patent improved quadruple evaporator, with a capacity to evaporate 1,500,000lb. of water each twenty-four hours, which is equal to the production of 200,000lb. of sugar in the same time.

RAPID TRANSIT IN NEW YORK.—Articles of incorporation of a company organised to construct a tunnel from New York to Brooklyn were filed in Albany on the 19th inst. The incorporators include some of the strongest money interests in the country. The organisation of this company is the first step to furnish the city with what is believed to be the only adequate system of rapid transportation. Not only are New York and Brooklyn to be connected, but each is to be connected with Jersey City, and New York City is to be tunnelled on both the east and west sides from the Battery to Jerome Park. The entire scheme involves the boring of forty-two miles of tunnels, large enough to accommodate a double track of railway, and will involve the expenditure of $61,000,000. Much preliminary work has been done, and borings have been made at every 500ft. of the proposed tunnel. With the exception of a distance of 2,400 feet in the North River, and a short distance in the city, the entire excavation will be through solid rock. The Brooklyn tunnel, on which it is proposed to begin work, will be 6,050ft. long, and 5,000ft. between stations. The underground station, as proposed, will be 330ft. long, 60ft. wide, and 30ft. high. Elevators having a capacity of 340 passengers per minute will be used to bring passengers to the surface. The incorporators estimate the cost of the tunnel itself at $1,250,000 a mile, exclusive of working plant.

COLORADO COAL MINES.—The Colorado coal mines, according to the *Engineering News*, produced 5,476,410 tons in the two years 1889-90. The coal production of 1873 was less than 70,000 tons; in 1890 it was 3,075,782 tons. Of this quantity the Las Animas mine produced last year 1,134,845 tons. The value of the coal taken out in 1889 and 1890 at the mines was $10,408,930, and nearly 6,000 men are employed. The average value of the coal in the cars at the mines is $1·87 per ton, for 1890.

THE PINTSCH SYSTEM OF CAR LIGHTING.—The Chicago and North-Western Railway has decided to replace the kerosene oil lamps in its passenger cars with the Pintsch system, and is erecting its own gas works. One great obstacle in the adoption of this system of lighting, says the *Railroad Gazette*, has always been the difficulty of recharging cars which have to make long round trips. The number of gas works for furnishing Pintsch gas has within the last year largely increased. Works have recently been erected in New York City, Jersey City, Syracuse, Boston, Cincinnati, St. Louis, Denver, Ogden, and Atlanta.

LOCOMOTIVE CONSTRUCTION.—Twenty-seven locomotives are in course of construction at the Baldwin Locomotive Works, which, when built, will be shipped to New South Wales, Australia. This is the largest foreign order filled by the Baldwin Works.

PHILADELPHIA, 23RD JANUARY, 1891.

STEEL RAILS.—The disagreement between steel rail producers has been at last satisfactorily adjusted, and the manufacture of rails is now practically in the hands of six companies. The price is at present $3 per ton over the lowest prices made during the struggle. There were until lately eleven companies which manufactured rails, but the Illinois Steel Company absorbed three, the Carnegie bought out one, and the Lackawanna and Scranton Companies have been consolidated, so that these companies, with the Cambria, Pennsylvania, and Bethlehem, have the control of the market.

RAILWAY EXTENSION.—It is now understood that the Niagara Central Railway has been bought by the Lehigh Valley Railway Company, and that the papers were signed last week. If this report is correct, the Canadian Pacific will probably run through Hamilton from the Bridge to Toronto very shortly, and when the Toronto, Hamilton, and Buffalo Railway is constructed, competition will be set up between the various companies.

RAILWAY STORAGE YARD.—The large transfer, classification, and car storage yards of the Pennsylvania Railroad at Walls Station, fourteen miles east of Pittsburgh, are nearly completed. In these yards there will be facilities for taking care of 5,000 to 6,000 cars, and the yards will contain the equivalent of sixty miles of single track. These, with two transfer stations, two round houses, and two car repair shops, will cost nearly $1,000,000. It is intended that in these yards all freight trains will be so made up that cars can be dropped at their destination without further arrangement. All traffic not destined for Pittsburgh will hereafter be carried around that city.

THE EDISON COMPANY.—The report of the year's business of the Edison General Electric Company states that the company has now in operation 1,371,000 lamps, and that more than three-quarters of a million dollars were expended on the plant at Schenectedy, New York, which will manufacture underground cables under the Siemens and Halske patents. During the year the production of the Schenectedy works increased by 117 per cent., and the sale of lamps increased 64 per cent. The gross profits for the year, after charging $206,000 for depreciation of plant and an equal amount for general expenses, were $1,896,177. The profits from the Edison Electric Light Company, which is owned by the General Company, were $1,023,011, which sum is not included in the above. The assets of the General Company are estimated to exceed its liabilities by $5,250,000. In this city the large Edison station is slowly approaching completion. At present the plant supplies 56,000 lamps of 16 c.p., and 7,000 lamps additional are being put in. The gross receipts were $190,000, and expenditure $120,000, and the net earnings, deducting interest accounts, amounted to $63,000.

PLATE GLASS FACTORY.—There is now in course of erection at Irwin, Pa., one of the largest plate glass plants in America. The firm will be known as the Pennsylvania Plate Glass Company. The contract for the building and its equipments has been placed with the New York firm of Messrs. A. C. Boyd & Co., which erected the large Tarentum and Howard plants in Allegheny Co. Over 600 men will be employed in the establishment, which will cost about $1,000,000.

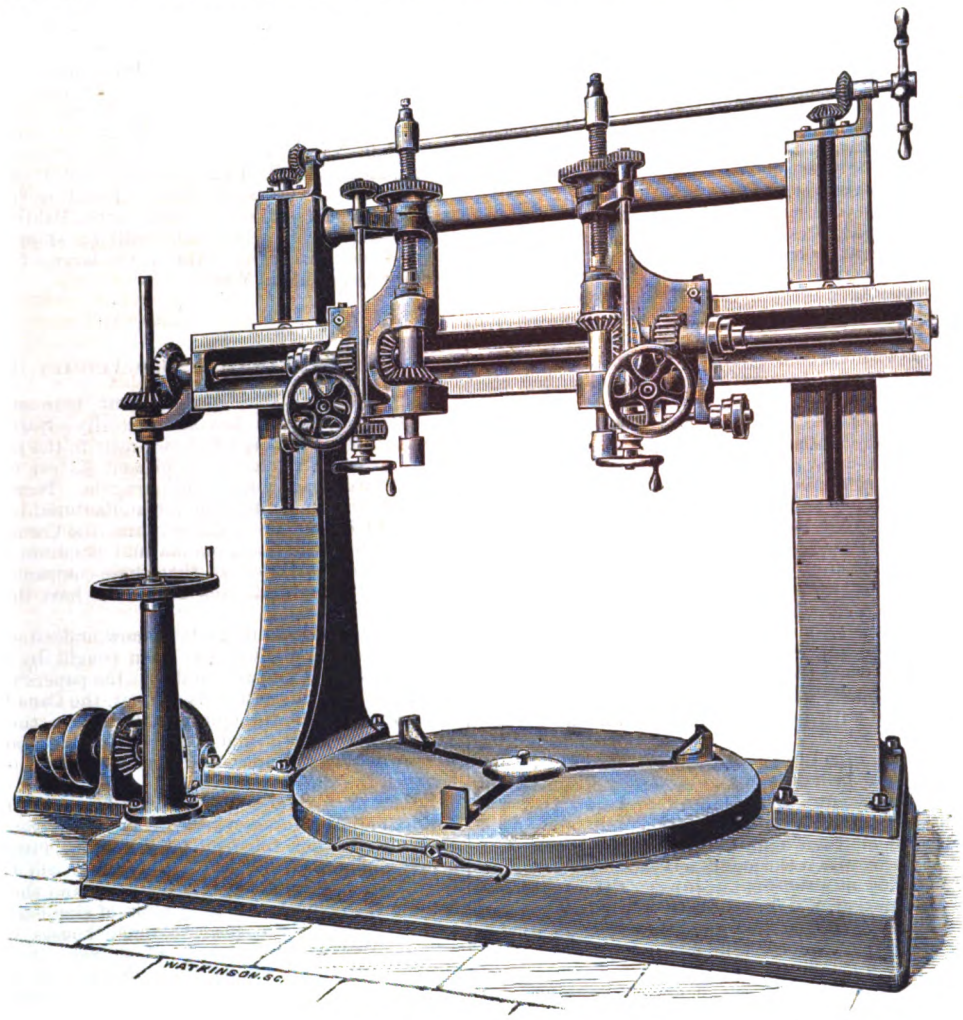
THE "NEWARK."—The report of the engineer officers detailed to watch the performance of the engines of the cruiser "Newark" on her recent trial trip was submitted to the Secretary of the Navy on the 22nd inst. It shows an indicated horse-power of about 9,000, or an excess of 500 horse-power over the contract requirements, and entitles the contractors to a premium of nearly $50,000.

STEEL WHALEBACK VESSELS.—The Steel Barge Company, of Duluth, has determined to establish a shipyard on Puget Sound for the building of its peculiar style of vessels for the Pacific coast trade. The cost of the yard will be about $1,000,000, and it will be larger than the original yard in Duluth. The company has submitted plans for its vessels to the United States Government, and may establish a shipyard on the Atlantic coast

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BOILER FLUE FLANGE DRILLING MACHINE.

CONSTRUCTED BY MESSRS. GEO. BOOTH & CO., CENTRAL IRON WORKS, HALIFAX.

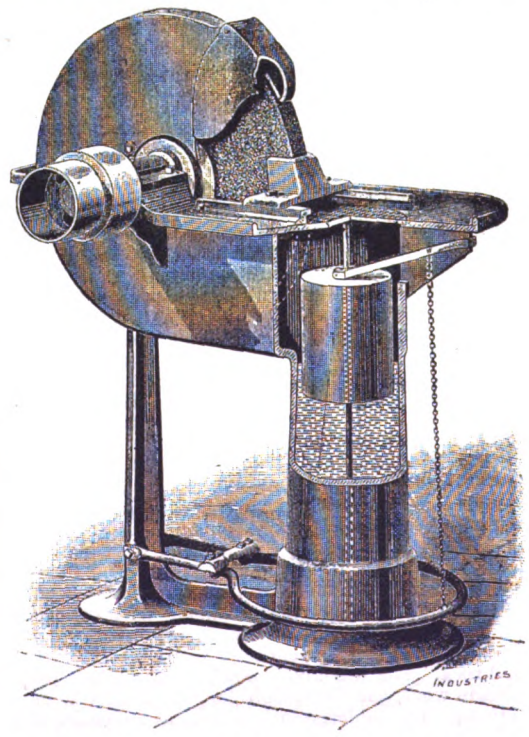


BOILER FLUE FLANGE DRILLING MACHINE.

The above illustration shows a special drilling machine adapted for drilling the holes in boiler flue flanges from 1ft. 10in. to 4ft. 6in. diameter and 1ft. 10in. to 4ft. 6in. in length. The machine has been constructed by Messrs. Geo. Booth & Co., Central Iron Works, Halifax, for Messrs. Penman & Co., boilermakers, Glasgow. The spindles are steel, 2¼in. diameter, and carried in long cast-iron sockets, the bottom end of which is conical and the top end fitted with nuts and washers for adjustment. Each spindle is fitted with a self-acting feed motion of 8in. traverse, and with a convenient arrangement for quickly engaging and disengaging the feed motion. The saddles can be easily adjusted to any position on the cross slide by a rack and hand-wheel placed conveniently in front of the saddles. The flues, while being drilled, are fixed on a circular table, which is fitted with three universal chuck jaws. The table is rotated by the hand-wheel shown in front of the left-hand standard. The machine is driven by a three-speed cone pulley, and is very conveniently arranged and substantially built. It is capable of executing work expeditiously, and is, we understand, giving Messrs. Penman every satisfaction.

THE BARNES WATER EMERY GRINDER.

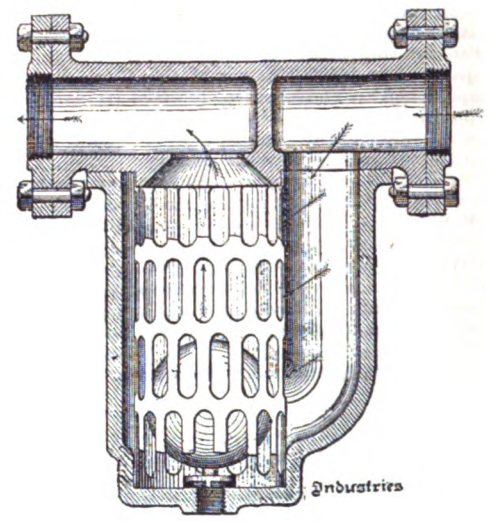
WE are indebted to our American contemporary, the *Electrical Engineer*, for the accompanying engraving, which represents an improved method of mounting an emery wheel. To the front of the curved treadle, pivoted to the rear standard and bent to encircle the water column, is attached a lever, whose free end carries a float. By pressing with the foot upon the treadle, the float may be made to enter the water chamber, thereby displacing the water and forcing it to rise and supply the wheel. When the machine is not in use the float rises and the water flows back out of the way of the wheel. This arrangement does away with all pumps and valves, which are liable to get out of order, simplifies the machine, and makes it more practical



under all conditions. The float chamber is divided from the chamber in which the wheel revolves by a partition, having in its lower part a small hole, through which the water slowly enters the wheel chamber. The action of the wheel carries the water to its front upper quarter, where it is arrested and thrown into a pocket, from whence it falls to the wheel and tool. The pocket is shown in the engraving with the outer shell broken away. Without the partition referred to, the water would be flooded into the wheel in a large volume, which would be undesirable. The small hole being in the bottom edge of the partition, allows all the water to flow back into the reservoir when the float rises. This construction simplifies the machine and renders it more efficient, and allows it to be used in shops where there is no water piping. The grinder is constructed by the W. F. & John Barnes Company, of Rockford, Illinois, U.S.A.

A NEW WATER SEPARATOR FOR STEAM PIPES.

THE accompanying illustration represents, in section, another addition to the many devices designed to avert the breakdown of steam engines from "priming." The separator we now illustrate has been invented by Mr. H. C. White, and is made by the Barnard Engineering Company, of 15, Cortland Street, New York, U.S.A. The action of the apparatus is fairly simple. Steam on its way to the engine is diverted in the direction shown by the arrows, and is prevented from passing directly through the T-shaped casting by a transverse wall, which deflects the flow of steam and suspended water



through the central cage, where the water is deposited by gravity and is drained off by a drip-pipe in any convenient manner. A glass gauge placed on the lower casting shows at a glance the height of the water in the separator. In case of an unusually large flow of water, greater than can be carried away by the drip-pipe, the ball will float on the surface, and, should the water rise sufficiently high, will become seated against the conical seating shown, and thus prevent the water escaping into the steam cylinder. We have some doubt about the ball leaving its seat, however, after the water below it has drained away. We are indebted to our American contemporary, the *Engineering and Mining Journal*, for our illustration.

SOCIETY OF ENGINEERS.

THE first ordinary meeting of the Society of Engineers for the present year was held on the 2nd inst. Mr. Henry Adams, the President for the past year, first occupied the chair, and presented the premiums of books awarded for papers read during his year of office, viz.:— The "President's Premium" to Mr. W. H. Brothers, for his paper on "Weighing Machinery and Automatic Apparatus in Connection Therewith"; the "Bessemer Premium" to Mr. R. H. Tweddell, for his paper on "Application of Water Pressure to Machine Tools and Appliances"; a "Society's Premium" to Mr. P. Griffith, for his paper on "Treatment and Utilisation of Exhaust Steam," and to Mr. W. Santo Crimp, for his paper on "Sewer Ventilation." Mr. Adams then introduced the President for the present year, Mr. William Newby Colam, to the meeting, and retired from the chair.

The new President then took the chair, and proceeded to deliver his inaugural address. After thanking the members for having elected him as President, he alluded to the very satisfactory position of the Society, the muster roll now showing a total of 448 members of all

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classes, and reviewed its work during the past year, which consisted in the reading and discussion of papers during the session, and of visits to works of professional interest during the vacation. He gave a brief outline of the papers read, and touched on the works inspected, which include the Thames Ironworks, Blackwall, the Royal Arsenal, Woolwich, and the London and North-Western Railway Works at Crewe. The President then indicated the advances which have recently been made in the practical application of electricity, both as a motive power and as an illuminant, and said that these advances were but small. He referred to the opening of the City and South London Electric Railway, and described some projected lines which it was proposed to work on the same principle, observing that the working and financial result of the system on the South London line was being closely watched in connection with the further proposed applications. He then described the special points of an electric tramway system proposed by Mr. Mansfield of New York, and which is on the "Spot" principle. Referring to primary batteries, the President observed that it was some time since they were previously heard of, but that three had made their appearances, during the past year. In electric lighting he said there had been no striking advances made as regards public street lighting. The St. Pancras Vestry had, however, set the first example of self-supply, and had started the building of an installation for supplying the parish without the intervention of outside companies. The applications of electricity to welding and to other industrial purposes were then referred to and briefly described. These applications include the manufacture of chlorate of potash, soda, paper pulp, chloride of lime, caustic soda, and leather.

The President said that he had only this week returned from an exhaustive professional tour through America, where he had been much impressed with the efforts that were being made to meet the modern demands for rapid transit in streets. He referred to many wonderful mechanical contrivances, some of which had been tried and condemned; others were being experimented with or were about to be tested as street motors. He thought that the cable system had given by far the best results mechanically and financially. In matters relating to mining and metallurgy, the President referred to the discovery of a perfect lode of uranium in Cornwall, to that of gold-bearing ores in France, and to that of coal in Kent. Elmore's process of producing copper tubes and cylinders direct by electro-deposition was described, and particulars of the tests of the metal produced were given. The Graydon dynamite gun, the manufacture of which has only just been completed, was also described, and the President concluded a most interesting address by referring to the opening of the Forth Bridge, the satisfactory progress of the Manchester Ship Canal, the progress of the Nicaragua Canal, and the efforts now being made to resuscitate the Panama Canal.

SHIPBUILDING NOTES.

On the 23rd ult. the s.s. "Ashley," built by Messrs. Craig, Taylor, & Co., of Stockton-on-Tees, to the order of Mr. Wm. R. Rea, of Belfast, for the North of Ireland Steamship Company, Limited, was taken out for trial. Her engines, supplied by Messrs. Westgarth, English, & Co., of Middlesbrough, have cylinders 21in., 34in., and 56in., with 39in. stroke, with two large steel boilers working at 180lb. pressure, and worked very satisfactorily, a speed of nearly twelve knots being obtained.

On the 24th ult. Messrs. Edward Withy & Co. launched from their yard at Hartlepool a large steel screw steamer, built to the order of Mr. F. Woods, London. Her length is over 320ft., and she is built throughout of Siemens-Martin steel, with a large measurement and dead-weight capacity, and is of the highest class at Lloyd's. The vessel has a long raised quarter-deck, short poop, long bridge-house, and a topgallant forecastle. The holds are fitted with iron grain divisions and iron cargo battens, all decks, deck erections, skylights, bulwarks, and bulkheads being constructed of steel and iron. A cellular bottom is fitted all fore and aft for water ballast. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. Four steam winches, two donkey boilers, patent steam steering gear amidships, screw gear aft, direct steam patent windlass, stockless anchors hauling up into the hawse pipes, and other modern appliances are fitted for the handy working of the vessel. She will be fitted with triple-expansion engines by Messrs. T. Richardson & Sons, Hartlepool.

On the 27th ult. an iron screw steamer of 3,250 tons gross was launched from the shipbuilding yard of Messrs. D. & W. Henderson & Co., Meadowside. The vessel is intended for trade between Calcutta and China, and has been built to the order of Messrs. Apcar & Co., Calcutta. The dimensions of the vessel are as follows:—Length, 452ft.; breadth, 42ft. 9in.; depth, 28ft. 9in. The triple-expansion engines have cylinders 27½in., 44in., and 72½in. in diameter.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, February 6th, at 9 p.m. Lecture on "Some Applications of Photography," by the Right Hon. Lord Rayleigh, F.R.S.

SANITARY INSTITUTE.—Friday, February 6th, at 8 p.m. Lecture on "Water Supply, Drinking Water, Pollution of Water," by Dr. Louis Parkes.

GEOLOGISTS' ASSOCIATION.—Friday, February 6th, at 7.30 p.m. Presidential Address on "Further Notes on the Geological Record," by Mr. T. V. Holmes.

SOUTH STAFFORDSHIRE INSTITUTE OF IRON AND STEEL WORKS MANAGERS.—Saturday, February 7th, at 6.30 p.m. Paper to be read: "The Theoretic Rationale of an Improved Design of an Open-hearth Furnace," by Mr. B. H. Thwaite.

NEXT WEEK.

SANITARY INSTITUTE.—Monday, February 9th, at 8 p.m. Lecture on "Drainage," by Professor H. Robinson, M.Inst.C.E. Wednesday, February 11th, at 8 p.m. Paper to be read: "Model Dwellings in London, and Overcrowding on Space," by Dr. Louis Parkes.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, February 10th, at 8 p.m. Discussion on the paper of Messrs. Atkinson on "Electric Mining Machinery."

SOCIETY OF ARCHITECTS.—Tuesday, February 10th, at 7.30 p.m. Ordinary meeting.

ROYAL VICTORIA HALL.—Tuesday, February 10th. Lecture on "Plants and Animals of the Coal," by Professor H. G. Seeley, F.R.S.

SOCIETY OF ARTS.—Wednesday, February 11th, at 8 p.m. Lecture on "The Proposed Irish Channel Tunnel," by Sir Roper Lethbridge, M.P.

OWENS COLLEGE UNION ENGINEERING SOCIETY.—Wednesday, February 11th, at 7 p.m. Union social meeting.

INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, February 12th, at 8 p.m. Discussion on "The Distribution of Electricity, with Especial Reference to the Chelsea System," by Major-General C. E. Webber, C.B., R.E.

PRICES CURRENT, 4TH FEBRUARY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
,, Angles	5 10 0	.....	6 0 0	,,
,, Plates	5 12 6	.....	6 2 6	,,
Staffordshire Bars	6 17 6	.....	7 7 6	London.
,, Angles	7 0 0	.....	7 10 0	,,
Crown Sheets	7 5 0	.....	7 15 0	,,
,, Hoops	7 0 0	.....	7 10 0	,,
"Siemens-Martin" Steel Boiler Plates			8 0 0	,,
,, Ship and Girder			7 0 0	,,

PIG IRON.

Middlesbro' Warrants, No. 3.	41/6	Cash.
Scotch Warrants, m/n	46/6	,,
Hematite Warrants, m/n	51/6	,,

Stocks in Stores.	Scotch	566,348—Dec.	for week 3,329	Tons.
	Middlesbro'	123,308—Inc.	,, 779	,,
	Hematite	212,861—Inc.	,, 151	,,

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	...	.....	...	f.o.b. Glasgow.
Gartsherrie	...	.....	...	,, ,,
Langloan	...	.....	61/-	,, ,,
Summerlee	...	.....	60/-	,, ,,
Glengarnock	...	.....	...	,, ,,
G.M.B. ex Store	47/-	.....	46/9	,, ,,

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£24	5	0	to	24	10	0
Copper: British Cakes and Ingots	57	10	0	,,	58	0	0
,, Chili Bars, G.O.B.'s	52	0	0	,,	52	5	0
,, Other sorts, G.M.B.'s (equal to Chili Bars)	52	0	0	,,	52	5	0
,, Manufactured (strong)	66	0	0		.....		
Lead: Common Pig	13	10	0	,,	13	15	0
,, English Sheet	14	5	0	,,	14	10	0
Tin: Straits	89	7	6	,,	89	15	0
,, Australian	89	12	6	,,	90	5	0
,, English Ingots	93	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER continues very quiet, with limited business. Transactions in raw copper during the past week have been unimportant, and values have gradually declined, to-day's quotations for Chili bars being £52 to £52 5s. cash, with small business reported. Manufactured quiet, with small demand; "strong," £66.

TIN is a shade firmer to-day, but prices of foreign are about 15s. per ton lower on the week.

LEAD: Inactive, with values a shade lower.

SPELTER is easier, a good deal of spelter having come forward on the breaking up of the ice at German ports.

CHEMICALS.

	£	s.	d.		£	s.	d.
Acid: Carbolic Crystals lb.	0	0	5½	to	0	0	6½
,, ,, Liquid gal.	0	1	0	—	.....		
,, Citric lb.	0	1	4½	—	.....		
,, Oxalic ,,	0	0	3½	—	.....		
,, Sulphuric ton	1	12	0	—	.....		
,, Tartaric lb.	0	1	8	—	.....		
Alum: Lump (powder 10/- ex.) ton	5	12	6	—	.....		
Ammonia: Carbonate lb.	0	0	3½	—	.....		
,, Muriate (Grey) ton	22	15	0	—	.....		
,, ,, (White) ,,	26	10	0	—	.....		
,, Sulphate ,,	10	15	0	—	10	17	6
,, Liquor lb.	0	0	3½	—	.....		
Antimony ton	.....			—	.....		
Bleaching Powder ,,	6	12	6	—	.....		
Bisulphide of Carbon ,,	18	10	0	—	.....		
Borax ,,	29	0	0	—	.....		
Benzole (90 %) gal.	0	4	9	—	.....		
,, (50/90 %) ,,	0	3	7	—	.....		
Copper Sulphate ton	17	10	0	—	.....		
Copperas ,,	2	0	0	—	.....		
Kieserit ,,	.....			—	.....		
Lead: Nitrate ,,	21	10	0	—	.....		
,, White Sugar ,,	24	0	0	—	.....		
,, Brown ,, ,,	19	0	0	—	.....		
Potash: Bichromate lb.	0	0	3¾	—	.....		
,, Caustic ton	22	0	0	—	.....		
,, Carbonate ,,	20	0	0	—	.....		
,, Chlorate lb.	0	0	5½	—	.....		
,, Prussiate (Yellow) ,,	0	0	10	—	.....		
,, Sulphate (Basis 90 %) ton	4	0	0	—	.....		
Precipitate: Red lb.	0	3	9	—	.....		
,, White ,,	0	3	9	—	.....		
Salts: Epsom {Bags ton	3	0	0	—	.....		
{Casks ,,	3	15	0	—	.....		
,, Glauber ,,	1	10	0	—	.....		
Sulphur: Sublimed Flowers ,,	9	0	0	—	.....		
,, Recovered ,,	5	0	0	—	.....		
Soda: Ash deg.	0	0	1⅜	—	.....		
,, Caustic (White 70%) ton	11	5	0	—	11	7	6
,, ,, {,, 60%) ,,	10	5	0	—	10	7	6
,, ,, {Cream 60%) ,,	9	5	0	—	9	5	6
,, Crystals ,,	8	0	0	—	.....		
,, Bicarbonate ,,	7	10	0	—	.....		
,, Hyposulphite ,,	6	5	0	—	.....		
Solvent Naphtha gal.	0	1	10	—	.....		
Tartar, Cream of cwt.	4	13	0	—	.....		
Zinc Sulphate ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: There is a good demand for general chemicals, and values, with few exceptions, are well maintained. In caustic soda, soda ash, and bleaching powder there is no change. Sulphate of ammonia is improving, and makers are quite disinclined to sell forward. Green copperas is rather quieter, but prices remain firm. Sulphate of copper in second hands is pressed for sale at considerably under present cost of manufacture. Acetates of lead and nitrate of lead are moving off better. Acetate of soda continues scarce.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	38	15	0
,, Ceylon	,,	28	15	0
Cottonseed	,,	18	7	6
Cod	,,	23	0	0
Lard	,,	33	10	0
Linseed	,,	22	0	0
Olive, Spanish	,,	43	0	0
Palm, Lagos	,,	25	10	0
Rapeseed: English	,,	29	5	0
Seal: Pale	,,	25	0	0
,, Brown	,,	.....		
Sperm	,,	48	0	0
Whale	,,	21	0	0
Turpentine	per cwt.	1	9	6
Coal	per gal.	.....		
Petroleum (Refined)	,,	0	0	5⅝
Spirit		0	0	8

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HOME INDUSTRIES.

LONDON, 5th February, 1891.

The Money Market.—Rates in the money market have hardened considerably, the revenue collections having diminished the floating supply of money by transferring it to the Government account at the Bank of England. Discount rates have been affected by the revival of the drain of gold to Berlin, which has proceeded intermittently. In the stock markets business remains dull and featureless. The better class of investment securities continue in fair request, but the investment buying of home railway stocks has fallen off, and in the absence of speculative dealing this market has been quiet. Brighton Deferred alone has been active, but the activity has not produced much effect. American railway shares have been somewhat brisker in response to New York, but little disposition to raise prices has manifested itself on this side. Canadian railway stocks have been steady. There has been no movement of consequence in foreign securities, Argentine, Chilian, and Portuguese bonds moving in accordance with the news of the hour. Silver securities have been quiet and depressed. South African mining shares have revived, the arrival of Mr. Rhodes in London drawing fresh attention to them. Industrial and miscellaneous securities have presented no feature.

The Royal Institution.—On the 30th ult. a lecture on "The Rejuvenescence of Crystals" was delivered at the Royal Institution by Professor J. W. Judd, F.R.S. The author said that the study of crystallogenesis in England had been begun by Robert Boyle, and the credit of British discovery had been maintained by the researches of Brewster and Sorby. The study of crystals had been of great assistance to the geologist, and the debt which the geologist owed to the chemist was more than repaid by the geologist's study of naturally formed crystals. Crystals had the powering of resuming their growth after an interruption of millions of years. If a crystal were taken from a solution, and afterwards returned to a similar solution, the growth of the crystal would continue as before. A specimen of the amethyst variety of quartz, surrounded by shells of the colourless variety of quartz, was shown. The formation of crystals depended on the temperature, the rate of deposition of material, the nature of material supplied, and the presence of foreign bodies, often quite minute, which, though themselves unaltered, had the power of completely altering the character of the crystal. The lecturer then described the formation of "zoned crystals," in which zones of different colours had been found during the growth of the crystals. If a crystal were injured, and the injury were not too deep, the crystal would complete itself before it continued its growth. In the mineral world, the smallest fragments of crystals were capable of continuing their growth. Some of the lower forms of animal life and plants had similar powers of attaining a complete existence.

Cheap Trains for London Bill.—A Bill has been introduced into Parliament by Mr. Theobald, which is intended to afford to workmen increased facilities for transit between their houses and their work. The Bill, which is an extension of the Cheap Trains Act of 1883, fixes a maximum return fare of a halfpenny per mile of the distance between the station and the terminus by all workmen's trains, from any station within twelve miles of the terminus, arriving at a London terminus before 8 a.m. The tickets are to be available for the return journey by any train departing from the terminus after 5 p.m. on the day of issue (the hour of 12 noon being substituted on Saturdays). Permissive powers are to be given to the Board of Trade to enforce the regulations of the Bill.

The Royal Naval Exhibition.—On the 31st ult. the First Lord of the Admiralty visited the grounds of the Naval Exhibition in order to see the arrangement of the buildings and the progress that had been made. He was met by Admiral Sir William Dowell, chairman, and Admiral Sir W. H. Stewart, vice-chairman, of the executive committee; Sir George H. Chubb, chairman of the finance committee; Captain A. Jephson, R.N., honorary secretary; and Lieutenant Gerald Maltby, assistant honorary secretary; and, after seeing the plans, was escorted round the whole of the buildings and grounds, where work on an extensive scale is in progress.

London Geological Field Class Lectures.—A course of four lectures, on "The Gravel Beds of the Thames and its Tributaries in Relation to Ancient and Modern Civilisation," will be delivered by Professor H. G. Seeley, F.R.S., on Saturdays, February 7th, 14th, 21st, and 28th, at 4.15 p.m., at the Gresham College, Basinghall Street. Tickets are to be had of Mr. J. H. Hodd, Hon. Sec., 78, Queen's Road, Finsbury Park, N.

Engineering Tenders.—The London County Council invite tenders up to the 10th inst. for work in connection with the construction of a weir at the Barking Outfall Sewage Works. Forms of tender may be seen at the Engineer's Department, Spring Gardens, S.W.—The Wimbledon Local Board require a new steam fire engine, with hose. Tenders are to be sent in by the 10th inst. to Mr. W. H. Whitfield, Clerk, Broadway, Wimbledon.

MANCHESTER, 5th February, 1891.

The Ship Canal.—The annual general meeting of the shareholders of this company was held on the 3rd inst., and there was an unusually large attendance, owing to a somewhat alarming report. It was stated on behalf of the directors that the contract existing with the executors of the late Mr. Walker had been rescinded and the works taken over by the company. Disputes had arisen under the contract between the directors and the executors, and the result was a resolution to free the latter from further control. The bargain concluded involved the acquisition by the company of plant amounting in value to £943,640, which sum had been advanced to the contractor by the directors, and which was to have been paid back in instalments. The effect of this is that much of the capital is locked up. In consequence also of extra works having been forced upon the company or carried out to increase the ultimate capacity of the canal, the borrowing powers of the company have been exhausted. It is therefore proposed to apply to Parliament for powers to obtain additional capital to the amount of £1,700,000 in order to complete the works. It was stated by Lord Egerton that this sum was more than covered by assets which could be realised at a profit after the opening of the canal, but not so profitably before that event. Mr. James Abernethy, C.E., had been asked to go over the works and report, and his report, which was read, was a very favourable one. The work at each extremity of the canal was in a very forward condition, and the remainder quite up to time. The plant at work was:—Horses, 187; waggons, 300; steam navvies, 96; steam cranes, 144; portable and other engines, 184; steam pumps, 212; miles of temporary railway, 228; and the number of men and boys employed, 15,000. The original estimate of land required was 2,845 acres, at a cost of £689,986, but 4,258 acres had been actually bought, at a cost of £1,022,390, of which 2,300 acres could be resold. As a further offset the dock space had been increased by 14 acres, the quay space by 69 acres, and the quay frontage by 1½ miles.

The Linen and Jute Trades.—The home demand has for some time been slow, and transactions are scarcely up to the average for the time of the year. The dulness of the foreign demand makes this want of activity all the more keenly felt, and, as the season is evidently to be a "backward" one, buyers being unwilling to operate for the future, there will be some difficulty in keeping up returns for the first quarter of the year. The partial resumption of traffic on the Scotch railways has enabled merchants to secure more prompt deliveries of Fifeshire linens here.

Indian Mills.—Some interesting statistics have been published with reference to the growth of the Indian cotton mills. In 1887 there were 103 mills, containing 2,421,920 spindles, the numbers being now 137 mills, with 3,274,196 spindles. The number of looms in the same period had increased from 18,356 to 23,412, and the number of workpeople now employed is 102,000. There is a keen interest being shown in the proposed Bill to deal with the hours of labour in Indian factories, and it need hardly be stated that the feeling in this district is almost universally in favour of it.

Quadruple Expansion Engines.—There is considerable activity prevailing among engineers, and several new departures are spoken of. The quadruple-expansion engines to which allusion was made recently are for a new mill in Bury, and are to be constructed upon the principles patented by Mr. Ferguson, of Paisley. Messrs. Musgrave & Sons, Limited, are to be the makers of this type of engine, as they have acquired the patent rights for England. The boilers which are to be employed are of the Lancashire type, each 30ft. by 7ft., and are to be constructed by Messrs. Edward Heaton & Son, of Manchester. The steam pressure to be used is 200lb. to the square inch, and this will be the first time that boilers of this type of such a size have been constructed for this pressure. We have given particulars of two smaller-sized boilers of this type for similar pressures which are the pioneers in this direction. The movement towards engines with greater expansion is gradually making progress in this district, an Oldham limited company being about to adopt triple-expansion to replace their present engines. As a rule, millowners still prefer the ordinary compound type, but as the limit of economy has been reached in this direction there is every likehood of a new departure being generally made.

Removal of Unhealthy Houses.—Acting upon a recommendation of the Sanitary Committee the Manchester City Council have determined to promote a scheme to demolish a large number of insanitary houses, and either make open spaces or cover the same with improved dwellings. In one of the districts of Manchester workmen's houses are being erected which retain the principle of self-contained dwellings, while at the same time they are fitted up in a superior manner and contain a number of improvements. This is an attempt to provide accommodation for the working classes free from the objections inherent in the tenement system.

Second-class Fares.—The chairman of the Manchester, Sheffield, and Lincolnshire Railway Company at the annual meeting, held recently, announced that in view of the very serious decrease in the number of passengers carried in second-class compartments they proposed to abandon their use except in certain suburban trains. The shareholders approved of this course, and it is announced that the change will take place on the 1st April next.

Manchester Gas Works.—Some interesting statistics have been published relative to these works. The mains extend a distance of ten miles, and 677 miles of mains are laid; 11,842 lamps exist within the city, 2,241 beyond it. The total producing power of the works is 16,368,000 cubic feet per day, and there is a storage capacity of 15,297,000 in addition. There are 78,259 meters on hire. The gas question is one which is exciting great interest in Manchester at present.

Micrometer Gauges.—Messrs. James Spencer & Co., of Hollinwood, have commenced the manufacture of micrometer gauges, which have hitherto been an American specialty, although largely used in this country. The gauges are well finished, and are made throughout by special machinery. Messrs. Spencer have constructed a gauge on this principle to measure from zero up to 2in., which has not hitherto been accomplished.

GLASGOW, 5th February, 1891.

The Railway Strike.—On the 29th ult. the men on strike belonging to the North British Railway effected a settlement with the company, and on the 31st ult. a similar settlement was arrived at on the Caledonian system. The strike is over, and traders feel a sense of relief, though some of the effects of the struggle may be permanently felt. The amount of loss to the trading public is incalculable. One extensive shipper, who customarily ships from sixty to seventy thousand tons per month, succeeded in shipping, during the six weeks of the strike, only ten or twelve thousand tons. The following is a fair estimate of the loss sustained through the strike. The men on strike have lost, in unpaid wages, £40,000. The loss to the companies in decrease in traffic receipts, in loss of the increment on these which would otherwise have been yielded, and in expenses connected with the strike, increased wages, bonuses, repairs to plant damaged by unskilled hands, may be stated at £200,000. The loss to the public in unpaid wages due to the closing of steel works, shipbuilding yards, factories, and loss of profit during five weeks may be estimated at £500,000. The total loss may thus be stated as £740,000. The close of the strike has caused business to become brisker. So many vessels, which have been laid up during the past six weeks, have offered for employment that freights have not materially advanced.

Shipowners' Club for Small Damage.—A number of Glasgow shipowners have formed themselves into a club for the insurance of small damage. Hitherto 3 per cent. was the limit below which damage was not paid. The extent of capital now invested in very large ships has resulted in this minimum becoming a serious amount; indeed, 3 per cent. upon a large steamer became a sum too large to be disregarded. The club which has been formed will take risk of damage under 3 per cent. to a minimum of ¼ per cent. The manager of the club is Mr. Nelson Bird, accountant, of this city.

Minerals.—The decrease in coal shipments for this year amounts to 158,887 tons. The principal part of this decrease must be set down to the railway strike. An important subject has been raised at the Clyde Trust in connection with the dues for bunker coal. A committee appointed to deal with the subject recommended that dues be henceforward charged for bunker coal. It appeared, however, that, having referred the question of powers to the opinion of counsel, they had found that, though counsel had advised that the Clyde Trust had the necessary powers, some difficulty had been found in enforcing them.

Engineering Bills.—Among Scotch Bills before Parliament this session involving engineering construction, there are the Aire and Calder and River Dun Navigations Junction Canal, the Caledonian Railway (Edinburgh and Leith lines), the Glasgow and South-Western Railway (steam vessels), the Partick, Hillhead, and Maryhill Gas, the Alloa Water, Dundee Water, and the Glasgow Police (Sewage).

Shipbuilding.—Messrs. Caird & Co., Greenock, have contracted with the Peninsular and Oriental Company to build for them two large steamers, each of 7,000 tons.—Messrs. William Hamilton & Co., Port Glasgow, are about to build a sailing vessel of 1,600 tons for a firm in London.—The Greenock yards generally are full of work, the orders which they have received during the past few months being sufficient to keep them busy for a long while.—It is expected that ere long the want of a large crane for shipping heavy machinery at Garvel Dock, Greenock, which has been much felt for a long time, will shortly be remedied by the erection either of large sheer legs or of a crane of suitable size.

High Speed Atlantic Steamer.—The Fairfield Company have now practically received the order to build a vessel to their five-day boat design brought out some years ago.

(From our own Correspondents.)

LIVERPOOL, 4th February, 1891.

The Liverpool and Belfast Steamship Trade.—Considerable interest has been aroused this week at the landing stage by the arrival of the steamship "Manchester" from Belfast, after her first trip. She is intended to compete with the existing company owning the "Dynamic" for the trade between this port and Belfast. She was built in Belfast by Messrs. McIlwaine & McColl, of 2,505 tons net register, has triple-expansion engines indicating 750 h.p., with a cargo capacity of 700 tons. The passage was made in 12½ hours, the speed on the trial trip being 11·78 knots per hour. The steamer is advertised to sail twice a week.

The Timber Trade.—The trade during the past year has been on a large scale, and, although the year com-

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menced with high prices, they were much reduced by the fall in freights. The high price caused increased the production, and the low freights caused heavy shipments to be forced upon the market. The stocks now held are in excess, and early arrivals will come to a weak market and will prevent any improvement in prices. The mahogany trade has been prosperous throughout the year, light stock and firm prices having been the normal condition.

THE GRAIN TRADE.—Although there have been great fluctuations in the trade to this port during the past fifty years, the imports have increased from 366,000 qrs. of wheat and 15,000 qrs. of maize in 1840 to 3,600,000 qrs. of wheat and 2,560,000 qrs. of maize in 1889. The imports of flour have increased very little, most of this going to London. In 1840 the amount imported was 988,000 barrels; in 1889 it only reached 1,135,000 barrels, although in 1882 the amount was 4,500,000 barrels. The average weekly consumption of the local market is 65,000 qrs. of wheat, 33,000 qrs. of maize, and 31,000 sacks of flour.

IMPROVEMENT AT SOUTHPORT.—The Southport Corporation has received permission from the Local Government Board to borrow the sum of £25,000 for foreshore improvement works. The scheme, which will be commenced immediately, embraces the widening of the existing promenade, the construction of a marine lake covering 27¼ acres, the erection of a shelter to hold 2,000 people, a boat house, and a large salt-water tank, the construction of the lower promenade, and other necessary works.

LEEDS, 4TH FEBRUARY, 1891.

LEEDS ASSOCIATION OF ENGINEERS.—At a meeting of this Association, held on the 29th ult., the President, Mr. Alfred Atkinson, being in the chair, Mr. William Johnson, M.Inst.M.E., read a paper on "Bricks and General Clay-working Machinery." The author spoke of the early efforts to introduce machinery in brickmaking, and showed why a machine, apparently perfect in design, failed utterly when placed in the brickfield owing to the constantly varying materials from which the bricks were formed. He described the several processes—viz., the plastic, the semi-plastic, and the dry—showing that one class of machine is suitable for one process, while an entirely different one is necessary for another. He also gave a description of various edge-runner mills, horizontal roller mills with one or more pairs of rolls, pug mills, and different kinds of compressing machines in use.

STEEL PITCH CHAINS.—The business in steel pitch chains is developing. Mr. John Whittingham, of the Victoria Iron Works, Hull, is supplying steel pitch chains for a variety of purposes, and of strength varying from 10 cwt. to 60 tons. A few of the principal uses for these chains are in connection with traction engines, cranes, hoists, elevators, dredgers, and pile drivers.

SHEFFIELD, 4TH FEBRUARY, 1891.

IRON AND STEEL.—The general condition of the iron and steel trades is fairly good. The high price of fuel operates adversely to local firms when their productions are brought into open competition with Belgian and German makers. Pig iron shows a downward tendency. Hematite is being offered here at 62s. per ton, and common forge iron from 40s. to 43s. General merchant iron is in fair demand, especially the better qualities, which continue to keep up their value. Ship and boiler plates are not selling at all well, owing to the productive power being so largely in excess of requirements. The Atlas Works are busily employed in turning out their specialties. The shop devoted to "Purves' flues" is being considerably enlarged and additional machinery added to meet the demand for these flues. The United States are now importing this flue in spite of the tariff. Steel castings and forgings are only in moderate demand. The use of wrought iron for axles in locomotive engines and rolling stock generally is on the increase. Many of these have now to be case-hardened—that is, converted into steel—at the journals for a depth of ¼in., and afterwards hardened. Messrs. Samuel Fox & Co., Limited, have declared a dividend of 10 per cent. per annum as the result of their year's operations in iron and steel.

ORDER FOR LACE MACHINES.—An extensive order for lace machines has been placed by Messrs. John Bromley & Sons, of Philadelphia, Pa., with Mr. John Jardine, of Nottingham. Messrs. John Bromley & Sons have been hitherto concerned in the manufacture of rugs and chenille curtains, and the plant which is to be laid down by Mr. Jardine will enable the firm to produce 5,000 pairs of finished lace curtains per week.

REGISTRATION OF NEWSPAPERS.—After some correspondence between the Post Office authorities and the Sheffield *Weekly Telegraph*, that newspaper has been removed from the register, so that a higher postage will henceforth have to be paid by its proprietors. The Postmaster-General stated that he would be willing to retain the *Weekly Telegraph* on the list of registered newspapers if "as much as one-fourth part were devoted to news or articles on current topics, provided always that the advertisements did not fill more than half the paper." In some respects the arrangements of the American Postal Service seem preferable to our own, newspapers there being weighed in bulk and distributed at a cost of 1c. per pound.

WIRKSWORTH WATERWORKS.—Mr. W. H. Radford, C.E., of Nottingham, has prepared a scheme for obtaining an increased supply of water at Wirksworth. The town is now supplied by gravitation from springs issuing from out of the millstone grit. There is a large surplus during the winter, but the springs run very low, and there is consequently a scarcity for about three months in the summer. It is proposed to construct an open stone-built reservoir to hold three million gallons for the storage of the winter's surplus.

CARDIFF, 4TH FEBRUARY, 1891.

IRON AND STEEL.—Pig iron makers are finding it difficult to make any profit, and at the Rhymney Iron Works the men have received twenty-eight days' notice, in view probably of a reduction in wages. Steel tinplate bars find a ready sale, but rails are hardly inquired for.

COAL AND COKE.—The steam coal trade continues fairly active, but arrivals of tonnage during the past week have not been so numerous. Colliery owners have, therefore, been obliged to accept a trifle less than last week's quotations, in order to secure immediate release for their loaded waggons. The sliding scale audit has resulted in an advance of 2½ per cent. to the men from the 1st inst. This means 55 per cent. above the standard, and it is clear that the men will make every effort to restrict the output, seeing the favourable position in which they are placed. The consumption must, however, be falling off, on account of the number of boats laid up—which now amount to 250—and it will, no doubt, be difficult to maintain prices at their present level, especially as the ironmakers find it impossible to pay present prices for fuel without incurring a loss. Steam coal is quoted at—No. 1 quality, 15s. 3d. to 15s. 9d.; No. 2, 14s. 3d. to 15s.; No. 3, 13s. 6d. to 14s.; and No. 4, 12s. 9d. to 13s. 3d. f.o.b. Small steam coal realises 7s. to 7s. 3d. Household sorts are moderately firm. Coke is quiet, but the high prices are maintained.

BARROW-IN-FURNESS, 4TH FEBRUARY, 1891.

HEMATITE.—A quieter tone is reported in the hematite pig iron trade, and the necessity of restricting the output of pig iron has been recognised in the blowing out of a furnace this week at the works of the Workington Hematite Company. There are now only 44 furnaces blowing, compared with 50 at the beginning of the year. The accumulation of stocks has been checked, the increase this week having been only eight tons. The value of pig iron has declined, and is quoted to-day at 51s. 9d. for warrants net cash, while makers are asking 53s. 6d. to 54s. for mixed Bessemer numbers, and say they cannot sell for less with raw material at its present price.

STEEL.—There is less doing in steel of all descriptions, and none of the works have many orders. The outlook, in fact, is cheerless, and the number of spring orders will determine whether the mills will be well employed during the year. Rails are easier at £4 15s. for heavy sections. In shipbuilding material the trade is very quiet, and the only prospect of new orders is on local account. Plates are at £6 5s. per ton, angles at £5 7s. 6d., and boiler plates at £7 2s. 6d. per ton. Little is doing in tinplate bars, blooms, slabs, and billets, but a good trade is springing up in heavy forgings and castings, and in steel hoops.

MIDDLESBROUGH, 4TH FEBRUARY, 1891.

PIG IRON.—The iron market has been very flat during the past week, and prices generally were weak. There is little buying, and consumers are disposed to wait until the stock returns for January are issued. A large increase in stocks is expected—probably over 30,000 tons. Deliveries to Scotland have increased since the termination of the railway strike. Merchants quote 42s. per ton for prompt f.o.b. deliveries of No. 3 G.M.B., but buyers will not give more than 41s. 9d. Middlesbrough No. 3 warrants are about 41s. 10d. cash, but no business is done in them. Grey forge is in better request for Scotland, as well as for local consumption, and is sold at 40s. 9d. Local hematite is down to 54s. 6d. at works for mixed numbers, buyers offering 54s. The decrease of freights from Bilbao to 5s. 3d. per ton is in favour of the makers.

MANUFACTURED IRON AND STEEL.—The manufactured iron and steel trade remains unaltered. Iron ship plates are £5 15s. per ton; steel ship plates, £6 2s. 6d.; steel angles, £6 5s.; iron angles, £5 12s. 6d.; common iron bars, £5 15s., all f.o.b. at works, and less 2½ per cent. discount for cash on the 10th of the month following delivery. The angle trade, though dull, is better than the plate trade. Heavy steel rails are £5 17s. 6d., and chairs £3 15s.

IRONMASTERS' RETURNS.—These returns show a reduction of 34,019 tons in stocks of pig iron. The mine owners met the miners' delegates to-day. After some discussion it was agreed that a reduction of 5 per cent. in miners' wages should take place. This settles, so far, the anticipated crisis.

SUNDERLAND, 4TH FEBRUARY 1891.

SHIPBUILDING AND MARINE ENGINEERING.—The shipbuilding and marine engineering business of Messrs. William Doxford & Sons, Pallion, has been converted into a limited liability company, the shares being all privately subscribed by members of the firm and their friends. Three steamers of 6,202 tons have been launched during the last month. No fresh contracts for steamers have been entered into but one firm has secured an order for a sailing vessel. There are still complaints of delay in the delivery of material ordered from Scotch iron and steel manufacturers.

THE SHIPPING TRADE.—The general aspect is not promising. Outward freights to the Mediterranean have failed to maintain the whole of the improvement recently shown. Black Sea homeward business continues, however, to evince firmness, but the rates obtainable are scarcely remunerative to the great bulk of steamships now trading, owing to the high price of coal and the increased cost of labour. Coal shipments have improved locally, owing to the liberation of ice-bound tonnage, but are not satisfactory, largely owing to the continuance of the strike at Silksworth Colliery. Last week 65,804 tons were shipped, a decrease of 9,606 tons as compared with the previous week. Shipments for abroad continue very low, more than three-fourths of the total quantity going coastwise.

THE DARLINGTON FORGE COMPANY.—As an example of rapid execution of work, the following achievement is interesting. Early in last month this company received an order from Messrs. D. & W. Henderson & Co., Glasgow, for a single crank-shaft for the Allan liner "Corean," the dimensions of which were 5ft. stroke, 15½in. diameter, and 9ft. 4in. over all. The forgings for this shaft were commenced on the morning of the 5th ult., immediately on restarting the works after the New Year holiday stoppage, and the shaft was built up, turned, and finished ready for despatch by the 12th ult. Nothing was done to the shaft on the 10th ult., so that the whole of the work in connection with it was completed in five actual working days.

NEWCASTLE, 4TH FEBRUARY, 1891.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending January 31st amounted to 103,393 tons, being an increase as compared with the shipments in the corresponding week last year of 9,263 tons.

SHIPBUILDING PROSPECTS.—The steady increase in the number of steamers that are being laid up week by week, and the continued lowness of freights, tend to make the future outlook for shipbuilding very gloomy. Some elements, however, in the situation justify the hope that the depression will not be so severe as that of the year 1888. The necessity which is placed upon shipowners of replacing old vessels and engines of obsolete types by new ones, better suited to the requirements of the time, will prevent the extremity of slackness being reached which existed from 1885 to 1887. There is also the encouraging fact that foreign shipowning companies are well aware of the advantage of buying English tonnage to fill up vacancies in their fleets during the period of restricted trade and low prices. A good many foreign orders for both ships and engines are now in the market, and quite recently one such order has been placed with a well-known firm on the Tyne.

ENGINEERING.—Messrs. John Abbot & Co., who for a considerable time have been very busy in their iron founding department, have just turned out a large flywheel rim, the weight of which is said to be 17 tons. This is one of the largest wheel rims that have ever been made in the district. It is intended for the new steel rolling mills of Messrs. John Spencer & Sons, at Newburn, to which destination it will be despatched after having been machined at Messrs. Black, Hawthorn, & Co.'s works. Messrs. H. Watson & Son, of the High Bridge Works, have just completed the fitting of the electric signalling gear in the cruisers "Sirius" and "Spartan," now being built at the yard of Sir W. G. Armstrong, Mitchell, & Co. They have an order from the Palmer's Company for similar installations in the cruisers "Pique," "Rainbow," and "Retribution." The firm are also commissioned to carry out the fitting of the pumping arrangements in the two cruisers being built by Messrs. Earles, of Hull, and are busy in the foundry department with gun-metal castings required in the equipment of war vessels for the home and several foreign Governments.

LEATHER AND INDIARUBBER WORKS.—Messrs. John Taylor & Co., Dean Street, are very well occupied in both their leather and indiarubber departments, their engineering specialties in indiarubber goods being much sought after. The firm have just taken up the agency for the new roofing materials "Duroline" and "Carboline," which appear to possess advantages that are sure to obtain for them a wide acceptance in the future.

DUNDEE, 4TH FEBRUARY, 1891.

EXPORTS TO THE UNITED STATES.—According to the return issued by the United States Consul at Dundee, the value of the exports of all kinds from this port to the United States for the quarter ending 31st December, 1890, was $2,035,457·24. For the corresponding quarter of 1889 the exports were valued at $2,300,119·85, and for the same period in 1888 they were $2,101,302·90. It would thus appear that the McKinley tariff has not affected the exports from this district to any great extent.

TRADE WITH CANADA.—In the Canadian tariff plain, dyed, and coloured yarns imported by manufacturers of jute goods for use in their own factories are in the free list, as is also unfinished jute cloth imported by manufacturers of jute bags. Canvas imported by manufacturers of oilcloth and duck for belting and hose imported by makers of rubber goods are also free.

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THE CHIGNECTO SHIP RAILWAY.

(*For description see page* 121.)

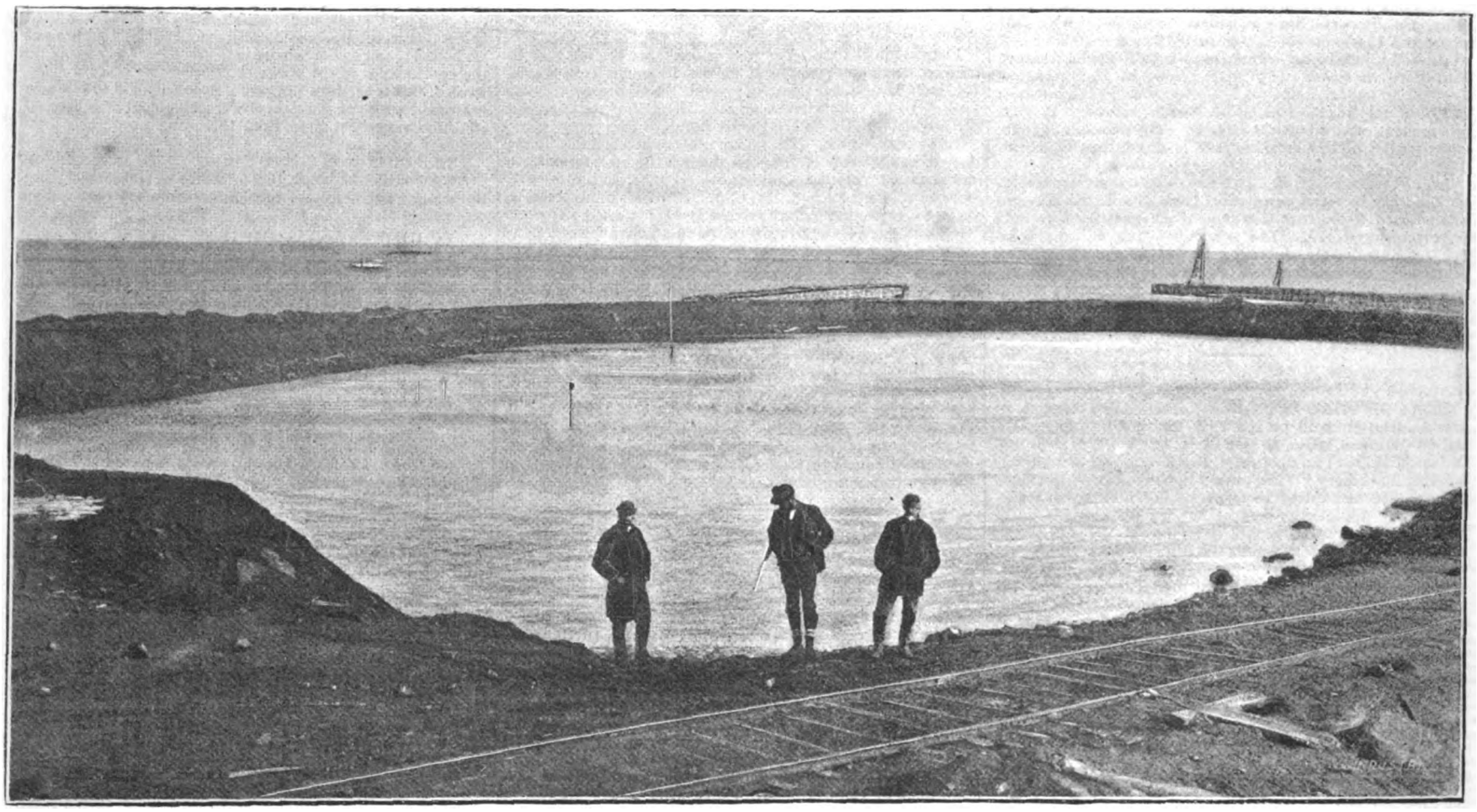


FIG. 11.—VIEW OF COFFERDAM PREVIOUS TO BEING EMPTIED.

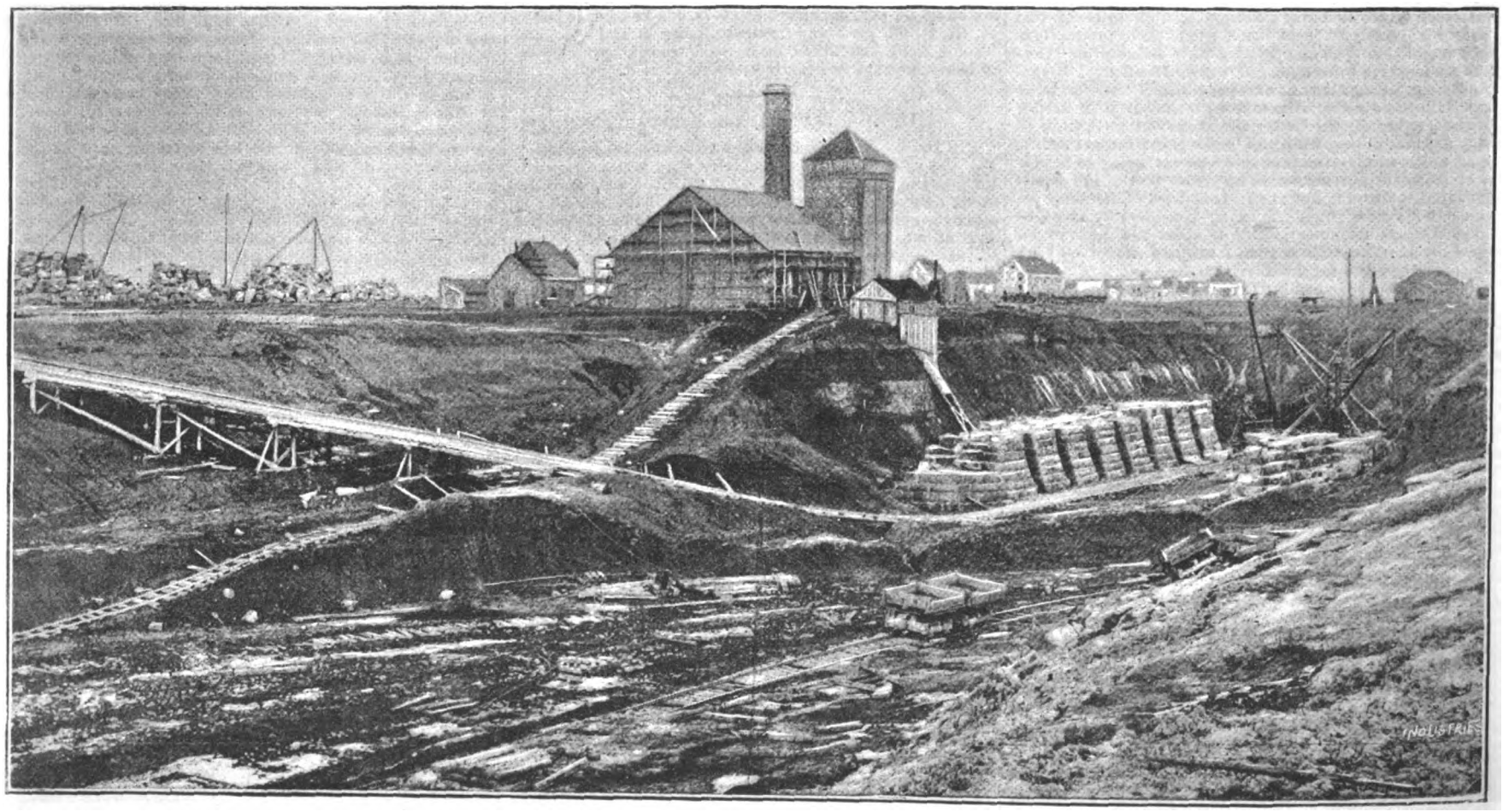


FIG. 12.—THE HYDRAULIC LIFTING DOCK AT AMHERST UNDER CONSTRUCTION.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 76, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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(Mr. G. N. Hennessey is Sole Agent for Ireland.)

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 6TH FEBRUARY, 1891.

THE EDUCATION OF ENGINEERS.

THE fact that such a question as "Is the study of thermodynamics of use to engineers?"—which is now being discussed in our columns—requires to be put, shows that the conditions and requirements of modern engineering education are still far from being understood. Of course these will vary considerably according to circumstances, and to the department of engineering which the student proposes to follow out, but there are some general principles which must be attended to in all cases. In the first place we must get rid of the idea that engineering is a single profession, and assume that it is a group of allied professions, all, more or less, closely connected with each other. These various departments of engineering have certainly a good many elements in common, but each of them requires a very large amount of special experience and training. No doubt there are many engineers who do good work in more than one department, but the tendency towards specialisation is increasing, and unless a man is a thorough expert in one department his general knowledge of several others will avail him little. A glance at the scope of the profession of engineering as defined by the Institution of Civil Engineers will show at once how thoroughly impossible it is for one man to study, far less to practise, all the branches therein enumerated. The programme includes methods of internal communication, such as roads, railways, tramways, and canals, telegraphs of all kinds, hydraulic works, relating not only to the sea-coast, but also to water supply for towns, and the irrigation and reclamation of lands. Architecture, both land and marine, and the operations of mining and metallurgy form part of the comprehensive programme. Moreover we find three sections which in themselves are capable of great variety, namely—(1) The design and construction of mechanical prime movers, such as steam engines, water-wheels, and other hydraulic motors, windmills, electric and other engines; (2) the design, construction, and adaptation to practical use of machinery and mechanical appliances of all kinds; (3) the design and manufacture generally of all large and important metallic structures, including artillery and other large articles of war.

The first thing, therefore, that a young man who wishes to become an engineer ought to do, is to form some idea of the department of engineering which he would like to pursue, and from the very outset he should give his training a certain amount of specialisation. For a year or two that specialisation need not be very pronounced, as a good general training in the principles and practice of mechanical engineering is serviceable to all classes of engineers, and provides a solid foundation for the special applications. One piece of advice, therefore, which we would give to intending engineers, is that whatever special department they may wish to pursue ultimately they should try to spend two or three years at least in a mechanical workshop in which a large variety of work is done. The old country millwright's shop, which has now almost disappeared, gave excellent opportunities for this kind of training. Referring to the school training of the future engineer, we are not by any means enamoured of some of the methods which are now being introduced. The aim of all school work should be to turn out good, healthy, manly boys, with active well-trained brains, which would enable their possessors to pursue almost any department of work with advantage. The old-fashioned high-class school was too exclusively classical in its tendencies, but it did much to preserve a healthy British spirit, which has really been the cause of our pre-eminence in so many departments. The modern school pays more attention to science and modern languages, and combines the training of the brain with that of the eye and the hand. A youth of 16 or 17 years of age who has gone through the curriculum of such a school, and wishes to become a mechanical engineer, and to follow the practical side of the profession, could not do better than go direct to a workshop for four or five years. He would there gain experience in the different departments, especially in pattern-making, fitting, and drawing office work, whilst at the same time he should attend evening science classes for two or three evenings a week. The majority of apprentices will get all they require in the way of theoretical training at such classes, and this, combined with their workshop experience, will have fitted them for some of the junior posts of their profession. Those who have displayed special aptitude for study might with advantage at the end of their apprenticeship attend for a year or so the day classes of a college or university, where they would have more time for the systematic study of some of the subjects which had previously engaged their attention. In some cases it may be found advisable to take a three years' course before apprenticeship, especially in the case of those who intend to take up the more theoretical side of the profession. It should not be overlooked, however, that a certain amount of workshop experience is of great service to college students.

It will be seen that, whatever plan be adopted, the practical training of the engineer is of as much, possibly of more, importance than the theoretical. The latter has, however, become very necessary by reason of the highly specialised state of knowledge. Moreover, modern machines are, in many cases, so complicated, that a good theoretical training is absolutely necessary, in order that their design, construction, and working may be thoroughly understood. True theory is, however, to be distinguished from abstract speculation, and is merely the condensed results of practical experience. It must be admitted, indeed, that in too many cases teachers of engineering do not seem to distinguish between such theory and their own hazy speculations, and thus they have brought discredit on college training generally. No subject has suffered from this method of treatment more than that of thermodynamics, about which some correspondence is now appearing in our columns. Its First Law, which enumerates the equivalence of work and heat, was too often misinterpreted, and false expectations raised as to the efficiency which might be expected from engines working under different conditions, until the bearings of Carnot's Law were recognised. But even that law has been strangely misused, by its application to cases entirely different from those from which it was derived. Without taking into account the limitations arising from the physical properties of the materials of construction and their influence on the action of the steam, it is impossible to make correct deductions from that law, or even to compare the efficiencies of two engines working

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with different initial steam pressures and under dissimilar conditions. The object of such a treatise as that of Professor Cotterill is to show how results are modified by the conditions of actual engines and the causes of loss of efficiency. The investigations into the physical properties of steam and of gases, and their applications to heat engines, freezing and cooling machines, injectors, and other appliances, all attest the great value of the science of thermodynamics to mechanical engineers. It must be admitted that few improvements in the steam engine have been the direct result of thermodynamical investigations, but of an expensive system of experiment. Science has been used to illuminate these after they were achieved, rather than to point out the direction in which they lay. But this is largely the case in all sciences, as experiment almost invariably precedes a complete theory, and is, in fact, necessary to it. This order of discovery does not lessen the value of the theory, which enables experience to be condensed, classified, and compared. Little progress would be made if we did not profit by the experience of the past, and if we had not a means of explaining that experience. But the science of thermodynamics is now sufficiently advanced, not only to explain the difficulties of the past, but also to illuminate the path of progress in the future. The position of thermodynamics illustrates the uses of theory in all other departments of engineering, and shows the connection between theory and practice. Moreover, the intellectual training to be derived from the systematic study of a theory of heat engines is one of the results which must not be overlooked. Such a theory is a highly complex mathematical and physical problem, requiring earnest and persistent attention from the student, and can only be mastered by a mind which has been thoroughly trained, and which is, therefore, capable of continued exertion in almost every department of physical science.

THE SCOTTISH RAILWAY STRIKE.

The settlement on Thursday in last week between the North British Railway Company and its employés, and on Saturday between the Caledonian Railway Company and those of its servants then remaining on strike, brought to a close by far the most serious industrial crisis through which Scotland has ever passed.

The manner in which the men acted in leaving their work without notice was of course indefensible; but there can be no doubt that the conditions of railway service needed radical improvement. It is to this task that the directors and managers must now set themselves. The companies have met with the utmost forbearance from the traders and from the travelling public, who have suffered incalculable loss in consequence of the strike. The public thus only makes a fair claim in requiring that the companies shall do everything in their power to prevent such a crisis from occurring again. It is quite plain that if they do not spontaneously adopt drastic reforms in administration, a cry must arise to have these forced upon them. The short method of legislation has already been thrust into prominent notice. Though there seems no probability of a Bill being brought forward this session, it is likely that one or other of the proposed measures will be brought forward next year. Although Select Committees have a somewhat doubtful reputation, the inquiry to be set on foot by Sir Michael Hicks-Beach's Committee will probably be very useful, even to railway managers. But the safety of the service really lies, not in any extraneous and compulsory regulation, but in administration wise enough to render the railway service attractive to the best class of workmen. This can only be done by making the conditions of labour very much more tolerable than they have been. The immediate cause of the strike appears to have been that the conditions of labour on the Scottish lines were so bad that the quality of the staff had deteriorated.

The railway companies may find it difficult to make detailed administrative arrangements to reduce the working hours of their servants within normal limits; but if the wit of their managers does not extend so far, the public and themselves must expect to suffer for it. It is a very easy but very delusive expedient to lay the whole blame of such crises upon the paid agitator. In this case there is really little evidence of his having had much influence. The men, or the noisy sections of them, seem to have managed matters in their own way, largely in open defiance of their leaders. The railway companies seem distinctly to blame for having endangered the public safety by allowing the conditions of work of their staff to drift into a position in which there was an accumulation of grievances, perhaps petty in themselves, but in the aggregate intolerable to the efficient and alert servant.

This is the natural history of the strike; and, although the managers of the companies have secured a nominal victory, the causes of the outbreak will have to be removed, or another will inevitably occur. It is serious enough to reflect that the men returned to their work in obedience to moral rather than to material pressure, and that the actual loss to themselves in consequence of the strike was probably less than a tenth part of the loss to the companies, and less than a twentieth part of the loss to the public. There is by far too strong a suspicion in the minds of the public that, as regards rates, the railway companies have opposed their interests to those of the public, so as to be able to exercise autocratic powers over the large bodies of men they control. Any attempt therefore to apply to railway servants the rules in force in regard to servants of the State would inevitably encounter serious opposition. The most effective and elastic method is the method of spontaneous regulation.

It is natural that, at a time when the whole subject of railways is in a state of fusion, suggestions for the nationalisation of the railways should be made. It is to be pointed out, however, that what this strike has proved is, not the absolute failure of joint stock railways, but that defective administration is not confined to public departments. The fault has been, as shown, largely an administrative one. Dissatisfaction with long hours and other conditions of employment has produced strikes among State servants—among postmen and policemen, for example—and mutiny among soldiers. It is, indeed, in one sense, fortunate that our industrial armies are not employed on the same footing as groups of State functionaries, for a strike among workmen is not treason, and there is practically no risk of civil war, whereas a strike among the servants of a public department, produced perhaps by mere want of tact on the part of some subordinate or superior official, might bring us to the verge of a revolution. In the particular case in question, patient and far-seeing reform in administration is the practical remedy which must be applied. Only by wise, just, and sympathetic management can the railway companies hope to secure the high-class and reliable servants they require, and which it is a public necessity they should have.

JAPANESE FOREIGN TREATIES.

We have on several occasions referred to our commercial relations with Japan, and pointed out the desirability of our Foreign Office meeting the Japanese Government in a broad and liberal spirit as regards this question. Quite recently Viscount Aoki made an important speech before the Japanese House of Commons, in which he reviewed the treaty revision question historically, and described the manner in which the early treaties with foreign Powers were concluded, as well as the circumstances which forced the "disastrous" tariff convention of 1866 on the Government of that day. He discussed the effects of the most-favoured-nation clauses in the later treaties made by Japan with certain Western countries, which, he said, were most serious for the legislative and commercial autonomy of Japan. He then referred in detail to the various efforts made since 1872 to conclude treaties on new bases. Attempts to this end were made in 1871, when a special mission came to Europe, in 1875, in 1878, when a special treaty was signed with the United States, in 1880, 1882, 1886, and finally in 1888. Viscount Aoki drew special attention to the fact that the treaties were not permanent. The Government had in nowise abandoned the work; it had been established for twenty years past as one of the national duties, and no Government could give it up. At the same time other duties fell on the Foreign Office; they could not be devoting themselves day and night to treaty revision only, and it was a popular mistake to suppose that the foreign relations of the country were all summed up in those two words. Speaking of foreign commercial relations, he said that at their doors was a nation of 270,000,000 people ready to take their manufactures and products and to give its own in return. The Chinese were the proper partners of Japan in trade and industry. In olden times the Japanese manned their boats and harried the coasts of China; the descendants of those hardy mariners ought to have something better to do than lose themselves in contemplation of the two words "treaty revision." Large spheres of activity and of national development lay before them; and when the treaties were revised those would become much larger He could not agree that the tariff question could be separated from the judicial question; both must be dealt with together, and he hoped in regard to the codes of law, which wrecked Count Okuma's scheme, to make an arrangement which would meet with public approval. The revision of the treaties was bound to come; the present system was inconsistent with Japanese progress and independence, and it was in conflict with the constitution. Hence the Government had opened negotiations, the details of which, however, he refused to disclose. He would only say that so far the result was reasonably satisfactory.

ELECTRIC LIGHTING OF THE CITY OF LONDON.

A complete scheme for the electric lighting of the City of London has now been projected, and on the 3rd inst. the first stone of the main junction box, near the Mansion House, at which the mains of the two contracting companies are to be joined, was laid by the Lord Mayor. For the purposes of the scheme the City has been divided into three sections. For the lighting of the eastern section, which consists of the whole of the City east of the Mansion House, the contractors are the Laing, Wharton, & Down Construction Syndicate. The central section consists of that part of the City which lies between the Mansion House and St. Paul's Cathedral, and will be lighted by the Brush Electrical Engineering Company. The western section extends west of the Mansion House to Temple Bar, and will also be lighted by the Brush Company. All the streets of the City of London are to be lighted electrically, and 400 arc lamps of 2,000 candle-power and 1,000 incandescent lamps are to be used. The cost is estimated at about £20,000 per annum, and the amount of light will be twenty times as great as that obtained from the present gas supply. As already mentioned, the two systems are to be connected together, so that, in the event of the failure of one system, the other will be able to light the whole of the City. The central station for the western and central sections will be situated on the south side of the river, and that for the eastern section will be near the Custom House.

THE LATE MR. JOHN DIXON.

The death of John Dixon, civil engineer, on the 28th ult., removes one who was widely known and much respected. The eldest son of the late Jeremiah Dixon, of Bella Wrag, near Windermere, he came of a well-known family of coalowners and engineers at Crockfield, in the county of Durham, and was nephew of the late John Dixon, the first chief engineer of the Stockton and Darlington Railway, who was intimately associated with George Stephenson in the original surveys and making of this, the first, railway. Born at Newcastle-on-Tyne in 1835, he commenced his education at Dr. Bruce's school, and served an apprenticeship at the engine works of Robert Stephenson & Co. Soon after completing his apprenticeship he was appointed engineer at the Consett Iron Works, where his eminent abilities soon secured him promotion to the management of the old Bishopwearmouth Iron Works, which were a branch of this establishment. When these works were abandoned by the New Consett Iron Company he went into business on his own account, but, this venture proving unsuccessful, he removed to London, where he began a succesful career as engineer and contractor, which was carried on till his death. In this capacity he carried out many important works in various parts of the world. In 1874 he got the concession for and made the first experimental railway in China, from Shanghai to Woosung, which was very successful and popular among the natives for a time, but, owing to the prejudices of the ruling mandarins, was shortly bought up and the materials taken out to sea and sunk. His discovery of an unexpected supply of water in the Rock of Gibraltar and his practical demonstration of it were due to his great knowledge of geological science, and brought him into high repute with the military authorities and the War Department, who purchased his concession, and thus established an invaluable constant supply of fresh water. His next enterprises were in Portugal, where he constructed the Custom House piers at Lisbon and a 60-mile line of railway, and where the confiscation and tardy payment by the Government required the intervention of our own Foreign Office and the suspension of a Government loan on the Stock Exchange before honest payment could be enforced. The rebuilding of Hammersmith Suspension Bridge over the Thames was his next work. But the work of all others which brought him most repute was the transport from

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Alexandria to London of the famous Cleopatra's Needle, which is now a familiar object on the Thames Embankment. In this enterprise he was supported by the late Sir Erasmus Wilson to the extent of £10,000, but owing to the unfortunate salvage claims, he was financially a loser to almost the same amount. Failing health some three years ago induced him to visit our colonies in South Africa, where his reputation as a harbour engineer caused his opinion to be sought in many important harbour works; but, broken down in health, he never thoroughly rallied after his return, and he died at the comparatively early age of fifty-six.

THE LATE MR. ROBERT F. MUSHET.

Mr. Robert Forrester Mushet, who died at his residence at Cheltenham on the 28th ult., was the remarkable son of a remarkable father, both of them having left indelible marks on the history of the iron and steel industries of the world. The father, David Mushet, was perhaps the most advanced metallurgist of his day, and in his well-known work, entitled "Papers on Iron and Steel," showed that he possessed an appreciation of the importance of these manufactures and of the conditions of their development that was very rare at the time when he wrote. He was of a practical as well as a philosophic turn of mind, and for a number of years he acted as the manager of some of the most important works in Scotland. Here young Robert was born, about eighty years ago, and, although the son did not enjoy the advantages of a very high-class education, as that would now be understood, he learned a great deal of the practical working of mines and furnaces from his father, who was something of a chemist, a geologist, a mining engineer, and a blast furnace manager combined. The young man was, however, of a more strictly scientific turn, and was no doubt a better all-round metallurgist than the father, having lived at a time when science was much more appreciated than it was a hundred years or so ago.

The original discoverer of the famous black band ironstone of Scotland was Mr. David Mushet, the father of the gentleman who has just died. This discovery was made about the year 1800, when the iron trade of Scotland was on a very limited scale indeed. Twelve years previously, according to David Mushet's well-known "Papers on Iron and Steel," there were in Scotland only eight blast furnaces, making between 6,000 and 7,000 tons a year of pig iron as a whole, while the finished iron industry was restricted to one forge and three refineries, which turned out about 240 tons of bar iron annually. From this period onwards, for many years, the quantity of iron produced in Scotland was doubled about every ten years, and one of the chief factors in the development that took place was the supplies of iron ore placed at the disposal of the iron trade by Mushet's discovery, aided by other factors of progress, of which the most important was Neilson's application of the hot blast to smelting. Until recently the make of iron from the local ores of Scotland, mostly black band, has averaged from 500,000 to 600,000 tons per annum, but this source of supply has of late years become largely exhausted, and foreign ores, as well as other local ores, have had to be called into use in increasing quantities.

David Mushet was also known as the patentee of a process for the manufacture of cast steel, which, in a modified form, was long carried on at Sheffield, and which, in its day, enjoyed a considerable reputation. The process, as originally introduced, is stated to have consisted "in fusing malleable iron, in the form of bar or scrap, or iron ore, when sufficiently rich and pure, in crucibles, with the proper quantity of carbonaneous matter." By varying the proportions of carbon different qualities of steel could, of course, be made. So-called Mushet steel has, of late, become identified with alloys of tungsten and wolfram, but there were really two distinct Mushet steel processes, and the latter process was for some time carried on by Mr. R. F. Mushet at Coleford. It is interesting to learn from Dr. Percy that David Mushet is stated to have disposed of his steel process to a firm in Sheffield for £3,000—a strange contrast to the rewards that have subsequently awaited Bessemer, Siemens, and other inventors.

The most interesting phase of the career of Mr. R. F. Mushet is undoubtedly that which connects him with the Bessemer process. Bessemer's first patent was dated 17th October, 1855, and his invention was stated to consist in "forcing currents of air or of steam, or of air and steam, into or among the particles of molten crude iron, or of remelted pig or refined iron, until the metal so treated is thereby rendered malleable, and has acquired other properties common to cast steel." A second patent for "improvements in the manufacture of iron" was obtained by Bessemer in the same year, and the aim of this patentee was stated to be "to form ingots suitable for puddling." The refinement of pig or crude iron was spoken of in the same patent as carried out "by a single process," and this process "cast the same into ingots suitable for rolling at once into bars or rods." In February of the following year a third patent was taken out, the object being "to convert into steel or into malleable iron, without the use of fuel for reheating," crude pig iron. Bessemer obtained further patents on the 15th of March and on the 31st of May, 1856, the objects of which were to secure modifications of his apparatus.

Up to this time the Bessemer process was incomplete. The radical defect from which it laboured was that the exact quantity of carbon required to produce steel could not be properly regulated, so that there was great uncertainty in the product. Bessemer was fully aware of the defect, and laboured hard to remedy it. He seemed, in his own mind, to have almost reached his goal, as a result of experiments made with metallic manganese—formerly employed in the casting of steel by Josiah Marshall Heath as an alloy—when Mushet obtained, on the 22nd of September, 1856, a patent for the addition of molten spiegeleisen to Bessemer's decarburised metal while still in a state of liquidity. This simple expedient made the Bessemer process complete. Instead of groping in the dark to ascertain the point of when decarburisation had proceeded to the required degree, Bessemer was now able to use the system that has since then been universally adopted, of first completely decarburising the metal in the converter, and then adding a given proportion of carbon in the condition in which it exists in molten spiegeleisen, so that, to quote the high authority of Dr. Percy, "spiegeleisen has given a value to Bessemer's process of making steel, which certainly it did not previously possess." This verdict has been endorsed by many subsequent writers on the subject, and it is probable that Sir Henry Bessemer would admit its substantial accuracy. Next to Bessemer himself, it is probable that no man, either living or dead, has been so prolific an inventor and patentee in connection with the manufacture of steel as Robert Forrester Mushet. Between March, 1859, and December, 1861, he took out thirteen patents for so-called improvements in the manufacture of iron and steel, all of them having more or less reference to the application of titanium as an alloy. An abstract of these specifications will be found in Dr. Percy's "Metallurgy of Iron and Steel," where it is remarked that "Thirteen patents to one man for the application of titanium in one form or other to the manufacture of iron and steel is a somewhat remarkable incident, even in the annals of patentism!" The learned doctor proceeds to state that, in spite of the fact that Mr. Mushet had proclaimed far and wide the "unrivalled excellence" of his titanic steel—articles of titanic steel having been profusely displayed in conspicuous shops, with large sideboards, in London, Birmingham, and elsewhere—some analytical chemists of skill and repute had declared their inability to detect any titanium in this steel, while Mr. Mushet had not succeeded in convincing the Sheffield manufacturers of the great merits claimed for his special description of metal.

Mr. Mushet took out several patents for the application of tungsten to the manufacture of cast steel. "Tungsten," says Dr. Percy, "tungstic acid, or oxides or ores of tungsten, are all appropriated by this gentleman, but wolfram is preferred, because it costs less and contains manganese, which facilitates fusion."

For a number of years past Mr. Mushet has lived in practical retirement at his favourite place of residence—Cheltenham, and has withdrawn from all active participation in business affairs. He has, however, every now and again come forward to communicate in the technical press his opinions or his experience relative to matters that were in dispute in the metallurgical world, and his remarks have always been received with respectful attention. He had, in some cases, a disputatious habit that did not tend to make him very agreeable with those from whom he differed; but he was, nevertheless, a man of warm heart and catholic sympathies. For the last sixteen or seventeen years of his life he suffered from ill-health; and when, even so far back as 1873, the Iron and Steel Institute presented him with the Bessemer Gold Medal, in acknowledgment of his services to steel-making, he was in such an infirm condition of body that he declared himself to be unable to make a journey to receive it. On that occasion Sir Henry Bessemer himself endorsed the action taken by the Iron and Steel Institute. Mr. Mushet's services to the steel manufacture have been differently regarded by different people, but owing to the failure of some of his friends who were left in charge of the payment of the necessary fees, the spiegeleisen patent was allowed to lapse, and he failed to receive any pecuniary benefit from it. It was under these circumstances, and while he was still being threatened by Mushet with proceedings that might have seriously crippled the value of his process, that Sir Henry undertook to make Mr. Mushet an annuity which he has paid regularly ever since.

Letters to the Editor.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—Your correspondent, "Londoner," cannot have any practical acquaintance with the subject on which he writes. If he will take the ordinary "asbestos radiators, which are white," and colour them black, he will find that the appearance and effective duty are both seriously reduced although the material remains the same, and he will also find that no black is known which is permanent at a red or white heat.

With regard to the draught caused by gas fires, it is a very simple matter indeed to partially close the outlets until they are correct for each individual case. No fixed area of outlet for products of combustion will suit all cases, and, therefore, the safest method is to make the outlets amply large for a sluggish draught and let the fitter close this as much as is required.

Yours, &c.,
Thos. Fletcher.

Warrington, 31st January, 1891.

To the Editor of "Industries."

Sir,—As a Londoner *pur sang* I am constrained to beg of you space in which to say a few words on Mr. Thwaite's colossal scheme.

In his original articles he very graphically sketched the danger and discomfort to which both weak and strong are subjected whenever a fog of any density occurs, and he has also indicated the monetary loss resulting from the same cause. This last item I would especially emphasise, as I am convinced that an adequate appreciation of the fact that they are suffering pecuniary damage is more likely to lead any body of Englishmen to adopt methods of reform than any other means with which I am acquainted. Perhaps the greatest source of actual loss is the waste of time caused by the disorganisation of ordinary traffic by road, river, and rail to which all those compelled to travel on a foggy day are inevitably subjected.

The vast size of London, and its frequently objectionable atmospheric conditions, have forced most professional and business men to live some considerable distance from their work, and to be under the necessity of depending upon some one or other of the methods of conveyance I have indicated in order to reach it. When a fog comes they are detained on their journey for periods of time that in many cases are not to be reckoned by minutes but hours. Were it possible to estimate the loss caused by this delay, both by actual shortening of the time available for the despatch of business and by the impossibility of adhering to that economic distribution of his time which every busy man strives to make, as well as the less tangible but even more important worry and irritation engendered in all but the most phlegmatic, by such conditions, I opine that the total would astound its computer, and make the cost of preventing the occurrence of these inconveniences appear relatively trifling, if not negligible.

These arguments will have additional weight when it is remembered that the misery entailed by a fog falls most heavily upon those possessing what used to be known as "the nervous temperament"—that is to say, those that are the salt of the earth, by whom alone it is kept tolerably sweet. The survival of the fittest here has its best exemplification; the fittest do survive—the fittest, that is, to exist in a fog, which, indeed, may be considered their natural habitat. Thus there seems little reason to deem Mr. Thwaite's scheme impracticable because of its money cost; money will be forthcoming in plenty, provided a reasonable prospect of a good dividend can be held out. It is on this side that we need further information. No method of financing the proposed undertaking has at present been suggested. I presume it is contemplated to carry out the plan by means of an ordinary public company in the usual way; if this be so, it is imperative to bring forward evidence that the scheme will be far from unprofitable. Considering the freedom with which investors part with their money to the shadiest concern that is adroitly promoted, there should be little difficulty in floating one intrinsically sound.

Descending from generals to particulars, it would certainly seem expedient, as materially reducing the amount of capital required, to adopt the "alternative scheme"—*i.e.*, leave the existing gas companies untouched. In spite of the cost of carriage, gas can be, and is, produced fairly cheaply from coal carbonised in London, and much domestic smoke might be done away with by using it more freely in place of coal. This naturally brings me to another subject, which, though intrinsically a detail, must be settled, and satisfactorily settled, before there is any hope that the general consumption of gas will come about. It is the question of the best means of heating by gas.

I must protest most strongly against the proposition made by your correspondent, "R. S.," and endorsed by Mr. Thwaite, that gas should be burnt in the basement of the house it is to warm, "and be a source of heat to the whole building" by the use of water or air as an intermediary. Mr. Thwaite fears "that we shall not readily overcome the insular prejudices of Englishmen in favour of the open and cheery fire, whether of coal or gas;" I most sincerely wish we never may. The system of heating by *convection*, instead of by *radiation*, is radically wrong. In the first case, the *air* in a room is warmed, and the occupants of the room are supplied with an atmosphere which is about as agreeable to breathe as tepid champagne or chilly claret is to drink, and infinitely less healthy. Such warm air is frequently loaded with moisture, which it promptly deposits on all objects colder than itself—that is to say, on everything in the room. The laboratory from which I write was originally heated by hot-water pipes, and the amount of condensation on every solid body in the place, from balances to bottles, was an unmitigated nuisance. The substitution of gas fires has improved matters, as far as improvement is possible, where much gas is burnt in the open room, and water baths and evaporating basins are constantly in use. Heating by hot air, whether it be derived from the surface of hot-water pipes or be directly heated, is only fit for large buildings occupied for, at the most, a few hours at a time, and for such places as halls, lobbies, and staircases, through which people pass, but in which they do not stay.

It may be freely conceded that heating by gas fires (which, by the way, I may tell "Londoner," are now made in many better

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forms than those he quotes) in the place of coal fires, is less economical than heating by hot air, but where it is considered of importance to utilise the whole number of heat units that can be formed by the combustion of the gas, the two methods can be combined, and the products of combustion, after heating the radiating material, may be allowed to expend the rest of their heat in warming the air of the room directly by means of ordinary arrangements of flues, such as are already in use for such purposes.

In conclusion, I may say that, in my opinion, Mr. Thwaite's plan is deserving of the closest attention, and its realisation would be the greatest boon possible to confer upon London, but that its benefits would be dearly bought were the unwholesome and irrational system of heating by hot air adopted.

Yours &c.,
B. B.

London, 3rd February, 1891.

To the Editor of "Industries."

Sir,—Referring to Mr. B. H. Thwaites' admirable articles in your issues of the 9th and 16th January, one is tempted to plunge into the discussion of such a subject in a most lavish manner, since there is so much that may be considered and so much that may be said.

With the prospect of possible enormous advantages to the general health, and not least that which would be felt by the middle classes in their continual warfare with domestic servants, any scheme promising such merits the greatest attention.

What appears to be most impressive is the conveyance of gas under pressure by pipe lines, the magnitude of which has hardly been hinted at. To displace fires in the metropolis alone, it seems quite conceivable that $\frac{1}{5}$th of a billion cubic feet of gas would have to be provided for in these mains. But would not these have to be tapped on their way for all the large towns adjacent to its course? For I have no doubt when once the convenience of an enormous saving of domestic labour by the use of gas for heating and cooking purposes is experienced, that the demand will extend to towns which have never suffered from the plague which it is the main object of this scheme to dispel.

The author of the articles has also apparently ignored the different values which the bye-products would have when produced in another part of the country. Is it not possible, therefore, to produce water and illuminating gas locally on a gigantic scale without the production of the pernicious smoke and gases which domestic fires at present evolve? Gas works are not, I believe, notorious for producing smoke, and there is a popular impression that their vicinities are not by any means unhealthy.

My suggestion for local gas works is in view of reducing the immense cost, practical difficulties, and leakage, due to the enormous gas mains proposed. By reducing the magnitude of this gigantic scheme I am of the opinion that it will receive greater support from a commercial point of view, and it is not likely in the present day that we shall find philanthropists who will take the burden of this project.

I wait to hear the views of others upon this matter, and trust that you will place your columns at the disposal of correspondents for some time to come.

Yours, &c.,
James Armer.

11, Queen Street Place, London, E.C.,
3rd February, 1891.

To the Editor of "Industries."

Sir,—Nothing could be much worse than our present method of consumption of coal, and any one who has taken the trouble to inquire into the effects produced by our smoke and sewage laden atmosphere, must be fully convinced that the present state of things cannot be allowed to continue.

It is not, I take it, at the outset, so desirable to find objections to Mr. Thwaite's proposal (for these may be easily brought against any proposal) as to compare it with rival schemes and with the present system, and to ask how far it will enable us to grapple with the problem, for which a solution must be found. We are face to face with a great plague, and one that the present generation have unfortunately grown up with and learned to tolerate, but which none the less carries off its victims by thousands annually. Mr. Thwaite's scheme, if carried into execution, will undoubtedly clear the atmosphere, and when this is done, the harm from sulphurous acid, organic matter, micro-organisms, &c., will be minimised.

But why does not Mr. Thwaite place his ideas before us here in Manchester? Here we have the coalfield at hand, and the Corporation has full control of the gas supply, whilst, as to the state of the atmosphere, London is comparatively a paradise. To speak from a .sanitary point of view: During the recent fog our deaths from diseases of the respiratory organs alone rose from a normal of 60 to nearly 170 in a population less than one-tenth that of London. That is to say, our normal death-rate from such causes equals the panic rate for fog in London, whilst the deaths in London from respiratory diseases in that dreadful Christmas week, instead of being 800, would have been at our rates 1,800! Our death-rate from the effects of fog and its accompaniments is understated if it is placed as *equivalent to the total death-rate of London!* And this to say nothing of widespread sickness and disorganisation.

Equally striking is the fact that whereas normally the births exceed the deaths by about fifty per week, they fell 169 below in that fatal week, and for the five fog weeks of December and January, instead of our population being increased by 250, it was actually diminished by 200. We are doing what we can to get at the root of the matter here, and to bring the public to recognise the nature of the devastation which the condition of our atmosphere is inflicting upon us.

Of one thing we are already convinced, that no amount of pressure (I had almost said coercion) put upon works and factories will do more than remedy a tithe of the mischief, and that any scheme which does not deal with dwelling-houses also may be at once rejected without further examination as worthless.

Yours, &c,
G. H. Bailey.

The Owens College, Manchester,
3rd February, 1891.

OUR BIG GUNS, AND HOW THEY ARE MADE.

To the Editor of "Industries."

Sir,—Your correspondent, "Yankee," has taken a meaning out of my letter which I did not wish it to convey. I ought, perhaps, to have said "that the method suggested by Sir William Siemens, and which had been previously carried out by the Government of the United States" in the manufacture of cast-iron guns, &c., but those who knew anything of the history of gun making would not suppose that I could mean that Rodman's method was due to Siemens. Your correspondent's insinuation about my wish to advertise the name of Siemens is quite gratuitous, as I had no such wish, and I have no connection either direct or indirect with the Siemens interest.

Yours, &c.,
C.E.

London, 31st January, 1891.

PRIVATE BILL LEGISLATION.

To the Editor of "Industries."

Sir,—The subject of "Private Bill Legislation," discussed in your article of last week, is one which, as you remark, has many aspects, and is leading to the expression of a great variety of opinions throughout the country. You have given some of these, but a few others may be mentioned. At the Dundee Town Council last week a report was submitted with regard to the Bill, stating that it did not touch one of the greatest evils in the present system—namely, the initiatory expenses attending petitions for and deposits of Bills. Further, that the new body would increase instead of reducing the cost of opposed Bills, while it would at the same time burden Imperial taxation with the salary of an appointed Commissioner and the expenses of all Sub-Commissioners, and with the rent and other expenses of an Edinburgh office, with its staff of officers, clerks, and messengers. The report concluded by stating that, in the interests of the public, the proposed Bill ought to be postponed, and that, as it at present stood, it would not work any good, but might produce evil; and the clerk was instructed to send a copy of the report to members of Parliament and the various local authorities in Scotland.

The Dublin Chamber of Commerce has also been considering the measure, and several objections were taken to it. In the first place, it was pointed out that the Commission would not be a permanent one, being appointed from year to year, and that one of its members was to be a member of Parliament. Now, if this Commissioner was a valuable member of Parliament, he ought to be left to attend to his Parliamentary duties, and not have his constituency practically disfranchised; if he was not a good and valuable man, he ought not to be put on the Commission. The opinions were further expressed that the expenses connected with private Bill legislation would not be reduced, and in many cases might be increased, and further that, if a Commission were to be appointed, it ought to be a permanent one, and have power to promote Bills at any time.

I think, moreover, that the custom of appointing judges to act in such matters concerning public opinion or expediency, as is suggested in the present case, one of the Lords of Session being nominated as a member of the Commission, is altogether wrong in principle, as it is a mistake to mix up judicial with what are practically a combination of legislative and executive functions. I am of opinion that Mr. Campbell Bannerman was right when he suggested that the powers of local bodies should be increased as regards those measures of purely local interest, so that they need not come before Parliament at all, while the larger and more important measures might be considered in a manner somewhat as at present, but simplified and cheapened in some respects.

Yours, &c.,
Lex.

Glasgow, 2nd February, 1891.

CYANIDE OF POTASSIUM AS A SOLVENT OF GOLD AND SILVER.

To the Editor of "Industries."

Sir,—Your correspondent, Mr. Andreoli, tries with great pains to make it appear that the "MacArthur-Forrest process" of gold extraction has been well-known since 1805! How is it that it is only after the proprietors of these patents have put them into successful operation on a large scale, and at a cost allowing a handsome margin to all concerned, that our learned friends come round and tell us how well they knew and understood all about it long ago? Not very long ago some experts, assumed to be competent to judge, prophesied nothing but failure and collapse!

It will probably be generally considered that a scientific and industrial periodical is scarcely the place in which to discuss the validity of patents, but as you have allowed Mr. Andreoli to commence such a discussion regarding the MacArthur-Forrest process, perhaps you will permit me to reply that the "Cassell Gold Extracting Company," Glasgow, who have the control of these patents, granted wherever applied for in the principal European countries (including Germany), the United States, the British Colonies, &c., after the most thorough search, have satisfied themselves of their validity, and mean to protect their valuable property.

Yours, &c.,
John S. MacArthur,
Technical Manager of the Cassell Gold Extracting Company, Limited.

157, West George Street,
Glasgow, 3rd February, 1891.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

To the Editor of "Industries."

Sir,—The question, "Is the study of thermodynamics of any use to engineers?" was a very natural outcome of the course of miscellaneous and contradictory reading to which "Student" had subjected himself, and his request that practical engineers and students of thermodynamics should point out the bearings of the subject on the work of the makers of heat engines is quite legitimate.

He must perceive, however, that if he wishes an answer which will show all the practical uses of thermodynamics, he must not expect to find it within the limited space of a letter. He must not only pursue his studies by means of the ordinary text-books, which can only give an introduction to the subject, but must continue them in the Transactions of engineering societies and in technical journals, where he will find their applications to the practical problems which an engineer requires to solve.

Mr. Bodmer's letter in your recent issue is a very good reply to the general question, and his recent articles which appeared in *Industries* on "Steam Engine Economy" should be read by "Student" as illustrations of some of the uses of thermodynamics to practical engineers. The recent experiments by Messrs. Willans and Muir, Major English, Professor Kennedy, and many others, all bear on the same point, while those of Hirn, Clausius, Dwelshauvers-Dery, Cotterill, Isherwood, Emery, &c., advance the earlier investigations of Rankine by a good many stages.

Mr. Bodmer does well to point out that such questions as those put by "Student," and such criticisms as appear in the *Engineer*, arise from a misconception of the purpose and scope of technical education, which is not meant in any way to supplant the practical discipline of former days (although it may shorten the wasteful drudgery), but rather to supplement the training which apprentices obtain in workshops. Even in the best establishments, that training is so one-sided that it is utterly impossible for any one to obtain a fairly good knowledge of the different departments of engineering unless it is supplemented by other studies, and, if possible, experiments. Moreover, no amount of workshop experience, by itself, would enable students to understand the action and the causes of high or low efficiency of modern heat engines. That can only be done by a study of the principles of thermodynamics.

It must be admitted that thermodynamics, like almost every other subject, has often been taught in such a manner as to lead to very erroneous ideas on the subject, but that is the fault of the teacher, not of the subject. The relation of the science of thermodynamics to practical steam engineering, or, more generally, heat engineering, is almost analogous to that of the science of political economy to practical politics. It is long since John Stuart Mill—we might also say Adam Smith—pointed out that there are few practical questions, even among those which approach nearest to the character of purely economical questions, which admit of being decided on economical grounds, and that when we apply political economy to the solution of practical questions we find it inseparably intertwined with many other branches of social philosophy. Political economists are only beginning to fully realise this, and to avoid being dogmatic when applying the results of their speculations to practical politics; so also writers on thermodynamics are becoming more careful in the application of results which have been deduced from ideal conditions to engines which are working under quite a different set of conditions. They must carefully examine the circumstances which modify the results, and this is precisely what Professor Cotterill has done in his valuable book, the review of which started the correspondence on this subject.

Professor Cotterill's book may be considered a treatise on the physics of the steam engine, and although in some points it is rather apt to run into details which are of more interest to the physicist than to the practical engineer, on the whole it is a most satisfactory production. I admit that the text-book on the steam engine, founded on the principles of thermodynamics and on practical experiment, has still to be written, although several books—curiously enough, chiefly from the Continent and America—have approximated to what a well-educated engineer would consider good treatises on the subject. In your columns, for instance, you have reviewed De Volson Wood's book on "Thermodynamics, Heat Motors, and Refrigerating Machines," and Peabody's "Thermodynamics of the Steam Engine," and while giving these their due share of praise, you have pointed out what practical engineers at once observe to be their defects. I mention these books, however, chiefly for the purpose of referring "Student" to their "Tables of Contents" for a reply to his question. If he considers for one moment what would be the position of any of the numerous subjects therein enumerated without thermodynamics he will have no difficulty in admitting that its study is of great use to engineers.

Yours, &c.,
Henry Dyer.

Glasgow, 2nd February, 1891.

Reviews.

Absolute Measurements in Electricity and Magnetism. By A. Gray. London: Macmillan & Co. 1890.

The teacher of electricity who wishes to impress on his pupils that "science is measurement" could hardly find a text-book better suited for this purpose than Professor Gray's "Absolute Measurements in Electricity and Magnetism." The student will find in it a clear definition of the various absolute units used, minute accounts of the methods of determining them, and careful descriptions of the instruments used in measuring electrical and magnetic quantities in terms of them. Besides this the book abounds in practical hints respecting the minutiæ of laboratory work which make all the difference between accurate and worthless experiment. To include all this, together with no inconsiderable portion of the theory of electricity, in a moderate sized volume of very legible print, Mr. Gray has carried compression of style almost to its utmost limit, and the reader who has no taste for what Professor Huxley calls "intellectual pemmican" will find it difficult to finish the book. Sometimes this is carried to such a point that the meaning is really obscure—for example, the ordinary reader would infer, from the statement on page 85, that a battery arranged to give maximum

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current through a given external resistance is joined in multiple arc. The student of science should be, above all things, patient, but his patience will be severely tried by the frequent occurrence of the reference, "*see below, p.* —." On comparing the present edition with the former, we find many changes and additions which add considerably to the value of the work. Sir William Thomson's graded galvanometers, which were fully described in the earlier edition, are now replaced by his current balances, but the description of the method of graduating them is retained, with slight verbal alterations, and applied to voltmeters in general. The meaning of parts of this description is clearer when read as referring to the potential graded galvanometer. The account of Mr. Thomas Gray's experiments for the determination of H at Glasgow, in 1885, is also new and extremely interesting. The student will find in these experiments a model of careful and accurate laboratory work.

We have noticed a few misprints in the book. On page 45 the reference "(p. 72)" should be "(p. 73)," and we are still in the dark as to the meaning of "equations (11.) or (12.)" on page 148; perhaps equations (1.) or (2.), Chapter IV., are meant. We regret that Mr. Gray should lend his authority to the barbarism "ohmic resistance"; as well say "yardic length" or "quartic capacity." "Current strength," also, is almost as loose an expression as "rate of speed." On the vexed question of units, Professor Gray takes up a reasonable position of impartiality. He does not, like Professor Garrett, tell us that [L] is not a number; on the contrary, by adopting Professor James Thomson's term of *change ratio*, he implies that it is one, and he explains in a note that he only uses such expressions as "the product of mass and velocity" to avoid "intolerable prolixity." Still, he hankers after the suppressed dimensions of Professor Rücker, and when, on page 71, he states that "we may with propriety speak of a resistance of one ohm as a velocity of 10^9 centimetres per second," we can only reply that our sense of "propriety" differs from his.

In the preface to this edition the author gracefully acknowledges his indebtedness to Sir William Thomson, and no one can dispute that, in the text, he has done his utmost to discharge his debt.

TREATISE ON THE EVAPORATION OF SACCHARINE, CHEMICAL, AND OTHER LIQUIDS, BY THE MULTIPLE SYSTEM IN VACUUM AND OPEN AIR; also, THE CONSTRUCTION AND WORKING OF THE DIFFERENT SYSTEMS. Compiled by James Foster, M.I.M.E. Published by THOMAS REED & Co., of Sunderland; SIMPKIN, MARSHALL, & Co., London; and E. & F. N. SPON, London and New York. 1890.

The question of economical evaporation is, at the present time, one of such great importance in many branches of industry, that it is a matter of surprise that no attempt has hitherto been made to gather together and systematise the numerous articles relating to the best and most successful system of evaporation—viz., that accomplished by what is known as the multiple effect. Owing to the fact that the principal employers of vacuum apparatus in connection with the manufacture of beetroot sugar are to be found on the Continent, the literature of the subject is almost entirely confined to foreign languages, and exists, therefore, in a form not readily available to ordinary readers. Even those who have a fairly good acquaintance with continental languages are apt to be easily misled by some unfamiliar technical word or mode of expression cropping up from time to time. As the inherent technicalities of the subject are sufficiently trying, without being aggravated by linguistic difficulties, it is a matter of congratulation that Mr. Foster has been able to give the substance of the most important of these memoirs in our own language.

The work may be said to almost entirely consist of extracts from treatises by Horsin-Déon, Hugo Jelinek, E. Peclét, Francisco Sach, E. J. Maumené, and Payen. It also contains complete specifications of recently invented multiple evaporating apparatus, and numerous tables and useful notes relating to the subject. The matters alluded to, together with their accompanying illustrations, which are exceedingly well engraved, form almost the entire volume. These extracts appear to be carefully selected, and are, in the main, very well translated, and the author has added to the value of the work by acknowledging the sources of his information, and by furnishing a good table of contents.

In his anxiety to please those connected with the manufacture of sugar, who will probably form the most numerous class of his readers, the author has occasionally introduced articles from the above-mentioned writers which have comparatively little bearing upon the immediate subject of his work, such as those relating to the manufacture of beet sugar, and the general plant and processes employed in beet and cane sugar factories. These details are to some extent old, and in addition to being out of place do not do justice to the present position of fabricants and refiners.

These defects, however, are far more than counterbalanced by the inherent merits of the work, which can be strongly recommended to all those who are interested in the important subject of which it treats.

METAL TURNING. By a Foreman Pattern Maker. London: WHITTAKER & Co. 1890.

The author of this book, in his preface, says that his ability to prepare such a work will probably be conceded by readers of his other works. This at first sight seems rather egotistic, but as we have read and reviewed his books we are willing to admit that it is correct. The book does well what it professes to do, its aim being to explain and illustrate the practice of plain hand turning and slide-rest turning as performed in engineers' workshops. The author's experience has been well fitted to qualify him for writing this book, since, as he informs us, he has been constantly employed as apprentice, workman, and foreman in an engineer's factory during a period of twenty-nine years. He has thus become familiar with all the departments of an engineer's work, amongst which metal turning is one of the most important. We need not enter into details of the book, but may mention that after explaining the construction of the lathe and its different parts, descriptions are given of the tools, tool angles, and chucks, and the methods of using them. After some general remarks on turning, there is a chapter devoted to hand turning and another to slide-rest turning, while the two last are devoted to boring and screw cutting. The last especially seems very complete, and explains very fully the method of cutting screws, and gives a number of examples of the calculations required, while an appendix contains some useful tables. We think the author's good opinion of his work is fully justified.

WATER PURIFICATION FOR MANUFACTURERS AND STEAM USERS. SAWREY & COLLETT. 1890.

This is a useful short description of the injurious effect of using hard waters in boilers and the remedial measures usually resorted to. Manufacturers and steam users are frequently ignorant on these subjects, and either do not have their attention drawn to the condition of their water supply until some disaster has taken place, or listen to the advice of some travelling agent with one of the many worthless secret compositions sold as specifics against boiler incrustation. Although the present notes have been compiled with the object of pointing out the advantages of the Stanhope Company's system of softening and purifying water, they discuss the subject in a straightforward and useful way, and do not unduly advocate this well-known system of purification. We can recommend a perusal of this little volume to manufacturers and others who are not satisfied with their water supply, as it will no doubt give them a simple explanation of their difficulties, and put them on the right way for improving their service. In many industries—*e.g.*, tanning and bleaching—the advantages of a soft water are too well known to need any repetition here, but it is often in the smaller industrial operations that the economy to be derived from a local softening of the town supply is overlooked.

CHEMICAL ARITHMETIC. Part I. By W. Dittmar, LL.D., &c., Professor of Chemistry, Glasgow and West of Scotland Technical College. Glasgow: WILLIAM HODGE & Co. London: WILLIAMS & NORGATE. 1890.

This book, in a certain sense, is a new edition of Professor Dittmar's "Tables to Facilitate Chemical Calculations," but the changes and additions have been so numerous as to practically make it a new book. It consists of a collection of tables and formulæ intended for the use of chemists and others, and will be completed by a second part containing an exposition of the applications of arithmetic to chemical problems. The object in the present part has been to offer to the scientific as well as to the technical chemist a fairly complete collection of what he needs of mathematical auxiliaries, and of chemical and physical constants, in the ordinary routine of his laboratory work, and that without going further. The book, therefore, does not pretend to compete with works of the order of Clarke's "Constants of Nature," or even of Landolt and Börnstein's "Tabellen," nor is it intended to supplant books which, like Lunge and Hunter's "Pocket Book," address themselves to specialists in this or that branch of technical chemistry. It differs from books of a similar tendency chiefly in this, that it is not a mere compilation, but essentially an original production. We need not go into the general details of the book, but may mention a few samples of its contents. After a series of useful mathematical tables, subjects specially chemical in their nature are taken up, such as correction of weighings, reduction of specific gravities, calibration, gasometry, gas analysis, gas absorption, and thermometry, and under each of those headings Professor Dittmar shows his originality. When the second part has appeared the book will be most valuable for reference to chemists and others, and we have much pleasure in commending it to the attention of our readers who are interested in the subjects the book embraces.

MAP STUDIES OF THE MERCANTILE WORLD. By John Yeats, LL.D., &c. London: GEORGE PHILIP & SON. 1890.

The author of this book, Dr. John Yeats, was for twelve years Examiner in Commercial Geography and History to the Society of Arts, and has written many books on the subject, which are recognised as valuable to the student and the merchant. The one before us is intended to show how maps should be read, and the information which should be given in connection with them with regard especially to commerce and industry. It is, in fact, a treatise on commercial geography, arranged in a somewhat informal manner, but not on that account, any less useful. It attempts to answer for all the chief countries of the world questions which should be understood by those who have commercial dealings with them. It shows, for example, how the capitals of the various countries are best reached, and refers not only to established mail routes, but also to competing lines for goods and passengers; it gives the industrial characteristics of the people, the chief natural resources of the country, the distribution of raw materials, the direction of the employments towards agriculture, mining, manufacturing, or maritime pursuits. The chief physical features of the different countries are also referred to, especially those which are of importance in commerce, such as inlets and outlets, ports, harbours, and rivers, while a considerable amount of information is given regarding the chief sites of industry and its distributing centres, and the means of internal communication by steam, canal, road, or railway. Of course the great variety of subjects taken up prevent any of them being dealt with exhaustively, but on each there is at least sufficient said to suggest the main points requiring investigation on the part of the student or extension on the part of the teacher. The author dwells on the competition and rivalry which has sprung up in recent years in the nations around us, and says that, in order to keep pre-eminent, our work and workers must continue the best. For them to continue the best they must advance; to stand still is relatively to go back, for all our rivals, especially America, Germany, France, the Low Countries, and even the small state of Denmark, are endowing their youthful communities with the principles of industrial and commercial science. The same spirit of enterprise which has placed us in the van of commercial nations will not yield, for want of effort, in the competition of the world, and the author offers his manual as a contribution of commercial facts and principles, which, within convenient compass, furnishes information bearing upon and applicable to the business of industrial, commercial, and social life.

THE GOLDEN GATES OF TRADE. By John Yeats, LL.D., &c. London: GEORGE PHILIP & SON. 1890.

This may be considered a complementary volume to the one noticed above, and therefore we need not enter into many details regarding it. It is intended to be introductory to a study of mercantile economy and the science of commerce, and contains much useful information in easy language. After an enumeration of the necessaries, conveniences, comforts, and luxuries of life, an account is given of the sources of supply, of the effects of division of labour, the nature of rural occupations, town pursuits, markets, and trade centres. The method of conducting business in large cities is sketched, and the chief features of internal and external trade, with its ebb and flow. Competition and co-operation is discussed, and the advantages and disadvantages connected with them pointed out. Then follows an outline of our great oceanic communications, our railway thoroughfares and trade junctions, and the facilities for importing and exporting.

There is a special chapter on a student's requirements for business which ought to be read with attention, as giving some idea of the demands of modern commerce. Note should be taken of the remarks about the necessity for consulting the tastes and wants of our customers, and of more attention being paid to the reports of Consuls and others which contain information regarding these. The remainder of the book is taken up with interesting information, chiefly on subjects connected with physical geography, and studies of the United Kingdom, of Europe, or Asia, Africa, America, and Australia, bearing on trade divisions and commercial resources.

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ELECTRICITY IN TRANSITU: FROM PLENUM TO VACUUM.*

(*Concluded from page* 115.)

Phosphorescence in High Vacua.—I have already pointed out that the molecular motions rendered visible in a vacuum tube are not the motions of molecules under ordinary condition, but are compounded of these ordinary or kinetic motions, and the extra motion due to the electrical impetus.

Experiments show that in such tubes a few molecules may traverse more than a hundred times the *mean* free path, with a correspondingly increased velocity, until they are arrested by collisions. Indeed, the molecular free path may vary in one and the same tube, and at one and the same degree of exhaustion.

Very many bodies, such as ruby, diamond, emerald, alumina, yttria, samaria, and a large class of earthy oxides and sulphides, phosphoresce in vacuum tubes when placed in the path of the stream of electrified molecules proceeding from the negative pole. The composition of the gaseous residue present does not affect phosphorescence; thus, the earth yttria phosphoresces well in the residual vacua of atmospheric air, of oxygen, nitrogen, carbonic anhydride, hydrogen, iodine, sulphur, and mercury.

With yttria in a vacuum tube, the point of maximum phosphorescence, as I have already pointed out, lies on the margin of the dark space.

Bodies will phosphoresce in actual contact with the negative pole. This is only a temporary phenomenon, and ceases entirely when the exhaustion is pushed to a very high point. A U-tube, shown in Fig. 12, has a flat aluminium pole, in the form of a

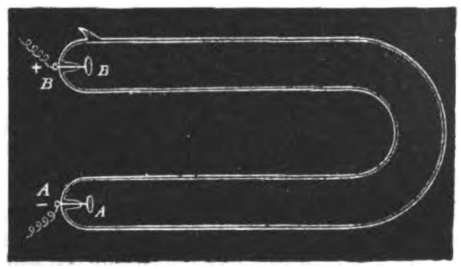


Fig. 12.

disc, at each end, both coated with a paint of phosphorescent yttria. As the rarefaction approaches about 0·5 mm. the surface of the negative pole A becomes faintly phosphorescent. On continuing the exhaustion this luminosity rapidly diminishes, not only in intensity, but in extent, contracting more and more from the edge of the disc until ultimately it is visible only as a bright spot in the centre. This fact does not support a recent theory that as the exhaustion gets higher the discharge leaves the centre of the pole, and takes place only between the edge and the walls of the tube.

If the exhaustion is further pushed, then, at the point where the surface of the negative pole ceases to be luminous, the material on the positive pole B commences to phosphoresce, increasing in intensity until the tube refuses to conduct, its greatest brilliancy being just short of this degree of exhaustion. The probable explanation is that the vagrant molecules I introduce in the next experiment, happening to come within the sphere of influence of the positive pole, rush violently to it and excite phosphorescence in the yttria, whilst losing their negative charge.

Loose and Erratic Molecules.—A C B (Fig. 13) is a U-shaped tube with terminals A and B at each end; D and E are two mica screens covered with a phosphorescent powder,

P = 0·076 mm.

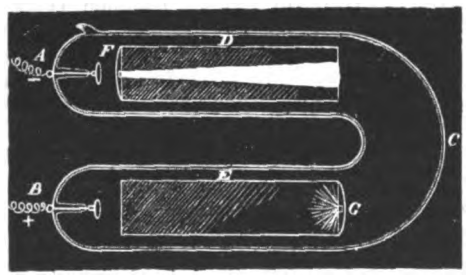


Fig. 13.—P = 0·000076 mm.

having at F and G other screens with a small slit in front, so as to allow only a narrow beam of charged molecules to pass through. At first the tube is exhausted to a pressure of 0·076 mm., or 100 M., and you see how sharp and slightly divergent is the luminous image on screen D, whilst not a trace of phosphorescence is to be seen on the screen E in the other limb of the tube. Now I push the exhaustion to the highest point short of non-conduction (0·000076 mm., or 0·1 M.), and the phenomena change. The initial line of light on D becomes wider and unsteady, whilst at the gate G a decided phosphorescence is observable entering the second screen E. This luminosity diverges to a considerable extent, much more than did the stream of charged molecules observed in the first limb of the tube at the lower exhaustion. This is only to be expected, inasmuch as those sparse molecules which have run the gauntlet of the crowd and have been hunted and buffeted round the corner will have little or no lateral support, but wander to the furthest part of the tube, and altogether behave differently to the orderly procession of molecules at more moderate exhaustion.

The Resistance of High Vacua.—The passage of an induction current at a high vacuum through a tube depends much upon the material of the tube or the substance enclosed within it. Given the same degree of exhaustion and the same distance between the terminals inside the tube, the e.m.f. necessary to force the current through may vary from 8,000 to 20,000 volts, according to the particular material used.

Fig. 14 is a double tube joined by a narrow open channel, and therefore in the same state of exhaustion throughout (P = 0·02 mm., or 26 M.). Each tube is furnished with a pair of poles A B and A^1 B^1. One tube contains the phosphorescent

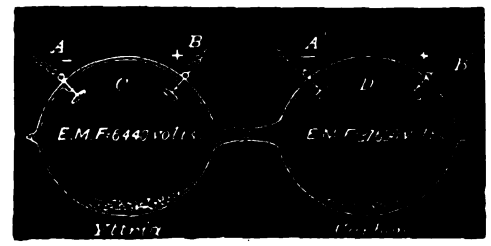


Fig. 14.—P = 0·02 mm.

earth yttria, the other contains finely divided carbon. I first connect the yttria tube C to the coil, and place in parallel circuit with it a spark gauge. To begin with, this gauge is set to a gap of 1 mm. (An e.m.f. of 920 volts is necessary to strike across 1 mm. of air; therefore the difference of potential at the terminals inside the yttria tube is 920 volts, and this you perceive is not sufficient to force the current through the tube.) I now gradually open the gauge until the potential of the inner terminals has risen to a point high enough to allow the spark to pass through the tube, making the yttria phosphorescent.

The gap is at 7 mm. equal to an e.m.f. of 6,440 volts. I next attach the coil wires to the tube D, containing the carbon, and the exhaustion in the tubes being the same as before, I repeat the experiment. You now see that the gap has to be opened to 30 mm., equivalent to an e.m.f. of 27,600 volts, before the current will pass through the tube. The fact of whether the vacuum tube contains yttria or carbon makes a difference of 21,160 volts in the e.m.f. required to cause a discharge between the terminals.

What Occasions Phosphorescence?—So far I have found this phosphorescence to be an attribute of non-conductors only. We know that in the act of phosphorescence the molecules of yttria are in a state of intense vibration. Each molecule may be viewed as the radiating centre of the entire bundle of rays, which, when decomposed by the prism, displays a discontinuous spectrum. We may also suppose that the residual atoms of gas charged with negative electricity give off their electricity on coming in collision with a phosphorescent body, and on their return take up a fresh charge.

The Electrolysis Hypothesis.—There is a certain amount of evidence in favour of an electrolytic hypothesis of the passage of electricity through rarefied gases.

A molecule of hydrogen gas, for instance, may be made up of one group of atoms of hydrogen having an equivalent of negative electricity inherent in it, and one group of atoms having an equivalent of positive electricity bound up with it. These atoms are also charged with *additional* equivalents of positive or negative electricity, which they carry about as a ship carries its cargo. We are not concerned with the inherent electricity—of which we are ignorant—but with the extra or "cargo" charge. Let us imagine a molecule of hydrogen near the face of the negative pole in a vacuum tube. I turn on the current, and the atoms of the hydrogen molecule are dragged apart. The positive atom is attracted to the negative pole, where the violence of impact, or the discharge of electricity, renders it apparent with evolution of light. The internal luminous layer, which is closely adjacent to the negative electrode, is due, therefore, to the positive atoms rushing to the negative pole, and not, like the glow round the edge of the dark space, to the negative atoms projected from it. The negative atom, on the other hand, is driven violently from the negative pole, in virtue of the mutual repulsion existing between any two bodies similarly electrified, with a velocity varying with the intensity of the electrification and the degree of the vacuum; the more perfect the vacuum the greater the velocity, the atoms flying outwards in straight lines until they meet with an obstacle. Such an obstacle may be a procession of positively charged atoms from the positive pole. In this case the two kinds of atoms mutually discharge each other's cargoes with a display of light. This phenomenon occurs at the margin of the dark space when the vacuum is only moderate; or the obstacle may be produced by the vacuum being so high that the atoms of gas present are too few to form a continuous procession.

The Dark Space in Mercury Vapour.—In applying the electrolytic hypothesis, I have used for illustration's sake the gaseous residue of hydrogen, which is known as a diatomic gas. I have found, however, the phenomena of the dark space, &c., to occur

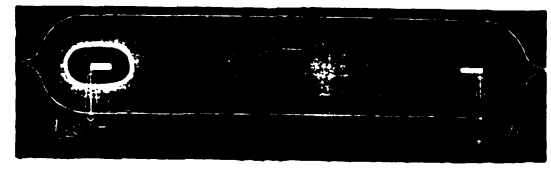


Fig. 15.

in the vapour of mercury, which is a monatomic gas. This important result induced me to patiently investigate this subject, and the result of one experiment is before you (Fig. 15). The tube is furnished with aluminium terminals, and is so arranged that the induction spark can be kept passing during exhaustion to drive off occluded gases. When at the highest attainable vacuum, the tube is filled with pure mercury by simply raising a reservoir. On applying heat the entire contents of the tube are boiled away and pass down the fall tubes of the pump, exhaustion going on at the same time. When the whole of the mercury has thus been boiled away *in vacuo*, except a little condensed at the upper part of the tube, the results on passing the spark are as follows:—When the tube is cold the induction current refuses to pass; on gently heating with a gas-burner the current passes and the dark space is distinctly visible. Continuing the heat so as to volatilise the drops of mercury condensed on the sides, the whole tube becomes filled with a green phosphorescent light, the dark space gets smaller and smaller, and ultimately the negative pole becomes covered with a luminous glow. On allowing the tube to cool the same phenomena ensue in inverse order. The luminous halo expands, showing the dark space between it and the pole, and this dark space gradually grows larger as the tube becomes cooler. The mercury again condenses on the side of the tube, the green phosphorescence grows paler and paler, until at last the induction spark from the large coil refuses to pass.

At first sight this result appears fatal to the electrolytic hypothesis, for if the molecule of mercury contains only one atom how can we talk of its separation into positive and negative atoms by the electric stress? It must be remembered, however, that we are as yet ignorant of the absolute mass of the atom of any element. All that can be said is that a molecule of free hydrogen becomes halved in combining chemically with certain other elements, whilst a molecule of free mercury does not suffer division on yielding any known compound of mercury; the physical atoms in the one behave as two separate groups, and those in the other as one undivided group.

THE HERMITE ELECTRO-BLEACHING PROCESS.

We have on previous occasions given our readers details of the progress made in the process of electrolytic bleaching, and herewith we illustrate the plant which is now at work at the wood-pulp works of MM. Darblay, in the Tyrol, for which we are indebted to the *Revue Internationale de l'Electricité*. It will be recollected that the bleaching liquid is obtained by the electrolysis of a solution of magnesium or calcium chloride. In Fig. 1 we show the electrolyser employed at the above works. It consists of a galvanised iron bath, through which

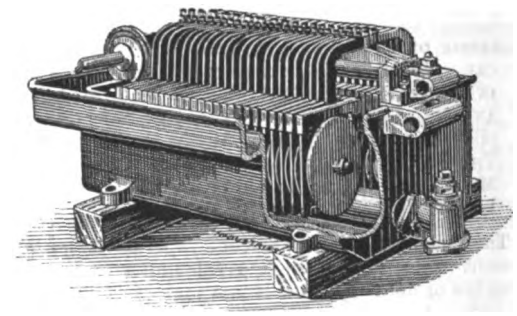


Fig. 1.

there passes a perforated tube. The solution of magnesium chloride is introduced into the bath by this tube, and the liquid, as it fills the tank, overflows into a channel which is connected with a pipe, not shown in the illustration. A continuous circulation of the liquid is thus ensured during the electrolysis. The negative electrodes consist of discs of zinc mounted on a frame which slowly rotates, and between each pair are fixed sheets of platinum, fastened on to ebonite supports, which form the positive electrodes. The several pieces of platinum are carefully soldered to strips of lead, which in their turn are connected by binding screws to a bar of copper which runs along the whole length of the vessel to the positive pole of the dynamo. One of the positive electrodes is shown in Fig. 2. The negative electrodes are in metallic connection with the tank itself, which is connected with the negative pole of the dynamo.

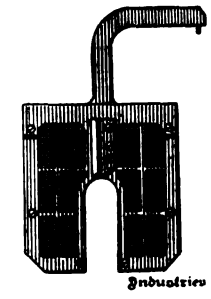


Fig. 2.

In order to keep the negative electrodes in their proper position, the positive electrodes are furnished with flexible ebonite rods, which press against the rotating zinc discs, so that their surface is kept clean and bright. The

* Abstract of Presidential Address given by Mr. William Crookes, F.R.S., before the Institution of Electrical Engineers on the 15th ult.

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apparatus works well and requires little attention; every few weeks the tank is emptied through a door at the bottom, and thoroughly cleaned by means of a powerful jet of water. There is little wear on the electrodes, and the dynamos employed, although specially constructed for the process by Messrs. Paterson & Cooper, do not differ in any essential details from ordinary types. The current employed is from 1,000 to 1,200 amperes, and when several electrolysers are employed they are connected in series. Each electrolyser in 24 hours produces a bleaching liquid which has the efficiency of 100 kilos. of bleaching powder, with a current of 1,000 amperes at a pressure equal to 6–7 volts. In Fig. 3 a sectional elevation of the works is shown, in which A is the tank containing the solution to be electrolysed, B B the electrolysers, and C the dynamo. D is a wooden conduit by which the electrolysed liquor is led to the bleaching vats E, and from thence transferred to the tank G after the bleaching has been effected. The spent liquors in G and those removed from the bleached pulp by the filter press V are returned to the vat A by the pumps K and H respectively.

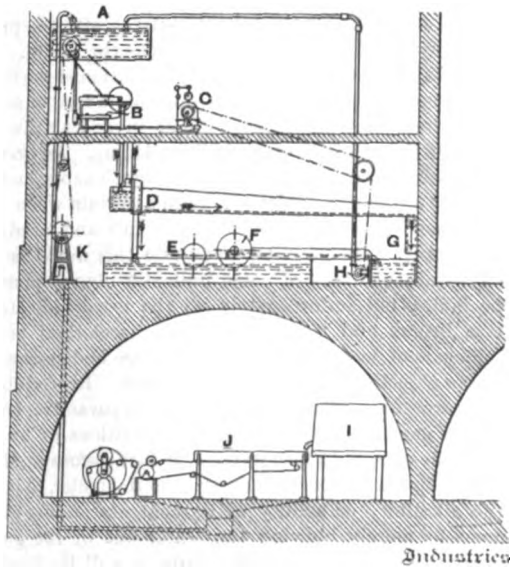


Fig. 3.

In England we regret to report that the experiment with this plant at the Ely Paper Works, Cardiff, has proved unsuccessful. It is to be hoped that further capital will be forthcoming, so that the difficulties met with in England may be successfully overcome.

ANALYSTS' QUALIFICATIONS.

Some important remarks were made by Mr. Adams, the late President of the Society of Public Analysts, at the meeting recently held by that body. It is the custom in most societies of the kind to encourage their retiring leaders to indulge in mild lucubrations on things in general in a conciliatory spirit. But on this occasion there was a specimen given of straight talking. In the first place the present system of appointing public analysts, astouched upon by Mr. Adams, claims consideration. It is notoriously true that the motives inducing the appointment of some candidates are far from single. Naturally in most districts a considerable proportion of the men constituting the local governing body in whom the appointment rests are interested in factories and shops concerned in the production and distribution of those materials which it is the business of the public analyst to examine, and upon which he has afterwards to pronounce an opinion. This being so there is a direct incentive to those who are conscious that their wares will ill bear scrutiny to endeavour to secure a lenient judge. We may feel certain that the fraternity of theft would appreciate the value of controlling the appointment of police officers, but it is not customary to consult the brotherhood in this matter. Similarly it is distinctly desirable that persons profiting by the variety of fraud known as adulteration should have no voice in the appointment of the functionary whose business it is to check that nefarious practice. The suggestion may here be made that it would be well, from the point of view of expediency, to enact that persons convicted under the operation of the Sale of Food and Drugs Act should be thereby incapacitated from holding any office in the local governing bodies concerned in the appointment of public analysts. Pending some such provision, a close watch should be kept on the character of the successful candidate, on those of the members of the appointing body, and on the relations that may exist between them. Since all appointments of the kind have to be approved by the Local Government Board, the rejection of an unqualified or unsuitable appointee can be secured by making the necessary appeal to that body.

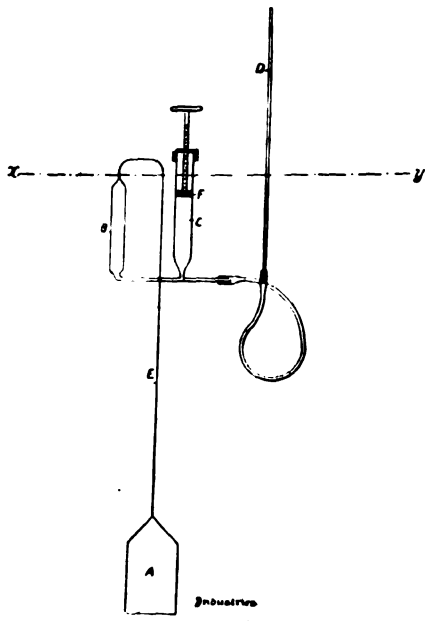
A second and equally important matter claiming attention is the practical question of the best method of electing a qualified man for the post of public analyst. At present there is absolutely no qualification specially designed for the purpose. Fellowship in the Institute of Chemistry is, or is supposed to be, a guarantee of general analytical competence, but the work of the public analyst is of a more specialised character, and those performing it should hold a corresponding diploma. We do not mean to assert that the duties of a public analyst need for their proper execution a higher training than is necessary for a good works chemist. Still less would this be true if comparison were made with the course of study and subsequent experience through which those occupying the higher grades of the profession must have successfully passed. As a matter of fact, the qualification necessary for a trustworthy public analyst is not difficult of attainment by any honest worker trained aright.

Passing to the consideration of the actual means to be employed in conferring a diploma that shall be a guarantee of competence on those seeking posts as public analysts, one is confronted by the inevitable examination question. It is clearly evident that no system of examination can pick out the best men of any profession, because the quality that ranks them as best—viz., original power—can be measured by no examinational standard. But a reasonable degree of competence without any particular originality suffices to ensure the proper discharge of the duties of a public analyst, and this can be secured by a *wisely devised* method of examination. The adoption of a plan similar to that already in force for the selection of officers having an adequate knowledge of hygiene would be perfectly feasible, and lead to satisfactory results. It remains a question whether the Society of Public Analysts might not itself assume an examinational function, and confer a diploma valuable as a testimony to the possessor's fitness for the post of public analyst. That can be decided by the Council, and, without wishing to dictate to it in any way, we commend it to its immediate and earnest consideration.

A third subject remains to be dealt with. About this time last year overtures were made by the Institute of Chemistry to the Society of Public Analysts to induce the latter body to throw in its lot with the former. As Mr. Adams reminded his auditors, there was a considerable section of the smaller society willing to listen to those overtures, and doubt was felt whether another year would see the Society of Public Analysts still possessed of a separate existence. But the wiser view of those who feared that the definite aims for the attainment of which the Society of Public Analysts was formed would be overlooked were it to be absorbed into the Institute prevailed, and the project is dormant, if not defunct. Considering the large and eminently useful programme now before the Society of Public Analysts, we can heartily endorse its belief in the necessity of retaining its independence for the better accomplishment of those purposes which it has in view.

A NEW FORM OF AIR THERMOMETER FOR TECHNICAL PURPOSES.

Professor A. H. Sabine has devised an air thermometer of simple construction, which should prove of service in varnish factories and for other technical purposes in which it is necessary to heat substances to constant temperatures and through a wide range. He was led to construct the instrument which we illustrate herewith from noticing that a comparison of several ordinary thermometers used for determining the temperature in a varnish factory gave considerable differences in reading under similar circumstances, these differences amounting to as much as 50° F. at a temperature of 500° F. The expansion of mercury is not, as is well known, uniform when we approach its boiling point, and under pressure, as in the nitrogen-filled instruments commonly used, it also probably behaves in an irregular manner. Glass, too, when near its softening point, has probably a different rate of expansion, and thus adds to the error in an uncalibrated instrument. Even when naphthalene and benzophenone are used for fixing two points high on the scale, no uniformity can be assured, and, as a matter of fact, it appears at present with such instruments only possible to put arbitrary marks instead of degrees, and heat up to these marks. Each instrument has, therefore, to be calibrated in this fashion before it can be safely used. The air thermometer proposed, as shown in the sketch, consists of an iron vessel A, containing air, which is connected by means of a long capillary glass tube E to a reservoir B containing mercury. By means of a small pressure pump F the air can be compressed to a constant volume for any desired temperature, a tube D, containing air, and connected with the mercury, serving as a gauge to indicate the mercury pressure required for different pressures. The air



gauge of the instrument should contain a small thermometer, and a sliding scale can be arranged if desired. In the original paper, in the Journal of the American Chemical Society, the author gives details as to the method by which the pressure readings can be converted into degree readings, and shows how corrections can be made so as to allow for the expansion of the iron bulb and any change of temperature in the air of the gauge glass. In the illustration the horizontal dotted line X Y shows the level of the mercury in the capillary tube and gauge glass.

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

At a meeting of this Society, on the 2nd inst., Mr. W. Young read a paper on "Normal Sperm Candles," in which he pointed out the conditions under which he had been able to obtain fairly concordant results with the official standard candles. He showed that under the present regulations of the Gas Referees, two gas examiners in the metropolis might obtain very different results with the same gas, and that although the details of manipulation laid down by the Referees were far more minute than formerly, they were not adequate, as shown by the more numerous appeals to the official returns since the new notification had been in force. His experiments tended to show that a candle could only be said to obtain its normal rate of burning after it had been allowed to burn for some time, then blown out, and relit for two or three times. In tables accompanying the paper, the author showed that a standard candle, when first lit and allowed to burn for the time prescribed, gave very different results to a candle which had been relit several times as above described, and he believed—although he had had some experience with the proposed new standards of light—that if candles were used in the way proposed they would be found to possess all the requirements of a practical light standard. The author also pointed out that the standard Argand burner in which the gas was burnt gave different readings with thick and thin glass chimneys, and that slight variations in the colour of the glass employed for the manufacture of these chimneys affected the result.

In the discussion, Mr. W. J. Dibdin pointed out that it was well known that with coaxing and care satisfactory results could be obtained with candles, but that the red tape of officialism prevented the gas examiners from using their common sense and practical experience when carrying out the tests; that so long as candles were the official standard the instructions of the Gas Referees had to be *legally* followed, and that, although the result obtained might be one which the operator in unofficial work would neglect, it would have to be recorded as the official test. He thought that the work which Mr. Young had done in this direction was of the greatest value, as showing the variation in the present standard of light.

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Mr. Foster suggested that a candle might be constructed with an incombustible wick, and thus overcome many of the difficulties met with in their use.

Dr. Rideal hoped that the time had come when they would cease to discuss what is meant by a standard candle, as the large amount of work which had been devoted to this subject had already proved that there were several species of standard candles. A point of great importance was the variation in the light emitted by a candle when surrounded by a different environment, and he thought that more good would be done by rousing the County Council from their lethargy in this matter, and urging on the Board of Trade to do away with candles of all sorts as a standard of light, than discussing what a bad standard they were.

Dr. C. R. A. Wright pointed out that sperm was a very indefinite substance, and that considerable variation might be expected in candles made from such a material.

Mr. Lacy, speaking from the view of the gas companies, thought that in any attempt at introducing a new standard of light it would be difficult to assign to it a value in terms of the parliamentary candle which would be agreeable to all parties.

Mr. Young then replied at some length to the points raised by the various speakers, and at the close of the meeting Mr. J. Brown exhibited the "orthophote," a slide rule arrangement for facilitating the calculation of the correct illuminating power from the photometer readings.

Notes.

NEW ZEALAND RAILWAYS.

From an official statement issued by the New Zealand Government, we find that in March last there were in that colony 684 miles of railway in the north, and 1,129 miles in the south island, and that during the year there were 43 miles opened. The average cost per mile has been £7,750. The average cost in Britain has been £37,800 per mile, or nearly five times as much. The best paying line shows a profit of about 5¼ per cent.

UNIFORM COLONIAL PENNY POSTAGE.

We recently stated in our columns the modifications which had been made in the rate of colonial postage, which had been reduced to 2½d. We understand, however, that Mr. Henniker Heaton's proposal for a uniform penny postage with all our colonies is being carefully considered by the Chancellor of the Exchequer, and that there is a strong probability of his finding the necessary funds for carrying it out from the expected surplus in the next Budget. The change, we believe, would only involve an initial loss to the revenue of £20,000 a year, and it is expected that this amount would soon be more than recouped by the great increase in the amount of correspondence carried.

COAL IN INDIA.

We recently directed attention to the competition Lancashire was likely soon to have with India. In the production of coal also it almost looks as if India may become a rather serious rival. Last year for all India the production was 2,045,359 tons, of which Bengal furnished 1,641,354 tons, the Central Provinces 144,465, Assam 116,676, and the Nizam's territory 59,646 tons. In 1880 the total production was 1,019,793 tons, so that in ten years it has practically doubled. At the commencement of that period the only fields worked were those of Bengal and the Central Provinces; at the end there were mines in addition in four other provinces and territories. In Bengal the yield increased from 988,565 tons to 1,641,354, and in the Central Provinces it increased nearly five-fold.

NEW LOCOMOTIVES FOR THE NEW SOUTH WALES RAILWAYS.

According to the *New South Wales Railway and Tramway Review* orders have lately been given out for no less than 130 new engines for the New South Wales railways. Our contemporary remarks:—"This is taking the bull by the horns with a vengeance, considering that we have wasted several years in deciding what shall be done, and that prices are now very high. The English makers will supply about 118, at a cost of £3,650 each. America will build twelve more, at a cost of £3,557 each, so we are told by the Minister. As we cannot get to know here on the spot just what kind of engine we are to have, we have gone abroad for the information. The *Railroad Gazette* (N.Y.) of 6th June states:—'The Government of New South Wales has accepted an offer of an English and Colonial syndicate to establish locomotive building works in the colony. Three standard types of locomotives will be built, one for main line traffic, capable of hauling either freight or passenger trains over the ruling grades of 132ft. per mile. These engines will be six-coupled, inside-connected, tender engines.' Another type will be tank engines for suburban passenger traffic, with four-coupled wheels and four-wheeled truck under leading end; while the third type, for local coal traffic and switching, will be also tank engines, but with six-coupled wheels and a rear truck. Mr. D. Drummond was to superintend all this, but we have lately seen that that gentleman has given up a good appointment on the Caledonian Railway for a 'castle in the air,' the whole business being now abandoned and orders given out as explained above."

SOLDERING METALS TO GLASS OR PORCELAIN.

M. Cailletet has devised a simple method for connecting glass tubes to metal work in the construction of physical apparatus, which may be of service to our readers. The end of the glass tube is first gently warmed, and then covered with a few drops of a solution of neutral platinum chloride and camomile oil. On gently warming the tube to a dull redness the platinum salt is reduced to the metallic state, and a brilliant deposit of the metal is formed on the end of the tube. The tube is then connected to the negative electrode of a battery and immersed in a bath of copper sulphate, when the copper is deposited as a malleable adherent coating on the platinum flux, and thus forms a material which can be brazed on to brass or copper in the ordinary way.

A NEW SOAP FOR METAL WORK.

The soaps used for cleaning metal work usually consist of mixtures of vaseline, oleic acid, and fat, mixed with a small quantity of rouge. When freshly prepared they leave nothing to be desired; but, unfortunately, such mixtures soon turn rancid and become unfit for use. A new soap for metal work, which is stated to be free from this objection, is made from cocoanut butter in the following way:—2·5 kilos of the butter is melted in an iron vessel, together with a little water, and to the mixture is added, with constant stirring, 180 grms. of chalk, 87·5 grms. of alum, 87·5 grms. of cream of tartar, and 87·5 grms. of white lead. This mixture is then poured into moulds and allowed to solidify. The soap so obtained is made into a paste with water and rubbed over the metal to be cleaned, and finally removed by a dry rag or chamois leather,

A BATTERY TRANSFORMER.

Professors Rowland and Duncan, of Baltimore, have designed a commutator arrangement for connecting up batteries in series and parallel, so that they are rapidly charged and discharged. For instance, if the transmitting pressure is 1,000 volts and the distributing pressure 100 volts, one battery is divided into ten parts. These are connected to twenty brushes, and the charging and distributing circuits have two more brushes each. The commutator has strips so arranged that for nearly half a revolution the cells are charging in series, and for nearly half a revolution discharging in parallel. In the intermediate interval they are disconnected. To keep both charging and discharging currents continuous two or three batteries are used. This arrangement would, no doubt, work, but we question whether it is practical. The commutator is a little complicated, and forty-eight brushes do not commend themselves to engineers. Certainly the commutator could be arranged to work with twenty-four brushes, but even that number is rather prohibitive.

FRANKFORT ELECTRICAL EXHIBITION.

A large number of officials of the Imperial Post Office of Berlin, representatives of the Prussian railways, and delegates of the postal and telegraph service of Wurtemberg met on the 24th ult. at the Oërlikon Works, where some highly interesting experiments were made in producing and transmitting high-pressure electrical currents. The experiments were made in order to furnish the delegates of the Imperial German Government with proof that such high-pressure currents can be transmitted to great distances without danger of accidents or loss of power. The party of visitors were busy all day in examining the various appliances and their working, and it was evident that they were well satisfied with what they saw. It has been arranged to transmit a power of about 300 h.p. from Laufen-on-the-Neckar to Frankfort, for the Electrical Exhibition which is to be opened there on the 15th of May next, and this will be effected by means of high-pressure currents, carried by conductors, which are to run by the side of the rails, telegraph, and telephone wires of the State Railway line. At Oërlikon the experiments were made on an open air wire about seven kilometres long. The electricity, after having been transformed from a pressure of only 100 volts into a pressure of about 30,000 volts, was sent through the wire at this enormous pressure without any danger, and with little loss of power.

AN INDICATOR OF ACIDITY IN BOILER WATERS.

As is well known, water containing magnesium chloride is injurious to boilers, as the salt dissociates with the production of hydrochloric acid which attacks the plates. In large installations, where systematic purification of the feed water can be adopted, this evil is prevented, but in most cases the treatment in vogue consists in adding caustic soda to keep the contents of the boiler alkaline. An excess of the soda is wasteful and otherwise objectionable, and it becomes desirable to be able readily to ascertain when the water in the boiler ceases to contain alkali and needs a further supply. The handiest way to do this would be to have a certain quantity of some indicator always present in the boiler, but unfortunately all the usual indicators, such as litmus and turmeric, become decolorised under the influence of water at high temperature and pressure; the same objection applies to Congo red. Dr. Goldberg has, however, found that the sodium salt of paranitrophenol is entirely unaffected either by these conditions or by the salts usually present in feed waters. It is therefore possible, by introducing a sufficient quantity into the boiler, to judge of the alkalinity or acidity of its contents at any given moment by merely blowing the water out of the gauge glass and allowing it to refill. To give a distinct yellow colour (the evidence of alkalinity) to the water, so that it may be seen in the small quantity of water in the gauge glass, about 30 to 50 grammes per cubic metre are requisite. The high price of the substance is the bar to its general use at present, the cost of the pure material being about 5s. a pound. As its successful application is not dependent upon its purity, a crude variety could doubtless be produced much more cheaply if a demand arose for it.

THE CANADIAN CATTLE TRADE.

In the course of the inquiry that is being held in Canada in connection with the live cattle trade, a good many suggestions have been made for the improvement of the accommodation on board the ships engaged in the trade. The managers of the Marine Insurance Company have been conferring upon the subject, and they have made the following recommendations to the Commission:—That no vessel for live stock should be passed by such an officer as suggested (that is, a Government inspector) unless she is equipped and built as follows:—(1) That there be at least 7ft. 3in. between deeks; (2) that she be provided with steam fans, or fans of sufficient capacity to force fresh air between decks in quantities ample for all the animals placed on said deck or decks. They also recommend that there should be a condenser of sufficient size to provide fresh water for all animals carried. That there should be angle-iron frames fitted side by side on the top deck, 3ft. apart, on all steamers carrying a deck load of cattle, to be fastened in 2in. planks. That steamers should be at least 1,200 tons net register, and have at least 250 horse-power. That there should be a sufficient number of water barrels and hose conveniently placed. That the space to be allowed for each animal should not be less than 2ft. 8in. by 8ft., it being understood that five stockers (not to weigh more than 1,000lb. each) may be allowed in the space for four fat cattle, and that not more than ten sheep be placed in the space allotted to one fat ox. Neither high nor over fed cattle to be carried on deck, but in every case to be stowed under deck in a convenient place. That no head ropes of less than 1in. in diameter be allowed. That all steamers carrying live stock be fitted with the electric light. That in fitting up stalls passages should be left so that the scuppers can be reached and kept clean. That cattle should have at least twelve hours' rest after leaving the car before they are put on board.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

19th January, 1891.

913. Winterton, J. ..... Platen printing machines.
918. Brimelow, P. ..... Reed pocket and mechanism for locking the same in a loose fast reed loom.
920. Dracup & Burrows ..... Doubling and twisting machines.
926. Sellers, J. M..... Screw and stud making machines.
934. Heys, W. ..... Miners' safety lamps.
942. Gedge, W. E. ..... Fluid meters (*Hesse*).
944. Kohler, E. ..... Sewing machines.
945. Lowe, S. ..... Knitting machinery.
949. Swinbourn, J. M..... Ball valve for hydrants, &c.

20th January, 1891.

961. Thompson, W. P. ..... High-speed steam engines (*Pyle*).
968. Sykes, G. D. ..... Apparatus for connecting and adjusting healds in looms.
970. Williams, H. ..... Gas engines.
978. Beardmore, I. ..... Regenerative gas furnaces.
988. Boult, A. J. ..... Punching machines (*Mason, Mason, & Wiegand*).
990. Jeeves & Gilmore ..... Implements for scraping steam boilers and the like.
993. Morison, W. C. ..... Railway brakes.
1003. Ruffles, R. G. ..... Steam boilers.
1006. Thompson, W. P. ..... Paper punches (*The Office Specialty Manufacturing Company*).
1010. Villeroy, E. ..... Crushing machines.
1017. Brosius, S. G. ..... Rotary steam engines.
1020. Birkbeck, H. ..... Machine for making paper tubing (*Greenfield*).
1022. Liley, Holland, & Page Railway signalling apparatus.
1034. Lake, H. H..... Direct-acting steam engines (*Groshon*).
1043. Bonne, C. R. ..... Machine for drying grains, &c.
1044. Wells, C..... Steam engines.
1052. Niclausse & Niclausse Multitubular boilers.

21st January, 1891.

1057. Leeder, F. G. ..... Sand-moulding machines.
1061. Makin, R..... Compound and condensing steam engines for heating, drying, &c.
1072. Williams, P. H..... Thermo-automatic pump.
1075. Harrison, W. ..... Knitting machines.
1077. Frankland, G. H. ..... Pickers for looms.
1081. Stephenson & Stephenson ..... Hay-pressing machinery.
1083. Robinson, H. ..... Gas engines.
1109. Attenborough, E. ..... Condensing engines.
1111. Otto, H. ..... Shuttle-guard tension devices for looms.
1119. Wallis, A. H..... Starting valves for compound engines.

22nd January, 1891.

1159. Newall, G. A. ..... Steam boiler.
1163. Brown, A. F. G. ..... Valve gear for rotary engines.
1164. Brown, A. F. G. ..... Coal-washing machinery.
1165. Brown, A. F. G. ..... Crushing mills.
1169. Lee, W. ..... Steam-lifting pump.
1180. Whittaker, T. ..... Perforated edge runner mills.
1193. Sheldon, J..... Screw rolling dies.
1196. Ross, Sir C. H. A. F. L.... Breechloading firearms.
1206. Jackson & Hoad ..... Pressure gauges.

23rd January, 1891.

1222. Pilkington, W. W. ..... Apparatus for forming molten glass into sheets.
1227. Lees & Lees ..... Steam engine governors.
1228. Whittier, C. ..... Elevator mechanism.
1232. Howard, J..... Railway brakes.
1234. Barber, T. W. ..... Gas engines.
1235. Andrews, G. ..... Lubricator.
1236. Kittner, W. ..... Paper-making machines.
1252. Portbous, A. N..... Rotary engines.
1264. Despret, G. ..... Machinery for grinding and polishing glass.
1265. Woodward, J. ..... Machinery for charging and drawing gas retorts.
1277. De Strens, E..... Steam boiler furnaces.
1282. Capell, G. M..... Centrifugal fans.
1286. Edwards, E. ..... Picking straps of looms (*Held*).

24th January, 1891.

1295. Blakenby, W. H. ..... Pneumatic tube conveying apparatus.
1296. Stewart, D. ..... Sugar cane crushing mills.
1298. Williams, P. H. ..... Locomotives and other motors.
1299. Williams, H. ..... Gas engines.
1306. Scott & Durnford ..... Cut-off valves.
1311. Scott, Hamer, & Carr... Flyers for slubbing, intermediate, roving, and other machines.
1315. Lees & Lees ..... Sawing machines.
1316. Lams, L. ..... Plug valves.
1326. Thompson, C..... Looms.
1328. Munns, W. H..... Car coupling (*McMillen*).
1330. Munns, W. H..... Car coupling (*Marshall*).
1338. Munns, W. H..... Car coupling (*Mohn*).
1348. Penn & Penn ..... Pile-driving machinery.
1369. Horn, W. W. ..... Car couplings (*Blagrave & Marsh*).
1370. Horn, W. W. ..... Box-stapling machines (*Beck*).
1375. Barnes, Sen., & Barnes Car couplings. (26th June, 1890.)

ELECTRICITY.

19th January, 1891.

912. Richards, D. ..... Automatic electric locking gear for railway signals.

20th January, 1891.

980. Walker, Walker, Sansom, & Cole ..... Railway signals.
984. Theiler & Elphinstone Telegraphic transmitting apparatus.
991. Snell, A. T. ..... Percussive rock drill.
1004. Thomson, Sir W. ..... Indicator for electric potentials.
1007. Ferraris, E. ..... Separating ores by electricity.
1035. Maquay, S. W. ..... Primary batteries.
1049. De Ferranti, S. Z. ..... Dynamos.
1050. De Ferranti, S. Z. ..... Electrical distribution.
1051. De Ferranti, S. Z. ..... Transformers.

21st January, 1891.

1066. Burton & Angell ..... Electric blank heaters for forging machines.
1084. Jackson, W. H. ..... Automatic throw-back for electric indicators.
1114. Churchward, A. ..... Electric railways (*Robertson*).
1121. Mayer, E. L. ..... Apparatus for telephonic transmission.
1122. Raine, A. D. ..... Incandescent lamps.

22nd January, 1891.

1173. Thomson, Sir W. ..... Transmission of electric energy.
1176. Newton & Hawkins..... Brush holders for dynamos.

23rd January, 1891.

1251. Atkins & Atkins ..... Switches.
1279. Wiley, Dickey, & Ainsworth ..... Electric railway signals.

24th January, 1891.

1318. Cutler, A. W. ..... Electric distribution.
1332. Munns, W. H. ..... Insulator for electric wires (*Miro*).

CHEMISTRY.

19th January, 1891.

914. Billington & Billington, Jun. ..... Production of aluminium.
950. Leigh, H. H. ..... Metallic alloys (*Huesmann*).

20th January, 1891.

962. Kynaston, J. W. ..... Manufacture of sulphate of alumina.
1001. Read Holliday & Sons, Ld., Holliday, & Seidler ..... Preparation of a new colour producing thio-base, and of sulpho acids of the same.
1047. West, W. ..... Treating zinc ores.

21st January, 1891.

1120. Imray, O..... Dyeing on woollens azo colouring matters derived from dioxynaphthalin sulphonic acids with metallic mordants (*Farbwerke vormals Meister, Lucius & Brüning*).

22nd January, 1891.

1154. Gossage & Williamson Manufacture of sulphur from sulphuretted hydrogen.
1168. D'Andria, M. N ..... Manufacture of barium chloride and strontium chloride.
1197. Mactear, J. ..... Treatment of ores for the extraction of precious metal.
1203. Jones, F. J. ..... Manufacture of sulphate of ammonia.

23rd January, 1891.

1224. Hunt, Wilson, & Stewart ..... Colouring matters.
1225. Tatham, H. ..... Treatment of sewage.

24th January, 1891.

1354. Imray, O..... Production of a blue-green and red-violet colouring matter (*Farbwerke vormals Meister, Lucius & Brüning*).
1355. Imray, O..... Production of disazo colouring matters (*Farbwerke vormals Meister, Lucius & Brüning*).

MISCELLANEOUS.

19th January, 1891.

930. Larder & Bagnall ..... Files.
946. Lébédeff, N. ..... Extracting iron or steel from ores.

20th January, 1891.

976. Johnson, S. A. ..... Furnace bars.
987. Mills, B. J. B. ..... Oil cans (*The Rau Manufacturing Company*).

21st January, 1891.

1107. Thompson, W. P. ..... Vices (*Schwendemann & Perrot*).

22nd January, 1891.

1172. Sintzenich, H. H. C. ... Railway chairs.

23rd January, 1891.

1210. Beeley, G. ..... Furnace bars.
1249. Senior, J..... Oil cans.

24th January, 1891.

1336. Munns, W. H. ..... Oil can (*Raleigh*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

116. Potts.
948. Thomas Haylor Howard & James Martin Lapping.
1176. William Sinclair & Murdoch Mackay.
1178. William Sinclair & Murdock Mackay.
1451. Clegg.
1714. Adair.
2142. Hood.
2426. Boult (*Bisson & Bal*).
2543. Warnant-Créon.
2571. Leadbetter.
2659. Parsons.
2789. Wilson.
2815. Harris.
2883. Esson.
3028. Reignier.
3045. Brawn.
3118. Billington.
3282. Alexander.
3343. Fletcher, Brown, & Ure.
3408. Bingham.
3506. Pickering.
3529. Ayres & Foster.
3614. Holgate.
3666. Tillett.
3746. Hall.
3795. Schulthess. (18th September, 1889.)
3851. Albaret.
3878. Avery.
3907. Harvey.
4006. Chanot.
4053. Drake & Gorham.
4110. Hartley.
4157. Wallwork.
4203. Vicars, Vicars, & Vicars, Jun.
4225. Von Langer & Cooper.
4275. Kingdon.
4278. Clowes.
4280. Wood.
4303. Wride.
4333. Lindsay & Allan.
4345. Ash.
4362. Binns.
4396. Baildon & Kershaw.
4401. Kenyon, Barnes, & Kenyon.
4452. Lowe.
4483. Fowler.
4509. Rylands & Stoner.
4551. Rudgard.
4564. Thomson.
4589. Hornsby & Edwards.
4682. Longmore & Watson.
4712. Doulton.
4750. Crossley.
4766. Griffiths.
4823. Otto.
4870. Weir.
4904. Pitt (*L. Cassella & Co.*).
4922. Dewrance & Wall.
4983. Hudson.
5006. Mills (*Messrs. A. Teste Fils, Pichat, Moret, & Cie.*).
5141. Ashbury.
5273. Otto.
5366. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
5551. Walton.
5777. Imray (*Farbwerke vormals Meister, Lucius, & Brüning*).
5972. Otto.
6113. Otto.
935. Austin.
1031. Von Peichl.
1132. Amson.
1165. Duck.
1177. William Sinclair & Murdock Mackay.
1311. Gant & Moy.
1394. Heaton.
1627. Robertson.
1805. Hazlitt.
2189. Kendall.
2466. Hartley.
2564. Smallwood.
2633. Leith.
2703. Dales.
2813. Mutch.
2880. Cunliffe & Duxbury.
2889. Fletcher & McFarlane.
3053. Smith.
3196. Walker & Mills.
3332. Sykes & Blamires.
3379. Bromell.
3395. Morgan.
3446. Riley.
3520. Arnold.
3563. Burgess.
3660. McClellan.
3683. Stanley.
3757. Neal.
3817. Gedge (*Wood*).
3835. Reynolds.
3856. Leconte.
3896. Dowler.
3969. Siemens Bros. & Co., Ld. (*Taylor*).
4061. Weir & Weir.
4129. Sykes.
4167. Marshall.
4207. Porter.
4221. Wood.
4258. Hogarth & Brandreth.
4279. Clowes.
4285. Barbour & Ireland.
4307. Gill & Bradley.
4334. Lindsay & Lindsay.
4348. Flower.
4382. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co*).
4416. Haddow.
4458. Le Maistre.
4504. Lee.
4522. Morris.
4561. Fanning.
4577. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
4725. Gillespie.
4757. Horn (*St. John*).
4794. Crowley.
4829. Noble & Murray.
4889. Casey.
4921. Perry.
4942. Card.
4985. Orpwood.
5103. Reade & McKibbin.
5121. Ring & Kelly.
5125. Lemon.
5143. Walton.
5275. Otto.
5398. Czischek.
5450. Tweedale.
5549. Drews & Sennet.
5638. Teague.
5780. Imray (*Farbwerke vormals, Meister, Lucius & Brüning*).
6059. MacLaine.
6951. Kellner.

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7195. Campbell.
7670. Abel (*La Société Anonyme Continentale pour la fabrication des Compteurs à Gaz et autres appareils*).
8891. Lindner.
9484. Jones.
11377. Merryweather.
12379. Mott & Perry.
12423. Kelsey.
13106. Erlenwein.
13688. Cheeld.
15887. Redfern (*Lönholdt*).
16512. Ashton.
16754. Bottriell.
16940. Riggs.
17050. Aurich & Lässig.
17482. Hock.
17716. Lake (*New England Butt Company*).
18187. Armstrong.
18365. Nagel.
18605. Burdon.
18636. Haddan (*Conkling*).
18789. Blanke.
18821. Redfern (*Theodor Otto Thiesing*).
19257. Esmarch.
19495. Carette.
19627. Bosworth.
19725. Redfern (*Ruttkowski*).
19806. Marshall.
19864. Richards.
19898. Leach.
19995. Swartout & Bengough.
20005. Gartrell & Knoepferl.
20089. Carson & Duncan.
20120. Cayron.
20197. Hodd.
20458. Woodworth.
20675. Horn & Kretman.
20691. Kenrick & Scilley.
20735. Parsons.
20820. Wimmel & Sandgraf.
20899. Buchberer.
20947. Konegen.
20991. Bigsby.
21026. Berne & Fish.
21067. Gardner (*Fischer*).
7610. Woodward. (29th November, 1890.)
8525. Allen. (7th November, 1889.)
8608. Clark (*Freckette & Circe*).
9466. Johnson.
10407. Antrobus.
11629. Hartley & Blenkinsop.
13904. Dewey.
13813. Bredenberg.
14975. Orwin.
16488. Oberst.
16570. Groswith.
16852. Mason, Mason, & Codner.
17169. Sim & Sim.
17701. Noble & Snyder.
17969. Bird.
18179. Callahan.
18212. Mills & Barr.
18470. Purdy. (15th April, 1890.)
18699. Thomson & Von Kohler.
19194. Lake (*Morse*).
19201. Johns.
19385. Foster.
19507. Carette.
19688. Fowkes.
19744. Harness.
19818. Thompson (*Congdon*).
19877. Hawkins & Barton.
19970. Birt.
20001. Michaud.
20010. Boult (*Hardinge*).
20110. Lake (*Shaw*).
20179. Heckhausen & Weies.
20236. Livet.
20686. Greenfield.
20679. Hall & Capstick.
20711. Anderson.
20805. Kersten.
20876. Stirn.
20942. Best.
20978. Lake (*Mowbray*).
21002. Richards.
21027. Johansson.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Cut-off Mechanism for Slide Valves.—*T. Metcalfe, Bradford.*—The invention embraces improvements in the cut-off mechanism of the slide valves of steam and other engines. Fig. 1 in the accompanying illustrations is a section of a valve and cut-off mechanism constructed according to this invention, Fig. 2 being an end view of the valve and cut-off arrangement, Fig. 3 a plan thereof, and Fig. 4 a plan of the valve without the cut-off plate. The slide valve A of an ordinary steam engine with one eccentric and rod, having steam ports A^1 A^1, and exhaust port A^2 is constructed with two projections B B at the back. C is a cut-off plate, the back of which is toothed and

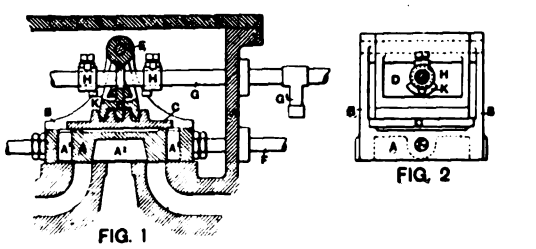


FIG. 1

FIG. 2

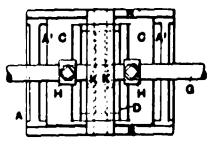


FIG. 3

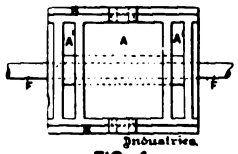


FIG. 4

gears with a toothed segment D pivoted on a pin E attached to the projections B B of the valve A. F is the valve spindle and G a shaft, which receives a circular motion from the governors of the engine through a lever G^1. H H are two stop pieces fixed on to the shaft E by set screws, and K K are inclined projections cast on to the segment D and arranged so as to come into contact with stop pieces H H in the following manner:—The valve A is being drawn, say, from left to right, the cut-off plate C being also carried in the same direction by means of the toothed segment D until the inclined projection on the toothed segment is drawn to, and comes into contact with, the stop piece H on the shaft G, when the horizontal motion with the slide valve A is arrested, and the segment oscillates on the pin E, giving to the cut-off plate C a contrary motion to the valve A, thereby closing the port and cutting off the steam to the cylinder. The inventor also describes a modification of the above arrangement. Claims: (1) In combination with the slide valve of a steam or other motive power engine, a cut-off plate attached to the slide valve by means of a toothed segment or lever, and appliances for changing the horizontal motion of the toothed segment or lever into an oscillating motion, in the manner as shown and described; (2) in combination with the slide valve of a steam or other motive power engine, a cut-off plate attached to the slide valve, and appliances for changing the horizontal motion of the cut-off plate into an oscillating motion substantially as shown and described, and for the purpose set forth.—No. 2329. February 13th, 1890. 6*d*.

Drilling and Punching Machines.—*W. Fortune & F. H. Bentham, both of Bradford.*—This invention relates to machinery for drilling the circles of circular combs used in combing machinery. Referring to the annexed illustrations, Fig. 1 is an end view and Fig. 2 a plan of an automatic arrangement for the above purpose. Upon the slide A on the gantry B is mounted the headstock C. Mounted in bearings in C is a shaft D driven from D^1, and carrying a cam E, which engages projections F F^1 on a horizontal slide G running in guides on the top of C, so imparting a reciprocating motion to the latter. A lever H pivoted at H^1 is connected at one end to the slide I operating the drill spindle J in a second headstock K, and at the opposite end by means of a slot and pin to slide G, so transmitting the reciprocating motion of the slide to the spindle J. To bring the circle into a position for drilling the next hole after one hole has been drilled, a cam face L is formed on E to engage a projection M on an arm M^1 of a lever M^2 pivoted at N in an opening in C. An arm O of this lever is coupled by links to arms P P^1 loosely pivoted on a shaft Q and carrying a pawl R, which pawl engages a ratchet wheel S keyed to shaft Q mounted on C. A spur wheel T, adjustably mounted on shaft Q^1, engages the pinion U mounted upon the standard V, which is the first pinion of motion of the usual mechanism for turning the face plate, and is operated by the handle V^1, the cogs of T being a multiple of those of U, and the teeth of S are equal to the number of times the cogs of T multiply into those of U. When the automatic mechanism is in use for drilling, the pin F is removed, and the slide G moved in the direction to feed the drill by means of a spiral spring W arranged as shown. For punching the holes after drilling, F^1 is replaced so as to reciprocate G in both directions. The ratchet

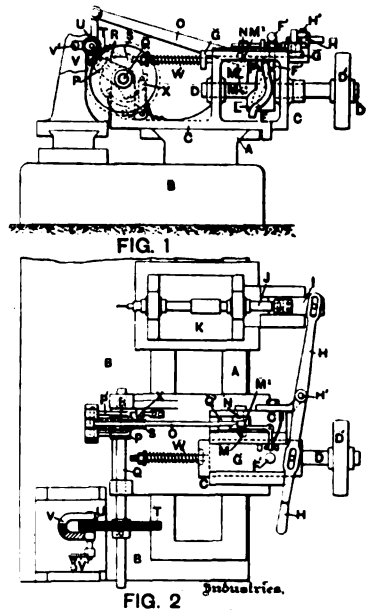


FIG. 1

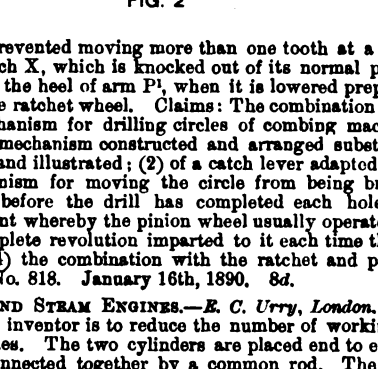


FIG. 2

wheel is prevented moving more than one tooth at a time by a second catch X, which is knocked out of its normal position, as shown, by the heel of arm P^1, when it is lowered preparatory to moving the ratchet wheel. Claims: The combination with automatic mechanism for drilling circles of combing machines—(1) automatic mechanism constructed and arranged substantially as described and illustrated; (2) of a catch lever adapted to prevent the mechanism for moving the circle from being brought into operation before the drill has completed each hole; (3) the arrangement whereby the pinion wheel usually operated by hand has a complete revolution imparted to it each time the circle is moved; (4) the combination with the ratchet and pawl of the stop X.—No. 818. January 16th, 1890. 8*d*.

Compound Steam Engines.—*E. C. Urry, London.*—The object of the inventor is to reduce the number of working parts in such engines. The two cylinders are placed end to end and the pistons connected together by a common rod. The high-pressure cylinder is single-acting, the inner end being always connected with the condenser. The second cylinder is double-acting, the outer side acting as an intermediate cylinder, by means of a hollow trunk fixed or formed on the piston and working in a stuffing-box in the outer end of the cylinder, so reducing the size of that side of the cylinder, and the inner end as a low-pressure cylinder. A valve box is formed on the upper side of the high-pressure cylinder, to the outer end of which is connected the steam supply pipe. Working in this box, and over a port in the outer end of it, leading to the outer end of the high-pressure cylinder, is a piston valve, which alternately allows steam to enter said port to the cylinder and the exhaust to escape by a second pipe. This pipe conducts the steam to the outer part of a double valve box on the second cylinder, a piston valve in which alternately allows steam to enter into and escape from the outer end of the intermediate half of said cylinder, the exhaust therefrom being allowed to escape by a suitable connecting pipe to the inner part of the double valve box, a piston valve working in which allows the steam to alternately enter into and escape from the inner end of the low-pressure half of the second cylinder, the exhaust then being allowed to escape through a suitable port and pipe to the condenser. All three valves are connected together by means of a common rod, and are actuated from the crank shaft of the engine in the usual manner. Claims: The construction and arrangement of compound expansive engines substantially as and for the purpose described.—No. 947. January 18th, 1890. 6*d*.

Tube Flanging Machines.—*E. Heaton, Holt Town, Manchester.*—In the annexed illustrations Fig. 1 is a front elevation, Fig. 2 a side elevation, and Fig. 3 a detail view of the flanging mechanism after the flanging operation. Running in a suitable bearing in the bed-plate A is the face-plate B, having sliding jaws B^1 for holding the boiler tube to be flanged, and driven by means of a gear wheel C on its underside and pinion C^1, as shown. Sliding in a vertical standard D is a carriage E, which can be raised or lowered in the ordinary manner by means of screwed

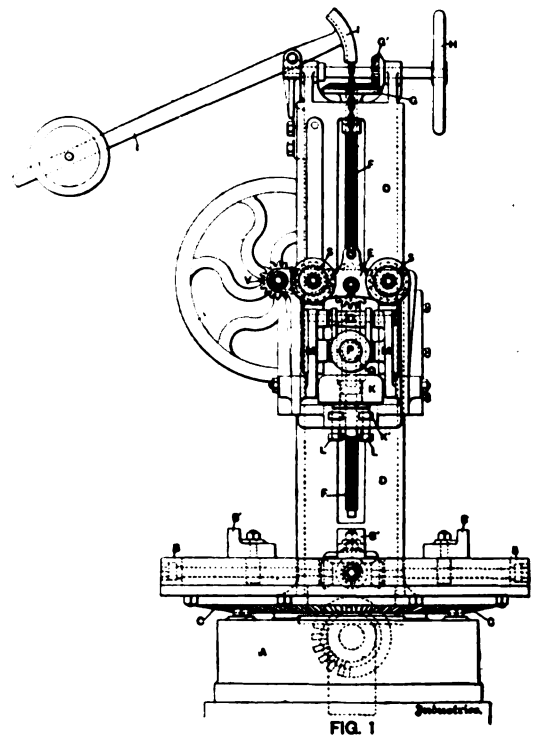


FIG. 1

rod F, passing through an internally screwed nut fitted to slide a short distance in a slide or slot in E, and gear wheels G G^1 and wheel H. In order that E may be raised and lowered quickly and independently of F and its nut, the carriage E is connected to a short arm of a weighted lever I, pivoted at the top of D by a chain, so that, by operating I, the carriage E can be lifted off its nut, which normally supports it. Near the centre of E, mounted upon an adjustable stud J, is a block K, resting on a washer K^1, which can be raised or lowered by set screws L. To the sides of the carriage E is hinged a swinging frame M, consisting of two quadrants N, connected together by a crosshead O, in which is fitted and secured a stud P for the flanging roller Q, so mounted that it can be adjusted relatively to the flanging block K by means of the four screws R. This swinging frame, with the roller Q, is turned about its centre of motion by means of two worms S, which gear into the quadrants; on the shafts carrying these worms are fixed pinions U geared together by an intermediate wheel T, and one of these pinions is driven by another pinion V fixed on the shaft of the hand wheel Y, consequently, when Y is turned in the proper direction both worms S are turned simultaneously, and by means of the quadrants N the swinging frame M is actuated to cause the flanging roller Q to turn the edge of the

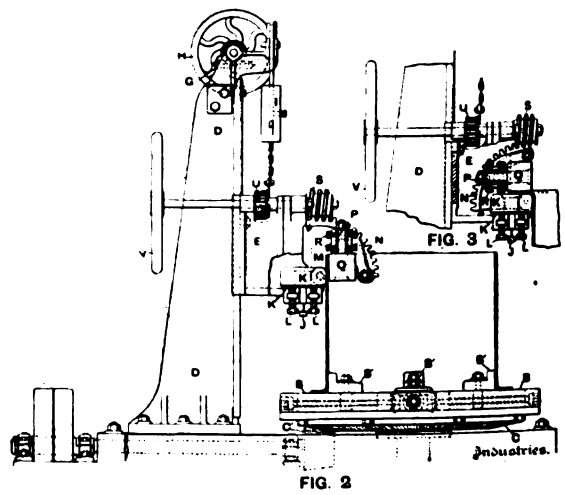


FIG. 2

tube over upon the flanging block K. Claims: (1) Mounting the carriage, which supports the flanging apparatus, so that it can be quickly raised and lowered again independently of the ordinary adjusting mechanism; (2) the combination with the flanging block or roller K of the plate or washer K^1 and the setting screws L; (3) the general combination and arrangement of parts embodying the improvements in flanging machines substantially as described and shown.—No. 16815. October 22nd, 1890. 8*d*.

Thrust Blocks.—*C. S. Snell, Culver Park, Saltash, Cornwall, & B. M. Fletcher, London.*—The object of the invention is to allow the variation in the thrust or pull on the shaft of a screw propeller, or the like, to be utilised to control the amount, direction, or influence of the actuating medium employed. The thrust block proper is mounted in grooves in a suitable fixed plate, in such a manner that it is capable of a slight movement in the direction of the axis of the propeller shaft. Fixed to one end of

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this sliding block are two arms projecting outwards at right angles to the direction in which the block slides, and fixed on these arms are two plungers working in cylinders fixed on either side of the grooved plate, and the axes of which are parallel to the propeller shaft. One part of each of these cylinders is filled with water, and is so connected by pipes to the governors of the engine actuating the propeller shaft that the more thrust there is the more the water will be compressed, and the governor so actuated to allow steam of a greater pressure to enter the cylinders of the engine, but allows of the reverse action when the thrust is reduced. Four claims are made, embracing the arrangements as described, with modifications to suit other shafts (windmill, turbine, &c.).—No. 15695. October 4th, 1890. 8*d.*

ROCK-DRILLING MACHINE.—*R. Stephens & W. C. Stephens, both of Pool, Cornwall.*—Fig. 1 in the annexed illustrations is a longitudinal section, Figs. 2 and 3 are transverse sections, and Figs. 4, 5, and 6 are details of the valve chest and valve of a rock-drilling

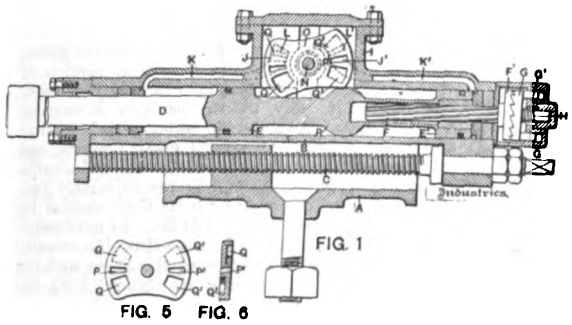


FIG. 1

FIG. 5

FIG. 6

machine embraced by this invention. A is the cradle, and B the cylinder adapted to slide in A by screw C as shown. Working in B is the piston rod D, carrying on its outer end the tool, and having two pistons E E¹. This piston rod is caused to rotate in the ordinary manner by means of the grooved rod F, working in a grooved collar in B, and carrying on its outer end a serrated disc F¹ which engages with a similar disc G prevented from revolving by lugs G¹ and normally held against F¹ by spring H. Fixed to B is the valve-chest I having two ports J J¹ communicating through passages K K¹ to the front and rear of B (Fig. 4), and two exhaust ports L L¹ communicating with the atmosphere, steam being admitted through M. Revolving on a stud N and on the face of I is the valve O (Fig. 5), provided with two ports P P¹, passing entirely through it, and with two pairs of recesses Q Q¹, and being oscillated by means of the protuberance R on D. The ports and recesses in O and ports in I are so arranged that steam will be alternately exhausted from and supplied to each end of the cylinder B, the two positions being shown in Figs. 2 and 3 respectively, the object of the second pair of recesses Q¹ in O being that when one face of O is worn the valve may be reversed. Claims: (1) In rock-drilling machinery the employment of a valve provided with three sets of ports or passages as and for the purpose described; (2) the combination with the twist-bar of two clutch-discs; (3) the combination in a rock drill of a piston, a valve having two sets of ports, one of which passes through the valve, and the other of which is cut out of the body of the valve, the said valve being operated as described, and a twist-bar adapted to be prevented from

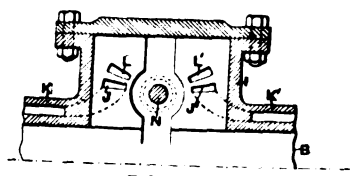


FIG. 4.

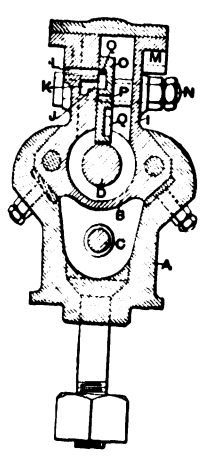


FIG. 2.

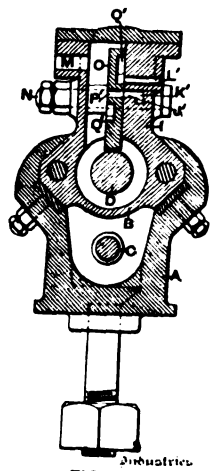


FIG. 3.

rotation in one direction by means of a disc secured thereto, and engaging with a second disc also prevented from revolving, the second disc being adapted to slide upon its axis to allow the disc upon the twist-bar to be rotated during the motion of the piston in the other direction, substantially as described.—No. 2053. February 7th, 1890. 8*d.*

STEAM ENGINE INDICATORS.—*J. D. Davies, Cincinnati, Ohio, U.S.A.*—The invention relates to a device for operating the card drum of any of the well-known indicators, and is constructed as follows:—Fixed on the cross-head of the engine is a stud provided with a sleeve having two projecting arms. In each end of these is fixed a stud, carrying free to revolve a large and small grooved wheel fixed or cast together. Passing over a pulley, at one end of the cross-head slide, is a cord which is then passed over the upper surface of the smaller of the upper pair of wheels on the cross-head, around the under side of the smaller of the two lower wheels, then back over the top small wheel, and continuing its course, passes around a pulley, fixed at the opposite end of the cross-head slide, and returning passes around the two larger wheels of the two pairs on the cross-head, and the two ends are then connected together. From the junction of the two ends of the cord two other cords pass over suitable rollers to the drums of the indicator placed and connected to the opposite ends of the cylinder of the engine. It will thus be seen that supposing the larger wheels on the cross head are 11in. in circumference and the smaller 9in., the stroke being 10in., at each complete stroke the cord will be moved forward through the space of 1in., and so the indicator drums moved correspondingly. Seven claims are made, embracing the arrangement as described, with modifications. —No. 19149. November 25th, 1890. 8*d.*

PERCUSSIVE TOOLS.—*R. Haddan, London.* (*The National Pneumatic Tool Company, New York, U.S.A.*)—In the annexed illustrations Fig. 1 is a longitudinal section along X X of Fig. 3, Fig. 2 a section along Y Y of Fig. 3, and Figs. 3 and 4 cross-sections along lines Z Z and Z Z¹ of Fig. 1 of a percussive tool, worked by fluid pressure and embraced by this invention. The casing A, constructed substantially as shown, has supply and exhaust channels B B¹ (Fig. 2). Within the casing is a piston C having a valve chamber provided with a valve D. The port E communicates with the supply B, port F with exhaust B¹, and port G with the rear end of the cylinder, and port H with the front end thereof. The action of the apparatus is as follows:—When the parts are in the position shown in Fig. 2 in full lines, steam injected through B passes into the valve chamber through E and out through G so as to press against the rear of the cylinder and drive it forward. The steam in front of the cylinder enters the valve chamber through H and passes out through F to the exhaust. When the cylinder has reached the end of its forward stroke, the valve is shifted to the position shown in Fig. 2 in dotted lines. Steam from B then passes through E into valve chamber and out through H so as to press against the forward end of the cylinder and drive C backwards.

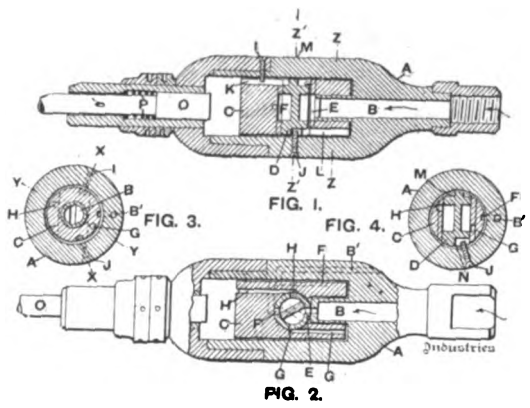


FIG. 1.

FIG. 3.

FIG. 4.

FIG. 2.

The steam in the rear of the piston entering through G into the valve chamber can pass through F to the exhaust. The oscillations of the valve are caused by set screws I J in A projecting into grooves K L in the cylinder. As the cylinder approaches the end of its forward stroke the shoulder M on D comes in contact with I, causing the valve to shift its position, as shown in dotted lines (Fig. 2), the reverse action taking place when the shoulder N strikes J. The forward stroke of piston C causes it to act percussively upon the reciprocating tool-holding rod O, normally held in the position shown by spring P. Five claims are made.—No. 18635. November 18th, 1890. 6*d.*

TOOL HOLDERS.—*W. L. Wise, London.* (*L. Berger, Fils, Thann, Alsace, Germany*).—In a tool holder for machine tools (mortising and like machines) according to this invention the tool is set and fixed at an angle of 60 deg. or thereabouts. The tool is fixed by means of two set screws in a slot formed in a heel on the lower end of the tool holder. The opposite side of this slot to that through which the set screws pass has fitted on to it a plate, the upper surface of which is formed with projections or teeth running across its width. The lower end of the plate is bent around the lower end of the tool holder to prevent it being moved, and is fixed by screws. That side of the tool which is opposite this plate is also toothed across its width, so that the two surfaces fit one another, renderingthe tool practically immovable. Claims: A tool and tool holder for machine tools, in which the tool is held in the holder at a large working angle in relation to the work to be done, is provided with a row of teeth or ridges on the side opposite to the cutting edge, and is pressed by set screws against a lining in the tool holder, this lining being provided with a row of teeth or ridges similar to those on the tool, and with a bent lower end that takes around one edge of the hole in the tool holder, substantially as described.—No. 2890. February 22nd, 1890. 8*d.*

BRICK-MAKING MACHINERY.—*W. Sayer, Derby.*—The object of the invention is to prevent the clay from clogging the knives, cutters, or worms used in brick-making machinery, and to prevent the clay becoming too dense from compression whilst passing through the die. To effect this the "pugging" and expressing knives and worms are made of a rounded or curved section, from where the knife blade joins its boss towards the peripheral tip of said knife, the curved portion receding from the direction of its thrust. To effect the second object, the inside opening of the brick die or mouthpiece of the machine is formed with a projecting cutting edge where it enters into and receives the clay from the expressing or "pug" barrel to which the die is connected by a flange. This allows of the stream of clay being divided from the central column as it is driven or forced up the inside opening of the die, so preventing it being compressed while passing through the latter. Claims: (1) In machines for making bricks and the like, forming the knives, cutters, or worms for "pugging" and expressing the plastic material of a rounded or curved section, as described; (2) in brick-making machines forming on the inner mouth of the dies a cutting edge, as and for the purpose described.—No. 3285. March 1st, 1890. 6*d.*

CUT-OFF VALVE FOR STEAM ENGINES.—*H. W. Morley, Bradford.*—The cut-off valves are arranged as shown in Fig. 1 (a part elevation and part section of an engine cylinder), the actuating mechanism being as shown in Figs. 2 and 3, respectively an elevation and part sectional plan of a steam engine cylinder, together with such parts of an engine necessary to illustrate this invention. The admission and exhaust valves A A at each end of the cylinder B are of the ordinary type, arranged and operated in the usual manner by means of levers C on spindles C¹. These levers are coupled together by the coupling rod D, and are operated by the eccentric E on the main shaft F, through the medium of the connecting rod G, vibrating lever G¹, and connecting rod G². The cylindrical cut-off valves H are mounted between and parallel to the valves A A, within valve chambers I, provided with liners J, for convenience of construction, and

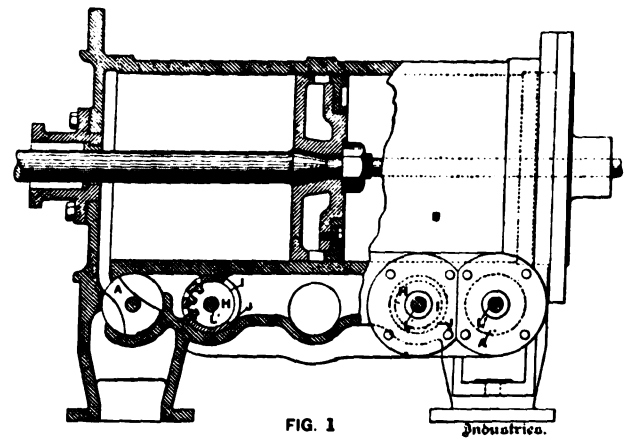


FIG. 1

having "gridiron" shaped ports E¹, to meet the similarly shaped faces of the valves. The valves H are coupled together by the rod K connecting the levers L on the ends of spindles L¹ of the valves, and are opened and closed by a cam M on the cam sleeve M¹ mounted on the shaft N. The shaft N is connected to and driven at the same speed as the main shaft by a pair of bevel wheels O connecting it to the shaft P, driven from the main shaft by the bevel wheels Q. The shaft N is hollow, and receives the end of the governor rod R, which carries the head S free to revolve thereon but confined longitudinally between the collars S¹. This head has a key T projecting through the longitudinal slot T in the shaft N into the helical keyway U in the sleeve M¹. The rod R from the governor is operated longitudinally in the usual manner as the speed of the engine varies, thereby moving the key T in the inclined keyway U advances or retards the cam in relation to the crank shaft or steam piston, and so regulates the cut-off. The cam M operates the slide W by engaging the anti-friction rollers X projecting therefrom, and the slide W is connected to the rod K by the connecting rod Z. Claims: (1) In a steam or other fluid-pressure engine the combination with the admission and exhaust valves of cylindrical cut-off valves, arranged and operated as described; (2) the com-

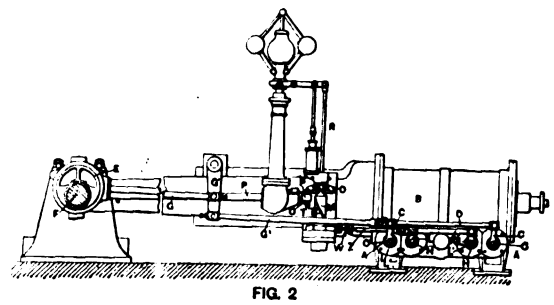


FIG. 2

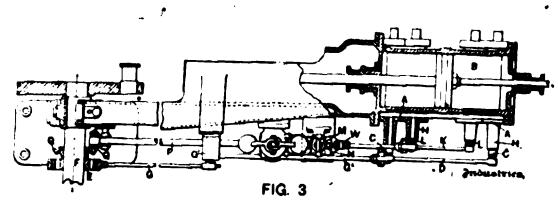


FIG. 3

bination with said cut-off valves of the cam sleeve M with the inclined groove U engaging the key T, arranged to be regulated by the governor, substantially as described.—No. 18318. November 14th, 1890. 8*d.*

TEXTILE MACHINERY.—*J. Haworth, Church Hall, Church, Lancashire.*—The object of the invention is to provide means of thoroughly washing textile fabrics. For this purpose revolving beaters or spurters of a special design are used. These consist of a number of troughs, preferably four, arranged upon radial arms on a centre shaft running in bearings in each side of the washing cistern, the troughs being at the outer end of the arms. The shaft is placed at such a distance from the water that the troughs are completely covered with water when in their lowest position. The outer sides of these troughs have perforations through which, as the troughs open in the same direction as that in which the shaft revolves, the water is caused to flow by centrifugal force. The fabric to be washed is passed around rollers in such a manner that it is brought in contact with the spray or jets issuing from the revolving troughs, which will so wash away any impurity or loose matter in the fabric. Claims: In washing or cleansing machines the use of revolving beaters or spurters arranged in a cistern in such a manner that when revolved they take up water or other liquid and spurt it in small jets with great force against the fabric substantially as set forth; (2) the several combinations and arrangements of parts embodying the improvement in machinery for washing and cleansing textile fabrics, substantially as described.—No. 19367. November 28th, 1890. 6*d.*

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HYDROCARBON ENGINES.—*J. Dheyne, Schaerbeck, Belgium, & Count de Nydprück & F. de la Hault, both of Brussels, Belgium.*—The invention relates more particularly to engines worked by explosive gases produced by the vaporisation of hydrocarbon and other like liquids. In the annexed illustrations, Fig. 1 is a side elevation of an engine constructed on the principle of this invention, Figs. 2, 3, 4, and 5 being enlarged details thereof. The

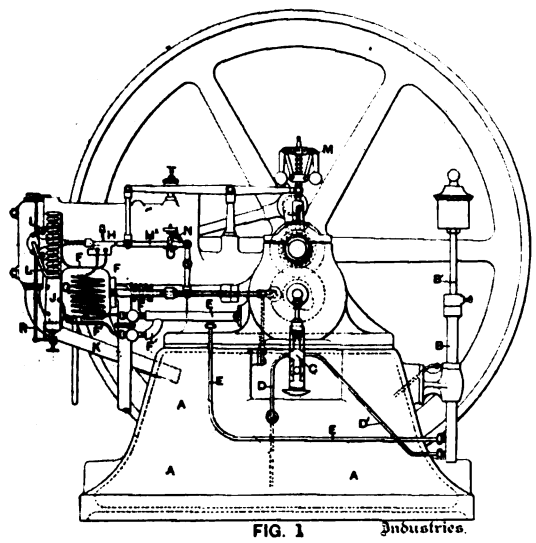


FIG. 1 Industries.

base A of the engine is in the form of a tank and contains the petroleum, which is drawn therefrom and supplied to a vessel B by means of a pump C, actuated from the crank shaft of the engine, through pipes D D¹. From the vessel B, which contains a weighted piston B¹ so as to keep a constant pressure therein, the oil passes through pipe E to two pipes F F¹ provided with stop-cocks. From F the oil passes through a coil (Figs 3 and 4) in the explosion chamber G of the engine, and thence through a slide valve H (Fig. 5) to a coil I, in which it is converted into gas, and the branch F¹ communicates with a coil J where the oil is converted into gas for supplying the flame for heating I and the igniter. From I the gases pass to the engine cylinder, together with air admitted through pipe K, through pipe L, being drawn in by the action of the piston in the usual manner. The valve H, normally kept closed by spring H¹, is reciprocated by push-rod H² and regulated by governor M, as shown, and also further regulated by an adjustable wedge-shaped piece N. The automatic device for regulating the action of the generator is constructed as represented in Fig. 2. The gas generated in the coils J is conducted by the lower end of the coil to a taper orifice O provided with a needle valve P connected to a rod Q, which is automatically regulated by an expansion apparatus consisting of a rod R fixed at its upper extremity S and acting through a lever T centred at U on a nut V, which it moves vertically along with

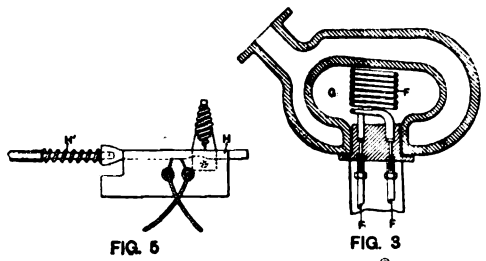


FIG. 5

FIG. 3

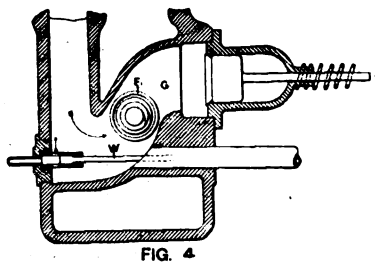
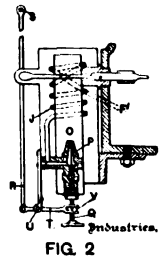


FIG. 4



Industries.

FIG. 2

the rod Q and valve W. The rod R being in proximity to the coil I, Fig. 1, expands when the heat exceeds certain limits in such a manner as to contract or close the orifice O by acting on the lever T, nut V and rod Q. Five claims are made.—No. 5933. April 18th, 1890. 8*d.*

PIPE COUPLINGS.—*C. G. Harrison & H. Howard, both of Halesowen, Worcestershire.*—On each of the ends of the pipes to be coupled the inventors form a flange, standing out at right angles to the peripheral surface of the tube, on the outer edge of which two or more radial arms are formed which extend through an arc of about 30 deg. The radial arms of one of these flanges stand out about twice the distance from the periphery of the flange than those on the other flange. These longer arms are bent over so as to form a clip to receive the shorter arm inside the bent portion. One of the inside bearing surfaces of the bent arms or clips and one of the outside bearing surfaces of the unbent arms are slightly inclined, the inclination following the direction of the curvature of said arms. To unite the ends of the tubes they are placed together so that the bent arms come between the unbent arms. One pipe is then slightly revolved so that the latter enter the former, into which they may be forced by means of a screw clamp, after which they may be fixed by means of screws if desired. Claims: The improvements in connecting metallic pipes as described—viz., forming on one end of the pipe a flange carrying on its outer edge two or more radial arms, one of their faces being preferably inclined, and forming on the end of the other pipe a similar flange carrying on its outer edge two or more clips, one of the bearing faces of which are also inclined, and securely engaging and locking said arms and clips together as described to form a joint.—No. 3719. March 8th, 1890. 8*d.*

ELECTRICITY.

ELECTROMOTIVES.—*J. Hopkinson, London.*—The invention refers to electromotives in which the dynamo armature or armatures are on the running axles, the object being to construct the armatures of as large a diameter as possible. To effect this the inventor uses a four-pole dynamo machine with the magnets arranged horizontally. Where there are armatures on two adjacent axles, the inventor extends the magnets across from one armature to the other, as well as in front of, and behind, or at the outer sides of the armatures. In this manner power may be applied to the axles of a bogie electromotive. The magnets are suspended from the frame by springs to relieve the weight from the journals by which the axles are connected to the magnets. Claims: In an electromotive the combination of an armature or armatures on the running axle or axles, and four-pole magnets arranged horizontally; (2) in an electromotive the combination of an armature or armatures on the running axle or axles, and four-pole magnets arranged horizontally, and connected together and supported by springs substantially as and for the purpose described.—No. 3732. March 8th, 1890. 6*d.*

INCANDESCENT LAMPS.—*J. W. Edmondson & W. Clarke, both of Gateshead-on-Tyne, Durham.*—For the purpose of cheapening the manufacture of incandescent lamps, of the larger type especially, the inventors, instead of attaching the filaments to platinum wires by a deposit of carbon, by electrotyping, or other ordinary process, connect the carbon rods or filaments with nickel wires or strips that can be attached either directly to platinum or nickel wires passing through the glass of the lamp, or to iron wires or rods that are in turn attached to the platinum or nickel wires above mentioned. The connection between the wires fused into the glass of the lamp and the lamp leads may be effected by means of loops of nickel. For the purpose of fusing the nickel wires into the glass without cracking it the said wires are coated with borax or other suitable flux, or with a thin coating of platinum. Five claims are made, embracing the modification in the construction of incandescent lamps, substantially as described.—No. 20652. December 23rd, 1889. 6*d.*

CHEMISTRY.

MANUFACTURE OF SODA AND POTASH.—*F. Ellershausen, Hebburn-on-Tyne, Northumberland.*—The invention relates to the manufacture of soda by the "Leblanc" process, the object being to effect the removal of the sulphur of the sulphide of sodium, a certain proportion of which is contained in the crude soda. To effect this the inventor uses ferrate of soda, which, when decomposed, the iron combines with the sulphur and precipitates in the form of sulphide of iron, while the soda enters into solution with the soda liquid. In case an excess of ferrate of soda is introduced, it is also decomposed, that portion of the iron not entering into combination with the sulphur precipitating as oxide of iron, while the soda enters into solution with the liquid soda. In the manufacture of potash ferrate of soda is substituted for ferrate of potash. Claims: In the manufacture of soda and potash, treating the crude solutions of the same with their respective ferrates, substantially as described.—No. 1584. January 29th, 1890. 4*d.*

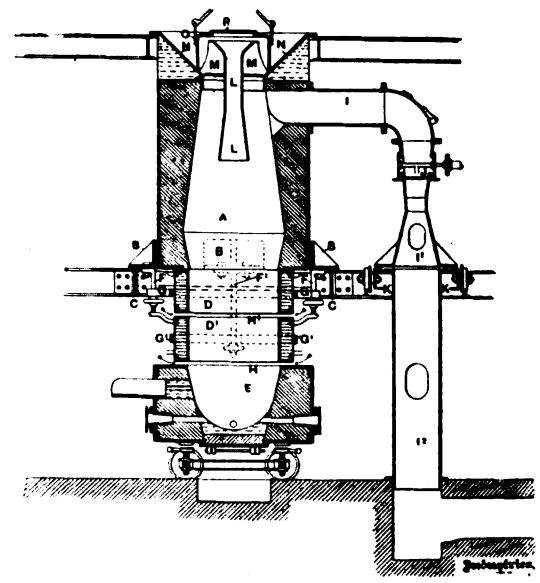
MANUFACTURE OF PAPER.—*E. Applegarth, London.*—The invention refers principally to a method of treating straw, esparto grass, and other fibrous materials, previous to their being used for the manufacture of paper. For this purpose the inventor uses a compound as follows:—15lb. caustic soda, 3 gallons water, 1½ gallons linseed oil, and 5 gallons kerosene oil. These ingredients are well mixed together and boiled until thoroughly combined and reduced to form a more or less firm compound. The straw, esparto grass, or other fibrous material is boiled in caustic lye or other suitable alkaline solution, to which has been added the requisite quantity of the above-described compound, preferably in the proportion of about 1 per cent. of the compound to the quantity of straw or other fibrous material when put into the boiler with alkaline solution (lye). Claims: (1) The improved compound made by mixing together water, caustic soda, kerosene oil, or other unctuous or spirituous hydrocarbon oil or spirit and animal fat or oil or vegetable oil in or about the proportion stated, and subjecting the mixture to heat as described; (2) the treatment of straw or other fibrous material by boiling the same in caustic lye or other alkaline solution in which a suitable quantity of the improved compound is dissolved; (3) straw or other fibrous material treated with the improved compound as described.—No. 2832. February 21st, 1890. 6*d.*

GENERATION OF CHLORINE.—*D. G. Fitzgerald & A. C. Falconer, both of London.*—The invention relates to means for the electrolytic generation of chlorine and compounds of chlorine with earthy bases. For this purpose the inventors employ anodes of peroxide of lead prepared as described in prior patents, No. 4671 of 1885 and No. 16608 of 1886. As electrolytes the inventors employ solutions of any suitable earthy chloride such as chloride of calcium or of magnesium or a solution containing a mixture of earthy chlorides. The anodes are of large surface, and are made by attaching a number of plates of compact coherent and conductive peroxide of lead as above described to a wooden support, the said plates being connected by means of platinum washers and insulated wires to a conductor, preferably of lead, insulated and imbedded in the support. When bleaching, the inventors arrange the anode at the bottom of the tank so as to utilise the free chloride generated and to maintain the anodes in contact with an earthy body. For the cathodes corrugated copper or zinc sheets are used. Claims: In the electrolytic generation of chlorine and compounds of chlorine with earthy bases the use of the aforesaid compact coherent and conductive peroxide of lead or lithanode as an anode in the electrolysis of earthy chlorides substantially as described.—No. 1246. January 23rd, 1890. 4*d.*

MISCELLANEOUS.

WELDING METALS.—*G. H. Cammell, Brookfield Manor, Hathersage, Derbyshire.*—To prevent the oxidisation of the surface of metals when heated for welding, the inventor coats (by electrical deposition or other means) the surfaces of the metals to be welded with nickel or other slowly oxidisable metal. The oxidisation is thus prevented, and the surfaces of the metals become chemically as well as mechanically combined at a welding heat, and different metals (which easily combine with nickel or other slowly oxidisable metal) may be so welded together. The invention is particularly applicable to welding pieces of metal of large surfaces, such as compound armour plates, the surfaces being first cleaned of all oxide, then plated with nickel or other such metal, placed together, heated to a welding heat, and rolled in the ordinary manner. Claims: The welding together of similar or dissimilar metals by the process described, viz., thoroughly cleaning, then nickel-plating the surfaces to be welded, heating the parts to a welding heat, and rolling, pressing, or hammering, substantially as described.—No. 3369. March 3rd, 1890. 4*d.*

SMELTING FURNACES.—*F. A. Herbertz, Cologne-on-the-Rhine, Germany.*—The annexed illustration is a vertical section of a smelting furnace embracing the principle of this invention. The shaft A is carried loosely by the brackets B resting upon the bearers C; under A are two water-cooled annular chambers D and D¹, consisting of several cooling chests, and under these circular coolers is the movable and adjustable hearth E. The annular chambers D and D¹ are adjustably suspended under A by means of the hanging bolts F F¹, carried by B, and the carriers G G¹, which surround D D¹. In connection with the movable hearth E are formed two adjustable annular air entrance passages H H¹. The suction of the gases and the consequent entrance of the atmospheric air through both the



annular air openings H H¹ into the shaft A is effected through the suction pipe I I¹ I² and the steam injector J. In order to remove any non-gaseous portions of the furnace smoke, which is deposited when the smoke comes in contact with the steam of the injector, without interfering with the working, two pipes I¹ I¹ are mounted on a carriage K, which runs on rails, and as soon as a deposit has formed in one of these pipes a clean pipe may be quickly substituted, and the pipe which has been used cleaned. In order as much as possible to prevent the collection of deposit, there is in the upper part of the shaft a depending tube L supported by four ribs M upon the funnel N, and the tube L reaches up to underneath the bell-covering O. The pulverised material is fed in through the damper P into this pipe, and thereby carried below the suction of the furnace, whilst coarser materials and coke reach the shaft of the furnace outside the pipe K through spaces between the hopper N and bell-covering O and by the lifting of the latter. Four claims are made.—No. 14053. September 6th, 1890. 6*d.*

REPAIRING DRAIN PIPES.—*W. Reynor, London.*—The inventor here effects the repairing of drain pipes by the use of the following apparatus. Two pistons are used for this purpose, each piston being composed of an indiarubber disc, which fits the pipe to be repaired, held between two metal plates 5in. in diameter, which plates can be screwed up so as to slightly alter their diameters if required. Each piston has an extending arm of a U-shape. The two pistons are made to slide on a hollow tube about 2in. in diameter and 2ft. 6in. long. When the pistons are closed together in the centre of the tube the ends of the U arms will be at the end of the tube. Two ropes are passed through the tube and fixed to the arms extending beyond the opposite ends thereof, so that by pulling these ropes the pistons will be brought closer together, so compressing the cement, which had previously been placed between them, into any orifice, open joint, or other cause of leakage. Claims: The combination of the different parts as above described, for the staunching and testing of drains, as described.—No. 579. January 13th, 1890. 6*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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AN IMPROVED BORING MACHINE FOR TAPER HOLES.

THE annexed illustration represents a general view of a new boring machine for boring taper holes. It is made by Messrs. James Spencer & Co., Chamber Iron Works, Hollinwood, near Manchester. The frame of the machine is triangular shaped, having slotted holes in the base to enable it to be fitted to the flat surfaces of cylinders, &c., when boring conical valve seatings or machining the flat surfaces round the said seatings. The headstock is adjustable, by means of a screw and hand-wheel, through a range of 12in. in a vertical slot in the main frame, and is provided with a strong cast-iron spindle with adjustable conical bearing on the lower end for adjustment for wear, and a steel tail pin for receiving the end thrust. This spindle derives motion from the driving shaft by means of a worm and worm wheel at its upper end, the steel worm running in an oil trough, and the wheel having a phosphor-bronze rim. On the lower end of the spindle is a slide adjustable transversely by screw and hand wheel to suit the different sizes of holes to be bored. On this slide is carried another oblique slide, which gives the requisite amount of taper to the surface operated upon. The latter slide carries an adjustable tool-holder, which has a self-acting feed motion derived from a star wheel coming in contact at each revolution with a suitable stud. The machine is driven by a three-speed cone pulley, and is suitable for boring holes from 21in. down to 7in. diameter and 12in. deep, and will face flat surfaces up to 2ft. 3in. diameter.

THE INSTITUTION OF CIVIL ENGINEERS.

AT a meeting on the 3rd inst., Sir John Coode, K.C.M.G., President, being in the chair, a paper was read on "Electric Mining Machinery," by Messrs. Llewelyn B. and Claude W. Atkinson.

During the last four years the authors had been constantly connected with the application of electricity to mining, and had spent a considerable amount of time underground, both in experimental work and in teaching those who would have charge of the electrical machinery. It was pointed out in what way the conditions of mining work differed from those existing in other industries, and how they had been dealt with, and some of the machinery now actually employed was described. The use of compressed air was then discussed, and the results of experiments were given, showing that the efficiency of this method of transmitting power was 45·8 per cent. for an air pressure of 19lb. per square inch, decreasing to 25·8 per cent. for an air pressure of 40lb. From more recent experiments by Professor Kennedy, F.R.S., M.Inst.C.E., it was found that in practice an efficiency of 31 per cent. might be realised, or 45 per cent. if the air was heated before being passed into the motor. In the case of the electrical transmission of energy, except when distributed into very small units, there was little difficulty in obtaining 50 per cent. of the power expended in the engine, and there were cases in which an efficiency of 75 per cent. had been realised. One of the most important points with regard to the employment of electricity in coal mines was whether a motor would be likely to cause an explosion. It was necessary in the case of a machine which perhaps might have to work for several hours without attention to guard against the possible accumulation of an explosive atmosphere around the brushes. For this purpose the authors had enclosed either the whole armature or the commutator only in a practically air-tight casing, and the method had been successfully applied to a motor of 40 horse-power. The temperature had been kept down to 70° F. above that of the atmosphere by allowing a sufficiently large cooling surface—namely, 2·3 square inches per watt. To meet the objection that if the firedamp should leak into these covers the resulting explosion might be as disastrous as if they did not exist, it was pointed out that that whenever the proportion of marsh gas to air exceeded 3 or 4 per cent., combustion would take place quietly, and the resulting carbonic acid would tend to prevent explosion in the case of further leakage. Moreover, the authors proposed, in special cases, to introduce a constant supply of carbon dioxide from a steel cylinder into the interior of the casing, thus preventing the ingress of an explosive mixture. Similar methods were adopted for enclosing the switches, and sparking was prevented by providing a resistance coil of small self-induction, which was always connected to the ends of the magnetising coil so as to form a path through which the current in the latter might continue even when the main circuit was broken. The switch itself also had a resistance coil connected to the several points with which it made contact, so that, by slowly opening the circuit, sparking was practically done away with. The application of electricity to pumping in mines was then described and illustrated. The use of belts for driving was not recommended, on account of the want of space and the difficulty of keeping them in good condition in dirty and wet situations.

The employment of electric power for actuating coal-cutting machinery was suggested in 1873 by Mr. Henry Wilde, and first practically applied by Mr. F. Mori, in 1887. This had a cutter of the bar type, revolving upon its axis, and was driven by a dynamo having a normal output of 10 horse-power, situated at a distance of about a mile. It was built by Messrs. W. T. Goolden & Co. Their next machine was one in which the armature shaft itself was made to carry the cutter bar. Later developments of these electrical coal cutters were given. The proper form and dimensions of the cutters were then discussed at some length, the authors preferring the bar type to that in which the tools were fixed into the periphery of a disc, not only as being less liable to be held fast by a fall of coal, but as cutting to a much greater depth. The cutter bar ran at the rate of 500 revolutions per minute, and on an average, including stoppages, from 20 to 30 square yards per hour might be cut in fairly hard coal. At Lord St. Oswald's colliery at Nostell, 55 yards were bared to an average depth of 3ft. 8in. in seventy-five minutes. The relative cost of cutting coal in this way and by hand showed a difference in favour of the machine of 1s. 6d. per ton.

An electric boring machine was described, and also an arrangement for driving an Ingersoll percussive rock drill by electricity, as well as a special form of dynamo adapted for use in transmitting power for electric mining work, with a high voltage.

The authors arrived at the following conclusions:—

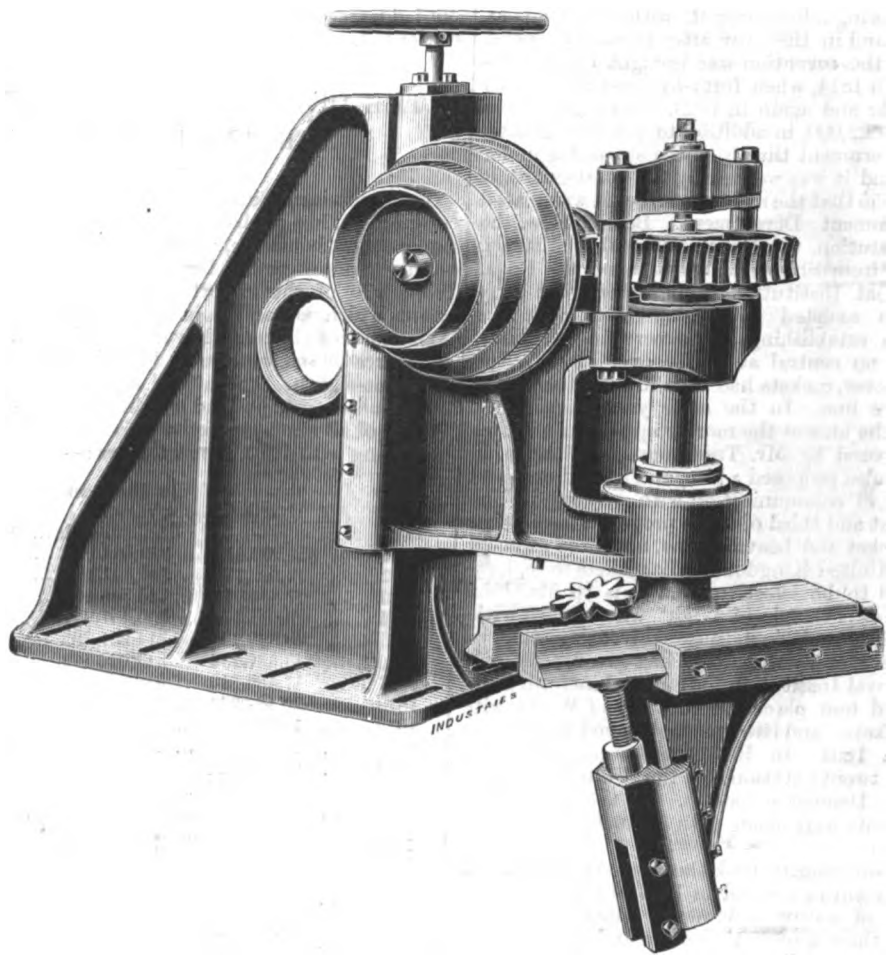
A. That electric power was destined to become an important factor in mining mechanics, on account of—
  (1) The facility with which it could be used with machines which required to be moved from time to time;
  (2) The great economy in first cost and reduced cost of working, owing to its efficiency being higher than that of compressed air, or any other medium of power transmission;
  (3) The smaller cost of maintaining the cables, as compared with piping, on shifting floors in roadways, &c.

B That the methods described were sufficient to obviate all objections to the use of electric motors in coal mining, whether by excluding inflammable gases or by constructions which would allow of their safe combustion.

C. That the experiments, trials, and practical work, extending over four years, showed that—
  (1) Electrical pumps might be used with advantage and economy for mine draining;
  (2) Electrical coal cutters could replace hand labour, with saving in cost, and increased production of coal;
  (3) Electrical drilling machines were available in place of machinery worked by hand or compressed air.

IMPROVED BORING MACHINE FOR TAPER HOLES.

CONSTRUCTED BY MESSRS. JAMES SPENCER & CO., HOLLINWOOD, NEAR MANCHESTER.



GENERAL VIEW OF MACHINE.

LIFE SAVING APPARATUS.

THE Board of Trade has recently issued an official report relating to life salvage for the year ending 30th June, 1890. The report states that during the year 1889-90, 132 lives were saved by means of life-saving apparatus. In order to stimulate the exertions of the men employed in the service of saving life from shipwreck the Board of Trade give medals in bronze and silver for acts of special gallantry. The lifeboat and the rocket apparatus form the principal means adopted for saving life on the coasts of the United Kingdom. With few exceptions the lifeboats are the property and under the management of the National Lifeboat Institution. The lifeboats at Ramsgate and Fair Isle are now the only lifeboats under the superintendence of the Board of Trade.

The rocket apparatus, on the contrary, are the exclusive property of the Board of Trade. The following is a short account of the history of the apparatus:—The late Captain G. W. Manby, F.R.S., was the inventor of

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the mortar apparatus, and therefore of the system of the rocket apparatus. The same idea had, however, previously occurred to Sergeant Bell, of the Royal Artillery, who, as early as 1791, devised a plan for throwing a rope on shore by means of a shell from a mortar on board the vessel in distress, or *vice versâ*, and similar experiments were made by a Frenchman named La Fère. Manby, however, had not heard of these inventions, and his own was the first that was used. The idea occurred to him in February, 1807, when present at a shipwreck, and in February of the next year he saved seven persons from a wreck by throwing a line over it, with which a boat was hauled off; and in the year after he saved several crews. In 1810 the invention was brought before Parliament; again in 1814, when forty-five mortar stations were established; and again in 1823, when a grant was made to him of £2,000, in addition to previous grants. Though the Government thus took the apparatus under its protection, and it was worked by the coast-guard, it was not until 1855 that the management of it was placed under a Government Department. Before this the Shipwreck Institution, the Royal National Institution for Saving Life from Shipwreck (now called the Royal National Lifeboat Institution), and other local shipwreck societies assisted and co-operated with the Government in establishing and supervising stations, but there was no central authority over all. In the meantime, however, rockets had been invented and used for carrying the line. In the same year that Manby had conceived the idea of the mortar apparatus a rocket had been proposed by Mr. Trengrouse, of Helston, in Cornwall, who also proposed a kite, and a hand and lead line, as means of communication with a vessel in distress. The first and third of these proposals have borne fruit in the rocket and heaving-cane, now used at every station in the United Kingdom. His rockets were, however, too small to be effective; and it is to Mr. John Dennett, of Newport, Isle of Wight, who worked without any knowledge of Trengrouse's invention, that we owe the first rocket by which life was saved. As early as 1826 the Royal Institution for Saving Life from Shipwreck supplied four places in the Isle of Wight with Dennett's rockets: and life was first saved by them at Bembridge in 1832. In 1853 there were about one hundred and twenty stations in the United Kingdom supplied with Dennett's rockets. In the autumn of 1852 experiments were made with an anchor shot and a grapnel shot.

When the Government took the life-saving apparatus under its own entire control in 1855, there was a large number both of rocket and mortar stations, at about half of which there were both rockets and mortars. The superiority of the rocket apparatus was acknowledged, but experiments were made by Colonel Boxer to improve both means of communication. He succeeded in improving both; the first by a new shot of different shape, and containing fuses, which threw a light over vessels as they passed, and the latter by a new rocket, a combination of two rockets in one case, one being a continuation of the other, so that the first compartment carried the projectile to its full elevation, and the second gave an additional impetus; the range thus obtained was found to much exceed that of two rockets attached side by side to one stick. This rocket was the same in principle as that now used. In 1857 the Board of Trade, who had then taken over from the Customs the management of the apparatus, issued fresh instructions, which adopted almost entirely the proposals made by Commander Ward, R.N., late Inspector of Lifeboats, to the Lifeboat Institution. Commander Ward was also the inventor of the cork life jacket, used universally by the coast-guard, specimens of which were exhibited at the Paris Universal Exhibition of 1855. In the same exhibition there were also shown the "Travelling Life Buoy," or "Sling Life Buoy," now used with the apparatus, which was invented by Commander Kisbee, R.N. The apparatus and the method of working it may be thus shortly described:—A rocket is fired which carries a line over the ship, the crew haul on the rocket line, and this brings anendless rope (called a "whip"), rove through a block with a tail attached to it, which they make fast to a mast or some other portion of the wreck high above the water. Those on shore then haul off to the ship a hawser attached to the whip, which is made fast to the mast or other portion of the wreck about 18in. above the whip. Those on shore then set the hawser up and send up to the ship the sling life buoy. When the buoy reaches the ship one of the shipwrecked persons gets into it, and it is hauled back with its occupant. This process is repeated till all, or as many as possible, are saved. It is sometimes better to use the whip and sling life buoy alone. When the vessel is close to the shore, the heaving cane is used instead of a rocket.

Life-saving stations, supplied with cliff-ladders for descending cliffs for the purpose of saving life, are also established at certain places where the rocket apparatus would be unavailable. A few life stations are also supplied with heaving canes and lines and life buoys only. The Board of Trade issue millboard tablets with instructions to crews of vessels. These tablets are supplied gratuitously to shipowners and masters for placing on their vessels in a conspicuous position, and are also fixed in public places along the coast. Gear is also supplied to all Royal Naval Reserve drill stations and to training ships, and every certificated officer in the mercantile marine is required to understand the working of the apparatus.

On the 30th June, 1890, the number of life-saving stations was 303—viz., rocket apparatus stations, 292; cliff-ladder stations, 7; and heaving line and life buoy stations, 4.

THE DECLINE OF THE AMERICAN MERCANTILE MARINE.

The American Bureau of Statistics, in its last quarterly report, has published some statistics of the American mercantile marine, which show that during the past twenty years there has been a continuous decline in the proportion of the imports and exports of the United States which is carried in American vessels. In 1870 American vessels carried over one-third of the country's commerce by sea, whereas in 1890 the proportion is little over one-eighth. The official figures for aggregate imports and exports by land and in American and foreign vessels of all kinds respectively for the twenty-one years, beginning with 1870, are as follows:—

	Overland.	In American Vessels.	In Foreign Vessels.
1870	——	$352,969,401	$638,927,488
1871	$22,985,510	353,664,172	755,822,576
1872	27,650,770	345,341,101	839,346,362
1873	27,869,978	346,306,592	966,723,651
1874	23,022,540	350,451,994	939,206,106
1875	20,388,235	314,257,792	884,788,517
1876	18,437,154	311,076,171	813,354,987
1877	17,464,810	316,660,281	859,920,536
1878	20,477,364	313,050,906	876,991,129
1879	19,423,685	272,015,692	911,269,232
1880	20,981,393	258,346,577	1,224,265,434
1881	25,452,521	250,586,470	1,269,002,983
1882	34,973,317	227,229,745	1,212,978,769
1883	48,092,893	240,420,500	1,258,506,924
1884	46,714,068	233,699,035	1,127,798,199
1885	45,332,775	194,865,743	1,079,518,566
1886	43,700,350	197,349,503	1,073,911,113
1887	48,951,725	194,356,746	1,165,194,508
1888	54,356,827	190,857,473	1,174,697,321
1889	66,654,378	203,805,108	1,217,063,541
1890	73,576,263	202,451,086	1,371,116,744

and the following tables give the vessels entered and cleared in 1890 from each country in which the tonnage exceeded 200,000:—

Vessels Entered—1889-90.

From	American.	Foreign.	Total.
United Kingdom	114,736	3,582,356	3,697,092
Quebec and Ontario	679,366	2,073,520	2,752,886
Germany	6,536	1,355,313	1,361,849
Cuba.....	590,593	595,023	1,185,616
British Columbia	1,025,923	111,466	1,137,389
Nova Scotia, New Brunswick, and Prince Edward Island	389,894	503,845	893,739
British West Indies	174,351	589,950	764,301
Brazil	80,204	434,393	514,597
Scotland	1,036	473,686	474,722
Belgium	28,765	428,963	457,718
Argentine Republic	45,025	373,729	418,754
France on the Atlantic.....	9,151	313,218	322,369
Spain on the Mediterranean	1,720	293,870	295,590
Uruguay	13,493	265,661	279,154
Italy (insular).....	2,608	269,909	272,517
Australia	50,550	220,841	271,391

Vessels Cleared—1889-90.

For	American.	Foreign.	Total.
England	114,109	4,345,089	4,459,198
Quebec and Ontario	677,450	2,057,656	2,735,106
Germany	3,340	1,482,584	1,485,924
British Columbia	1,049,652	109,558	1,159,210
Nova Scotia, New Brunswick, and Prince Edward Island	393,680	571,525	965,205
Cuba.....	562,243	278,036	840,279
France on the Atlantic.....	9,128	645,418	654,546
Scotland	3,706	626,057	629,763
Ireland.....	16,185	581,907	598,092
Belgium	22,964	520,531	543,495
British West Indies	103,133	295,328	398,461
Netherlands	3,534	364,913	368,447
Argentine Republic	59,998	172,117	232,115
Brazil	83,719	131,857	215,576

Of these, while 3,709,005 tons of foreign steamships cleared for England, while the American steamships aggregated only 41,648 tons, while there were no clearances of American steamers to Germany, the Atlantic ports of France, or the Netherlands—on the other hand, American vessels monopolise the sea-going commerce of the United States with British Columbia, and have a large proportion of that with the maritime provinces of Canada and Cuba.

SAWING MACHINES FOR BEVELLED TIMBER.

Some thirty-five years ago, when the picturesque wooden walls of old England ruled the waves—that is, before the introduction of the present metal monsters for our first line of defence—there were, at the old Woolwich Dockyard, since abolished, several machines for sawing balks of timber into bevelled pieces for ships' work. These consisted of vertical reciprocating saw-frames, driven from below. Each machine was fitted with a skeleton swing-frame, carrying one or more saws capable of lateral adjustment on transverse guides whilst working by means of conveniently placed levers. The log to be converted was advanced to the saw on a travelling drag, to which it was secured by dogs at each end. These dogs were pivoted in such a manner that they could be turned by hand independently of each other within certain degrees of a circle, according to the required sweep and bevel of the work. This was lined out, and men were told off to the swing-frame and each of the quadrant dogs, whose duties were to manipulate these and follow the lines on the timber as it passed through the machine.

Some years later M. Normand, of Havre, introduced several improvements in this class of machinery, whereby its efficiency and producing capacity were considerably increased. He arranged means by which the quadrant dogs between which the timber was held and the swing frame carrying the saw could be worked in conjunction without any manual assistance. This proved of great importance, as not only were the services of the workmen dispensed with, but the work was better done—a result which can be well understood when the difficulty of several men working at one machine, and almost irrespective of one another, is taken into consideration.

Not long after the suitability of the band-saw for cutting heavy timber was shown, ingenious minds turned it to account for the purpose under discussion, to which it seems admirably suited. The best machine of the kind is unquestionably that invented and patented by Messrs. Western & Hamilton in 1873. It may be thus described in brief. The two pulleys for the saw are carried by a rectilinear bar, simple mechanism being provided for adjusting the distance between them to suit the length of the saw, and for compensating for the contraction and expansion of the latter when working. One end of this bar is carried by a pivot in the axial line of the driving pulley, whilst the opposite end is fitted to a block in which it is free to swivel and slide longitudinally. The pivot and the block slide on parallel rods by means of a rack and pinion or a screw. According as the one or the other is so moved, the saw is induced to make a more or less oblique cut in the timber as the latter advances on a table actuated by gearing after the usual manner.

The saw-bar carries two brackets, furnished with circular discs having guide slots for the blade. These discs can be turned so as to give a greater or less degree of twist to the saw at each side of the "stuff" under operation, which has previously been lined out according to the required bevels and curves. The attendant adjusts the saw-bar and pulleys, and at the same time regulates the twist of the saw in such manner that it is made to follow the marking-out lines.

The saw-bar, with pulleys, can be fixed so that the work can be sawn without bevels, as in an ordinary horizontal band-saw machine, or the pulleys may be placed in opposite positions, to cut spiral or helical pieces. The table to which the balk is secured is of the ordinary kind, and not adjusted to various angles, as the saw renders this unnecessary. Several of these machines are working, notably one at Messrs. Samuda's shipyard, Millwall, and give great satisfaction, fulfilling all requirements well and expeditiously.

Mr. Thomas Greenwood obtained a patent in 1861 for a novel and ingenious band-saw machine, one of which was shown at the London Exhibition of 1862 by Messrs. Greenwood & Batley, of Leeds. This machine is now in constant use for cutting curvilinear, bevel, and twisted work. The saw-pulleys are carried by a vertical segmental standard, capable of axial movement on its supports, and a rack is fitted to this standard, into which gears a worm, to give the canting or axial motion. By this means the direction of the cut of the saw is determined, and it can be adjusted to make a vertical or diagonal cut at pleasure. The gearing of the canting motion is self-acting, and comprises a friction disc—for

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SAWING MACHINES FOR BEVELLED TIMBER.

CONSTRUCTED BY MR. S. W. WORSSAM, 7 AND 8, IDOL LANE, LONDON, E.C.

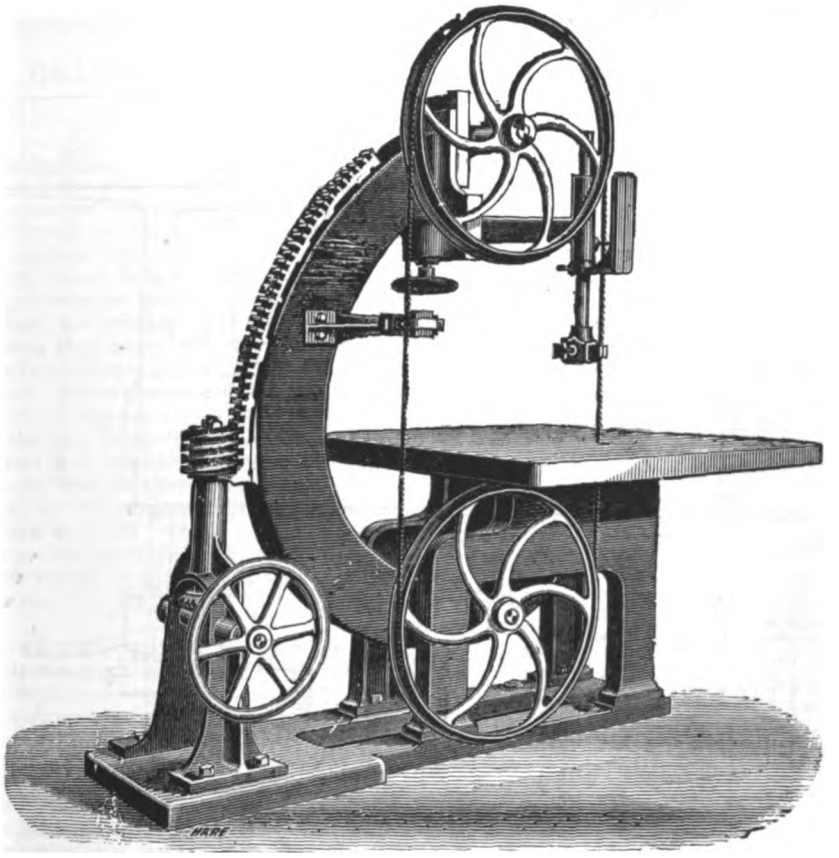


FIG. 1.

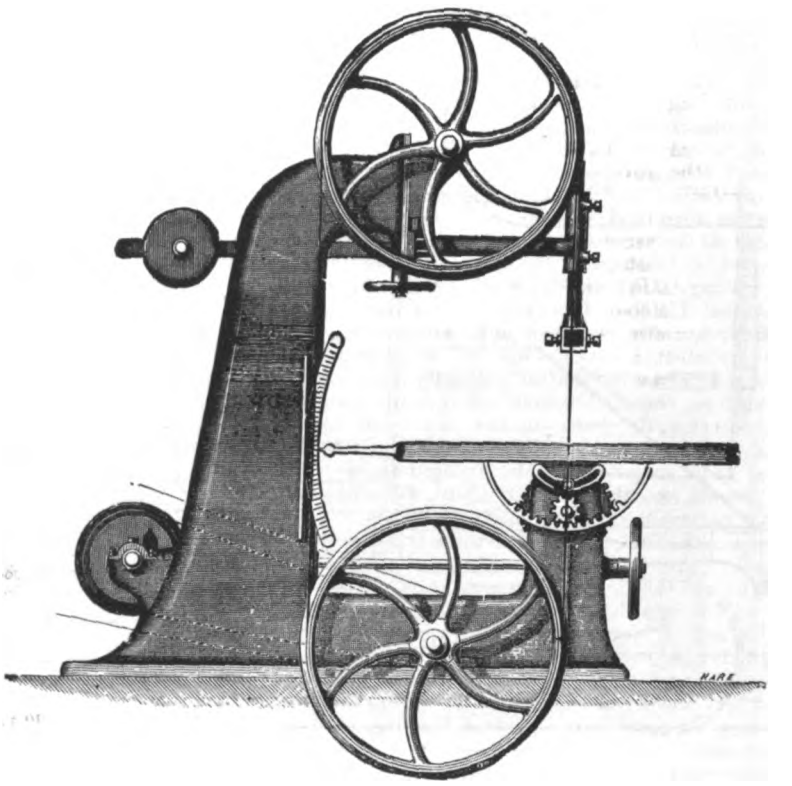


FIG. 2.

varying the rate of motion—and cone pulleys. The inclination of the saw is variable whilst working, a graduated index being provided to show the degree of inclination. The table of the machine is a fixture, and does not cant, as in ordinary machines. This machine has been found highly serviceable for light ships' work, such as bow-ribs and stringers, which have to be sawn in double curvature to suit the bilge of the boat from the keel upwards, and also adapted to the inward curves of the bow. The desired curvatures are marked out in degrees on the stuff at intervals, each degree expressing the successive angle of obliquity. The standard, with saw, is then slowly swivelled on its fulcrum to the successive degrees as the stuff advances. The graduated scale fitted to the machine shows the respective angles of the saw.

The illustration Fig. 1 represents a somewhat similar machine to the one just described, designed by Mr. Samuel W. Worssam, engineer, 7 and 8, Idol Lane, London, E.C., several of which are in operation. The standard carrying the saw pulleys is capable of canting or axial motion, regulated by hand through the medium of a quadrant, worm, bevel gear, and hand-wheel at the back of the standard. An important feature of this machine, and one which, it is claimed, makes it superior to any other, lies in the fact that the centre of radial motion, or axis of the standard, is struck from the surface of the horizontal table at the point where the saw passes through it, and ensures the latter working at any angle through a centre which remains constant, thereby obviating the necessity of altering the saw guides above and beneath the table, or the table itself, each time the angle of the saw is varied, as must be done in another machine we shall hereafter describe.

As in the preceding case, the angle of the standard and saw may be varied while the saw is at rest or while running. In consequence of the constantly changing position of the driving pulleys of the machine, an adjustable counter-shaft or strap-tightening pulleys are necessary for driving it.

In 1878 Mr. Knowling took out a patent for a canting standard band-saw machine differing from either of those just alluded to, in having the standard pivoted on the spindle carrying the lower saw pulley, and the table movable in a horizontal direction instead of being fixed. The principle of this machine is similar to the preceding, but it has a grave defect in that the saw does not pass through the table at a fixed point irrespective of the angle of the table. This defect is not of importance for straight bevelled pieces, which can be lined out at the ends, but it renders the machine useless for cutting varying bevels.

Fig. 2 shows another design of machine for this class of work. Here the table is canted by self-acting motion, and the standard is a fixture. This plan may suit very well for light work, but for heavy work it is not so well adapted, because of the difficulty of holding the balk in position on the table when this is at rest or working at an angle. The machine is constructed after the ordinary manner, as far as the standard, saw pulleys, guides, &c., are concerned, but the table is fitted underneath with a toothed quadrant into which gears a gun-metal pinion, keyed on a spindle carrying a worm-wheel. A spindle or shaft, having at one end a worm gearing into the afore-mentioned wheel, and at the other a bevel wheel in connection with others, and cone pulleys, serves to cant the table. A clutch between the bevel wheels serves to arrest the motion of the table or to angle it in either direction. A scale of degrees is marked on a plate affixed to the standard, and, with a pointer or index finger on the table, indicates the position and swivelling course of the latter.

Double canting-standard band-saw machines have been designed for sawing the bevel edges of cask staves, but are not now in use. This work can be done with less expense by other methods. As we have before remarked, there is practically no end to the adaptability of the band-saw. For nearly half a century after its invention this interesting cutting instrument lay practically useless, whilst at present it is invaluable, not alone for light wood sawing, for which it was in the first place intended, but for the conversion of large balks of timber, straight and bevelled, for sawing metal, and with a knife edge blade for cutting cloth, linen, leather, paper, skins, and other materials.

GERMAN IMPRESSIONS OF AMERICAN IRON AND STEEL INDUSTRIES.

THE Iron and Steel Institute on its recent American trip was, it will be remembered, accompanied by 140 representatives of the Society of German Ironmasters. It is interesting, therefore, to note that at the general meeting of this Society at Düsseldorf a complete record of the excursion was laid before the members who were not fortunate enough to be able to take part in it. The reports were entrusted to various members, a general introductory narrative of the trip being furnished by Mr. A. Thielen, who acted in America as President of the Society. The report on American blast furnace practice was written by Messrs. J. Schlink and A. Schilling, and that on rolling mills by Mr. A. Spannagel. The remaining reports were postponed until the next meeting. The list includes reports on the Northern excursion, by Mr. H. Brauns; on steel manufacture, by Mr. R. N. Daelen; on metallurgical machinery, by Mr. E. Klein; on foundry practice, by Mr. Haedicke; and on railway practice, by Mr. Macco. The meeting excited considerable interest, and was attended by some 600 members.

In the introductory address, Mr. Thielen gave an interesting account of the whole excursion. When the party divided at Chicago forty-five of the German visitors selected the Northern trip, and sixty the Southern. Mr. Thielen selected the latter. The impression the iron industry of the South made upon him was very variable. In some places he saw the very latest improvements; in others, however, he saw nothing but antiquated practice, frequently with the evident object of earning money as rapidly as possible with the least expenditure of capital. Financially the industry is not nearly in such firm hands as that of the North. Indeed, there can be little doubt that many of the mines and works are still in the hands of speculators ready to sell at any moment. The cost of production of the iron ore is 2s. per ton. Coal, usually of good smelting quality, is obtained quite as cheaply. There is an abundant supply of negro labour, and the climate is apparently not unhealthy. It is thus evident that the cost of production of pig iron cannot exceed 26s. to 51s. 6d. per ton. The pig iron contains 2 to 3 per cent. of silicon and 0·4 to 0·6 per cent. of phosphorus, and is now used almost exclusively for foundry purposes. There is no doubt, however, that with proper application of modern processes, steel of good quality might be made.

In his report on the production of pig iron in the Northern States, Mr. Schlink began by pointing out the rapid growth of the American iron trade. The production of pig iron in the United States in 1889 amounted to 7,725,755 tons, compared with 8,377,261 tons in the United Kingdom and 4,525,000 tons in Germany. He then discussed the sources of iron ore supply, and described some of the leading iron works. The enormous daily output of 335 tons from one furnace, as obtained at Carnegie's works, is, he points out, the exception and not the rule. In 1889 there were in the United States 169 furnaces, using coke, in blast, the average daily output being 101 tons, whilst that of the anthracite furnaces and of the charcoal furnaces were 58 and 28 tons respectively. These are figures that need cause no anxiety. All the large American works are intended for the production of rails. It would be

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THE "MOGUL" LOCOMOTIVE.

CONSTRUCTED BY MESSRS. BURNHAM, PARRY, WILLIAMS & CO., BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, U.S.A., FOR THE JAPANESE GOVERNMENT RAILWAYS.

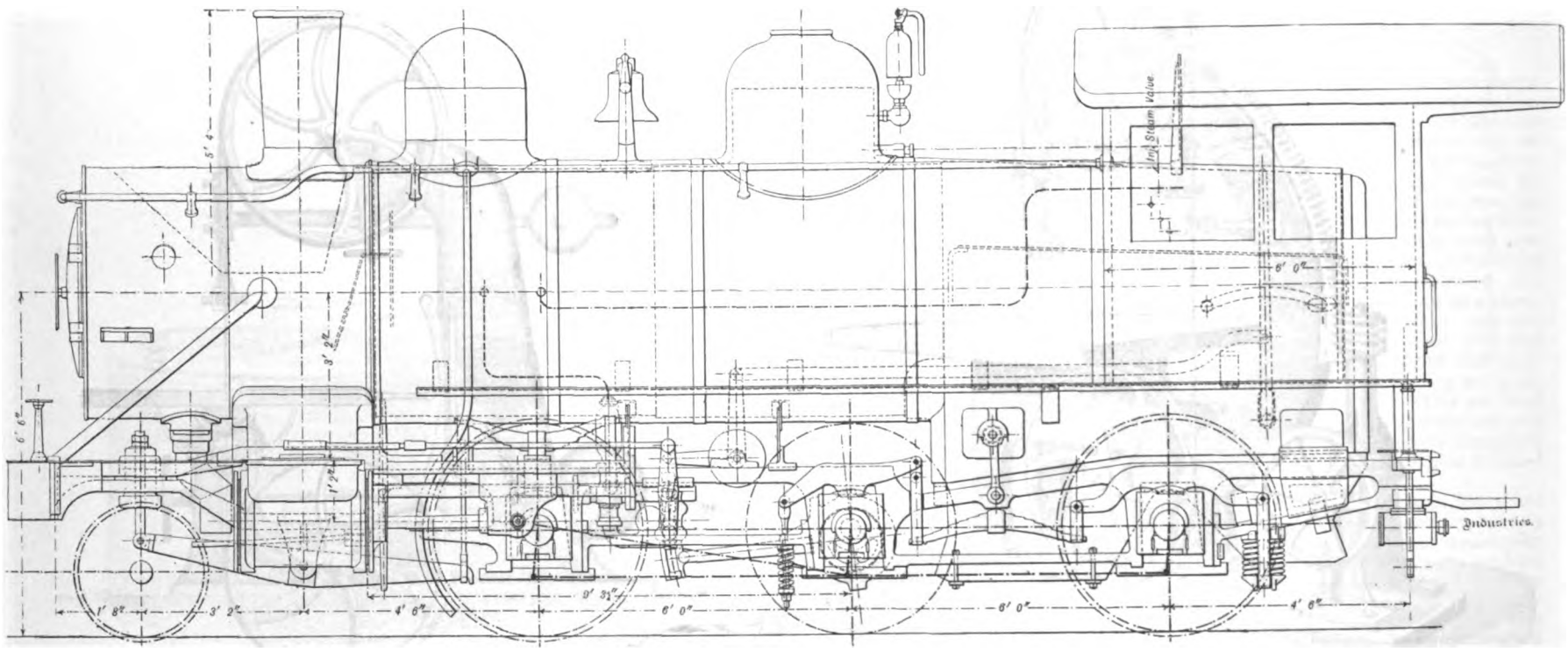


FIG. 1.—SIDE ELEVATION OF ENGINE.

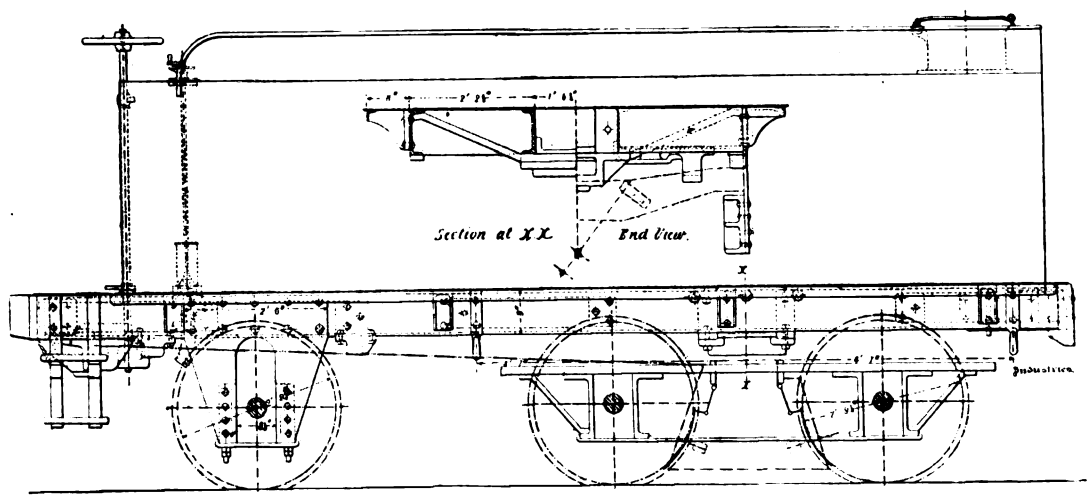


FIG. 2.—SIDE ELEVATION OF TENDER.

impossible to adopt American practice in German works, as the pure ores are wanting, and there would be not sufficient demand for the rails produced. The Lake Superior ores, it will be remembered, contain 6 to 8 per cent. more iron than the Spanish "campanil," now unfortunately unavailable. In conclusion, Mr. Schlink points out that the daily wages of furnace-men at the South Chicago Works average 8s. 8½d. The wages, with a furnace producing 175 tons daily, amount to 4s. 5d. per ton of pig iron, whilst with smaller furnaces they increase to 6s. and more.

In his report on the iron industry of the South, Mr. Schilling pointed out that it was not so highly developed as that of the North, coke blast furnaces having been in operation for not more than twelve years. At Birmingham, in Alabama, the centre of the industry, iron ores, coal, and limestone occur in close proximity. The ores smelted are partly red hematites (red iron ore and Clinton ore) and partly limonites. The former are of chief importance. They occur in Silurian limestone, and have the following percentage composition :—

	Soft Ore.		Hard Ore.
Silica	15 to 18	.....	8
Alumina	3	.....	5
Lime	1	.....	28
Phosphorus.....	0·26 to 0·9	.....	0·2 to 0·8
Iron.....	48 to 52	.....	40

The ore is mined by contract, 1s. to 1s. 8d. being paid per ton for soft ore, and 1s. 8d. to 2s. 6d. for hard ore. The brown iron ore contains so much admixed clay that it has to be washed. It then contains 46 to 52 per cent. of iron. The coal of the Warrior Coalfield is 6ft. to 14ft. thick, and the coke obtained from it contains a considerable quantity of ash. The operatives at the mines and works are almost exclusively negroes, who are found to be unintelligent and difficult to deal with, as they will not work except to obtain the bare necessities of life. The wages are 4s. to 6s. per day. In conclusion, the various blast furnaces throughout the region are described, and the rapid development of the iron industry pointed out. In 1878 the first coke blast furnace was built. Now Alabama produces 780,000 tons of pig iron, of which quantity the Birmingham district yields 75 per cent.

In his report on the American rolling mills, Mr. Spannagel gave a lengthy account of the various works visited. The enormous advantages presented by natural gas in the Pittsburgh district were pointed out. The gas is paid for, in the case of puddling furnaces, at the rate of 6s. per ton of iron produced, and, in the case of boilers at the rate of £10 to £20 per month. At the Philadelphia works at Pittsburgh the consumption of gas amounts to 182,400,000 cubic feet daily, the quantity of coal thus replaced amounting to 10,000 tons. In conclusion, Mr. Spannagel discusses the rolling of tubes in the United States. As it was not permitted to visit these works, his data are based on observations made by Mr. Bendix Meyer, Director of Huldschinsky's Tube Works at Gleiwitz. The American works, he considers, are in advance of the European ones in many points, notably in the amount they produce. He estimates the daily production of the chief works to be as follows:—

	Tons.
National Tube Works	500
Pennsylvania ,, ...	250
M. Clean ,, ...	200
Pittsburgh ,, ...	200
Reading ,, ...	200
Total	1,350

This total is exclusively gas and oil pipes, and is about five times as great as the production of all the German works. Whereas in Germany the lap-welded pipes are usually sent three times through the rolls, in America it is found sufficient to weld the pipe in one heat, and then to pass it for calibration through rolls placed at the side.

An interesting discussion followed the reading of these reports. Dr. Wedding described various methods of transporting and loading material, notably at South Chicago Works, where ore has to be transported from the ship to the works in sufficient quantity to yield 1,600 tons of pig iron daily. The plant employed for this purpose was constructed by the Brown Hoisting Company, of Cleveland, Ohio. The greater portion of the discussion that followed related to the comparative cost of labour in Germany and America.

AN AMERICAN LOCOMOTIVE FOR THE JAPANESE GOVERNMENT RAILWAYS.

WE give above and on pages 149 and 156 illustrations and particulars of a "Mogul" locomotive, constructed by Messrs. Burnham, Parry, Williams, & Co., of the Baldwin Locomotive Works, Philadelphia, U.S.A., for the Japanese Government Railways. Fig. 5 (see page 156) represents a general view of the engine and tender; Figs. 1, 2, 3, and 4 represent a side elevation of the engine, a similar view of the tender, an end view partly in section of the driver's cab, and a section of the locomotive respectively. It will be observed from the illustrations that the engine has three pairs of driving wheels coupled—an arrangement found necessary to give the engine the requisite tractive force, as the engine has to run over a moun-

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tainous country—and in front a two-wheeled bogie truck with swinging bolster and radius bar. The engine has two cylinders, 18in. diameter, with a stroke of 22in.; the diameter of the driving-wheels is 48in., and the total wheel base 19ft. 6in. The smoke-box is of the extended pattern, and is provided with netting, deflecting plate, and spark ejector. The cylinders are placed outside, and are fitted with cast-iron pistons, having brass rings.

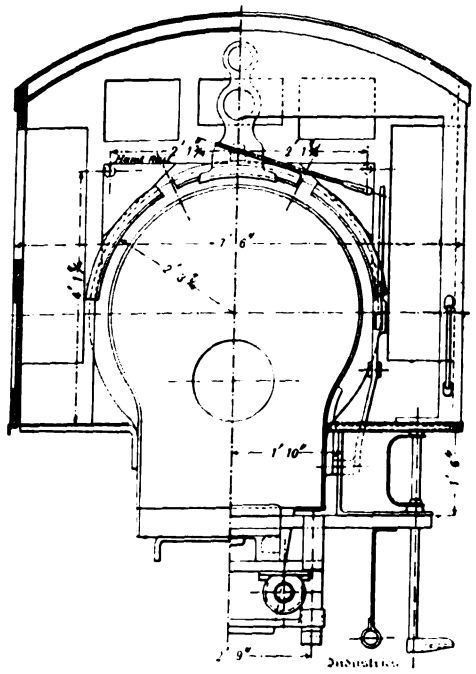


FIG. 3.

The piston rods are of steel, and are keyed to crossheads of the same material. A shifting link motion, adjusted to cut off the steam equally through a wide range of the stroke, and balanced slide valves, are provided. The tender at its fore end runs on a pair of wheels 33¼in. diameter, and at its rear end is supported by a four-wheeled centre-bearing truck, with square forged wrought-iron frames. A tank constructed of channel iron, and having a capacity of 2,600 gallons, is carried by the tender.

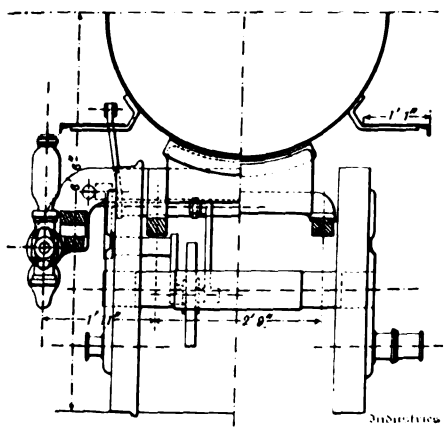


FIG. 4.

One of these engines has recently undergone a series of severe tests in Japan over the hilly country between Gotembo and Numadzu, a distance of fifteen miles, in which there is a total rise of 1,500ft., with gradients varying from 1 in 60 to 1 in 40. This journey, we are informed, was accomplished at the rate of eight miles per hour, under the supervision of Mr. F. H. Trevithick, locomotive superintendent. The leading particulars of the engine we illustrate are given in the accompanying table:—

LEADING PARTICULARS.

	Ft.	In.
Cylinders—		
Diameter of cylinders	1	6
Stroke of pistons	1	10
Length of steam ports	0	16
Width " "	0	1¼
Length of exhaust ports	0	16
Width " "	0	2¼
Axles—		
Diameter of driving axle	0	7⅛
" truck axles	0	5
Wheels—		
Diameter of driving wheels	4	0
Width " " tyres	0	5½
Thickness " " "	0	3
Wheel base—		
From centre of truck to centre of front driving wheels	7	8
Between centres of first and second pair of driving wheels	6	0
Between centres of second and third pair of driving wheels	6	0
Total wheel base of engine	19	8
" " " and tender	40	0
Boiler (steel)—		
Height of centre of barrel from rails	6	6
Minimum inside diameter of boiler	4	7
Maximum " "	4	9
Thickness of plates of boiler	0	0⅜
Pitch of rivets	0	3¼
Fire-box (steel)—		
Length	7	5½
Breadth	2	5⅜
Depth at front	4	8
" back	3	11
Tubes (charcoal iron)—		
Number of tubes, 201		
Length "	10	9
Outside diameter of tubes	0	2

	Sq. ft.
Heating surface of tubes	1,122
" " fire-box	109
	1,231

Working steam pressure, 140lb. per square inch.
Weight of engine, 40 tons.
Gauge of road (clear between rails), 3ft. 6in.
Capacity of tank on tender, 2,600 gallons.

NAPHTHA ENGINE FOR PUMPING PURPOSES.

CONSTRUCTED BY THE GAS ENGINE AND POWER COMPANY, NEW YORK, U.S.A.

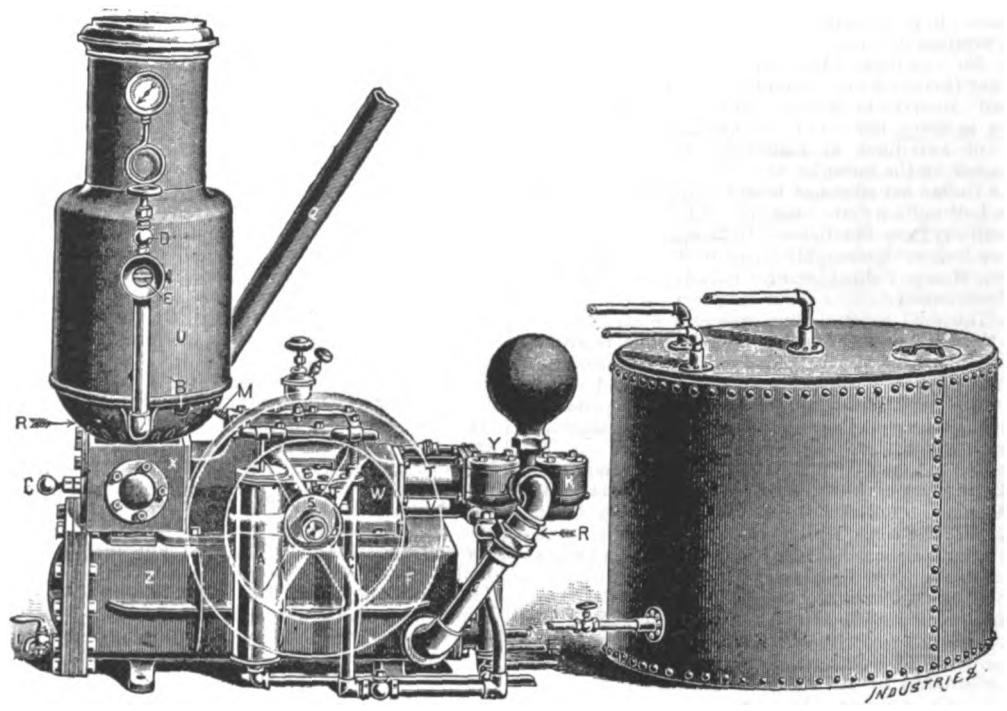


FIG. 1.

NAPHTHA ENGINE FOR PUMPING PURPOSES.

THE above illustrations, Figs. 1 and 2, represent a general view and part sectional view of a two horse-power naphtha pumping engine, capable of pumping 1,000 gallons of water per hour, constructed by the Gas Engine and Power Company, of Morris Heights, New York. The operation of the engine is as follows:—To start the engine the naphtha gas is first forced by the air-pump A (Fig. 1) from the tank to the gas burner M, when it is ignited at the hole B in the base. After the retort U has been heated, liquid naphtha is drawn by the hand-pump C from the tank, and forced into the retort at the inlet R, and converted into gas under pressure. The injector valve D is then opened, delivering gas to the base burner B, and the pump started, the intensity of the flame being regulated by the damper E. The further action of the engine is automatic, as the naphtha pump V forces a continuous supply of naphtha to the retort, which drives the expanded gas to the pressure cylinder

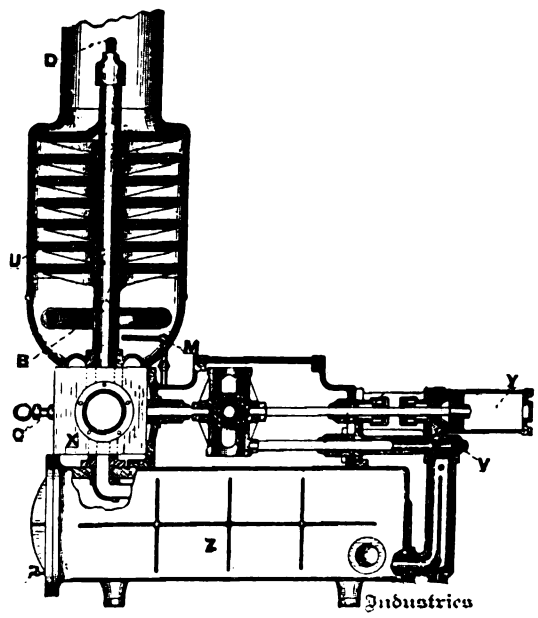


FIG. 2.

X, driving the piston and its attachments, and is then exhausted into the condenser Z to be condensed, after which it is again taken up by the pump V and forced to the retort U. As its volume is being constantly diminished by the amount used in the burner B, a second feed pipe or "make-up" is attached to the pump V, and supplies this constant loss. The water-pump Y is of the ordinary double-acting type, and needs no explanation. We are indebted for our illustrations to our American contemporary, the *Iron Age*.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 10th February, 1891.

Iron.—There has been no change worthy of note in the general state of the iron market during the past week. The outlook continues good, especially as regards the building industry, but the demand has not yet made itself felt, and prices remain the same as those of the previous week. In one or two instances business has been transacted at the exceptionally low prices of 125s. a ton for bars and 133s. a ton for joists. Reports from the provinces show a tendency to greater firmness in general without any advance in prices. The price for castings—112s. 6d. per ton—remains unchanged, but there is a fair amount of activity in the Haute Marne and Meurthe-et-Moselle districts. The Conseil Général de la Seine has voted a concession for the construction of two lines of tramways, with mechanical tractive power, in the suburbs of Paris. The administration of the Indian colonies has been empowered to borrow two and a half million francs towards the construction of a line of railway from Pondicherry to Tirupapaluir. A contract for an iron bridge weighing over 10,000 tons has been secured by Messrs. Schneider, of Creusot, from the Roumanian Government.

Coal.—The coal market continues very firm. Reports from the Northern and Central mining districts testify to a great amount of activity, and even to the opening of new shafts. It is with difficulty that the demand can be supplied even now that the waterways are re-opened for traffic, since consumers in general are anxious to replenish their stocks, which were almost exhausted.

Copper, Tin, Lead, and Zinc.—The copper market is very dull and prices have fallen since last week. Best Chilian bars are quoted £57*s* 5*s*., and ordinary Chilian bars at £55 5s. the ton. Tin has fallen; Billiton is quoted at £96 10s., and Banca £98 10s. the ton. The lead market remains stationary, and, although there is little doing in zinc, quotations continue to hold firm.

Cupolas for Frontier Defence.—The Belgian Government has given an order to Messrs. Schneider, of Creusot, for two cupolas for frontier defence. This makes a total of twelve ordered by the same Government from Messrs. Schneider. The order for these two last was not confirmed until the results of the trials of the cupolas furnished by other firms in France and Germany had testified to the superiority of the Creusot type.

The Short Time Question.—A report has been handed into the Chamber of Deputies of a census taken of workmen in the Department of the Seine in order to ascertain their individual views with regard to the legal control of the hours of labour, and as to what number of hours should constitute the working day. Out of a total of 21,394 there were 5,419 for the eight hours system without any overtime; 1,513 were for eight hours with overtime, 1,247 for the day of nine hours, 7,010 for ten hours, and 429 for eleven hours and over. Of the above over 72 per cent. were for a legally limited working day.

BERLIN, 9th February, 1891.

Prize Essays on the Removal of the Smoke Nuisance.—In order to ascertain the present state of our knowledge with reference to appliances for the abatement of the smoke nuisance, the Association of German Engineers (*Verein Deutscher Ingenieure*), Potsdammerstr. 131, Berlin, W., has offered 8,000 marks in prizes for two essays. The subject of the first essay, which is to be sent in before December 1st, 1892, is "The Appliances Employed in Steam Boilers for the Attainment of a Smokeless Consumption of Fuel." The subject of the second essay, which is to be sent in before December 31st, 1894, is "The Appliances which have been hitherto employed, both for household and business purposes, for the Attainment of Smokeless Consumption." The writer of the second essay is to deal with the subject of appliances for steam boilers only in so far as it immediately concerns his own subject. Each essay must contain, besides a short examination of appliances used in the past, a thorough criticism of those now in vogue in the countries dealt with. Especial importance will be attached to an exact statement of the amount of success which has attended regulations made in the various countries, districts, and towns for the abatement of the smoke nuisance. The appliances described in the essay are to be illustrated by drawings, and the committee of judges are empowered to offer 1,000 marks for the drawings in addition to 3,000 marks for each of the two essays. The competition for either of the prize essays is not restricted by nationality. Committees of experts have been appointed to make the awards for each of the prize essays.

Strikes in Germany.—From a recent Government report we learn that, in the period from January 1st, 1889, to April, 1890, no less than 1,131 strikes took place in the German Empire, affecting 394,440 men. As regards the results of the strikes, the men obtained their entire demands in 187 cases, and partly so in 468 cases, while in 420 cases they were entirely unsuccessful. As to the remainder, details had not been obtained in time to include them in the report. As regards the different branches of industry affected by the strikes, mining claims about 48 per cent. of the strikes, which is followed by the building trade with 18 per cent., the textile industry with 12 per cent., the iron trade with 4 per cent., and miscellaneous with 17 per cent.

Electric Lighting at Lockstedt.—The Common Council of Lockstedt, near Altona, which has over 2,000 inhabitants, has decided to introduce a system of electric lighting in the streets of the town. The carrying out of the installation has been entrusted to the Thomson-Houston International Electric Company of Hamburg.

Shipbuilding in Germany.—During the past year were built in the shipyards in Stettin 238 ships, with 18,400 registered tons gross tonnage. At the beginning of this year twenty-three ships were in the course of construction, among them a double-screw fast steamer of 11,600 tons displacement for the Hamburg-American Mail Company, and two armour-plated corvettes of each 1,000 tons for the Imperial Navy, which are being built by the "Vulcan" Company.

VIENNA, 9th February, 1891.

The Iron Market.—The condition of the iron market remains unchanged. In the Bohemian market there was a tendency towards better prices, in consequence of an increased demand for iron for agricultural purposes, and large quantities have been taken from the market. There is a brisk demand for axles, and prices tend to increase. Foundry goods have a lessened sale, but prices remain unchanged. The prices of wire and wire nails are to be raised shortly by the Bohemian Syndicate. A discussion between Austrian and German manufacturers with regard to their respective spheres of trade has been followed by the export of German iron into Bohemia, the prices, including customs duties, being lower than those of the syndicate. Sheets, both black and tinned, have a good sale, and prices are firm. In Hungary the situation is improving, especially as regards refined iron. Consumers expect an important decrease in the price of pig iron, and are at present unwilling to buy. The present price of pig iron in Hungary is 5·75fl. per 100 kgrs. Prices at Vienna for best qualities are:—Bar iron, 13fl.; black sheets, 16fl.; boiler plates, 19fl.; tinned plates, 32fl.; and sleepers, 12·5fl. per 100 kgrs. The price of Titna pig iron is, for home products from 46fl. to 59fl. per ton, Scotch Coltness (in Vienna) 72fl., and English Clarence 62fl., ingots, 92fl. per ton.—The recent negotiations between the Austrian and German manufacturers were caused through the expiry of an agreement, which lasted up to the end of last year, that German rolling mills should not traffic with Austria nor Austrian rolling mills with Germany. This agreement has not been renewed, and the market for German rolling mills has been considerably widened. Both from the Ruhr and from Bohemia it is announced that the traffic of the Rhine district and Westphalia with Bohemia has become much more active.

The Coal Market.—The active market and the difficulties of traffic encouraged the Silesian coal mines to raise their prices. Although these difficulties have now been overcome, prices are well maintained, since the demand for coal, both for industrial and for household purposes, shows a tendency to increase.

Designs for New Railway Station.—The Warsaw-Vienna Railway Company, at Warsaw, Russia, has offered prizes for competitive designs for a new station at that city. There are to be prizes of 3,000, 2,000, and 1,000 roubles for the best three designs respectively, and three additional prizes of 500 roubles each for three designs next in the order of merit. Detailed information can be obtained by addressing the company at Warsaw.

DÜSSELDORF, 10th February, 1891.

The Iron Market.—Prices of pig iron remain unaltered. There was a brisk demand for spiegel iron, and for wrought iron there was an active inquiry. For rolled rods there is no great alteration in the market, and the business in both coarse and fine sheet iron was also quiet. The stock of foundry pigs at the end of December, 1890, was 23,736 tons. The prices of iron are—For 10–12 per cent. spiegel, 58-60 marks; pig iron, No. 1, 75 marks; No. 3, 63 marks; Thomas pig, 49 marks; and Bessemer, 75 marks; wrought iron, 170 marks.

The Coal Market.—The want of waggons which was reported last week continually increases, and great discontent is expressed with Mr. Maybach, the traffic manager.

Transportation Difficulties.—Although the ice on the Rhine has fortunately disappeared without causing any material damage, the injury done to trade and traffic is by no means at an end. The blast furnaces have no raw material, and one in the possession of Messrs. Krupp, at Duisburg, has been blown out for want of ore. A similar consequence is feared at the works of the Vulcan Company Limited.

Accidents.—The accident at the Hibernia mine has now claimed fifty-three victims. This is the third accident which has occurred at the same seam within the last few years. At the works of the Bochumer-Verein a ladle has been upset, and eight workmen were more or less severely wounded.

General Engineering.—The well-known Humboldt machine-making company is about to add to their establishment a new department for the construction of electrical machines.

Steam Boilers and Engines in Prussia.—The official record gives the following figures relating to steam boilers and engines in Prussia:—

	1889.		1890.
Stationary boilers	47,151	...	48,538
Stationary engines	45,192	...	46,554
Portable boilers and engines	12,177	...	12,822
Marine boilers	1,836	...	2,046
Marine engines	1,674	...	2,007

The boilers and engines of the imperial marine and locomotive engines are not included. The important increase in the number of the marine engines is to be attributed to an alteration in the manner of recording.

Electric Transmission of Power.—The Oërlikon Machine Works have acquired at the village of Hochfelden, in the Glatt valley, water power which will be sufficient for driving two turbines, each of from 200 h.p. to 300 h.p. Electricity will be generated at Hochfelden, the pressure being 25,000 volts, and transmitted to Oërlikon, a distance of twelve miles, by means of overhead wires supported on 40ft. poles, alongside the railway and the country roads. There will be four cables, each 4 mm. in diameter, of which one will serve as a reserve. At the works the pressure will be reduced to 50 volts, and the power will be utilised for driving the whole of the machine tools in the establishment.

AMSTERDAM, 9th February, 1891.

The Mail Contracts.—The Government has been defeated in the Lower Chamber upon the question of the new mail contracts with the "Nederland" and Rotterdam "Lloyd" Steamboat Companies, as the Bill embodying those contracts—of which particulars were published in *Industries* (see Vol. IX., page 556)—was rejected by a small majority. Numerous members were of the opinion that the Government had not made such an advantageous bargain with the steamboat companies as it professed. They also opined that a period of fifteen years was too long for such contracts. The Ministers contended that a centralisation of the double service of steamers between Holland and Insulind, so as to obtain regular weekly sailings in the two directions, had become a necessity, especially in the face of the severe competition with foreign steamboat companies which draw increased and increasing State subsidies. The Government received a defeat, and the difficulty now will be how to deal with the matter before July 1st next, upon which date the present arrangements will come to an end.

New Exhibition.—In 1892 there is to be a second International Exhibition in Amsterdam of appliances to minimise dangers to life and limb in factories and workshops. The first one took place last year, and was a great success. It led to the establishment of a permanent association having the same objects in view.

Canadian Poplars in Holland.—The Dutch Society for the Reafforestation of Heaths has obtained a large supply of cuttings of Canadian poplars from North America, through the medium of the Dutch Consul-General at New York, for distribution among agriculturists generally. The twofold object is to reafforest heath, and to replace the native poplars which are being decimated by a strange disease, supposed to have its origin in the impoverishment of the soil.

STOCKHOLM, 7th February, 1891.

Present State of the Iron Market.—The dulness in the foreign iron markets still exists, and the difficulties besetting the industry in Sweden have not been overcome. Although the prices for coal and cokes are firm, the quotations for iron are weaker, and there is little inclination to buy at present. Foreign buyers are well stocked with pig iron, more so than with manufactured iron, but they are holding back. The following official base prices per ton are agreed upon:—

	F.o.b. Gothenburg.		F.o.b. Stockholm.
Ordinary hammered iron	£8 0 0	...	£8 0 0
Ordinary rolled iron	8 5 0	...	8 0 0
Fine rolled iron	8 15 0	...	8 10 0

The Production of Iron.—The comparatively young Society of Swedish Ironmasters bids fair to prove a useful institution, and its work has already resulted in bringing about a greater uniformity in prices and in the collection of some instructive statistics. These were laid before the first quarterly meeting this year, which took place at Orebro. The production during the last two years is given in the following tables:—

	1889.		1890.
Pig iron	421,176 tons.	...	435,522 tons.
Blooms	228,546 ,,	...	227,786 ,,
Bessemer ingots	80,614 ,,	...	92,247 ,,
Martin ingots	54,613 ,,	...	67,779 ,,

During the two years there have been in operation:—

	1889.		1890.
Blast furnaces	150	...	145
Furnaces	404	...	396
Bessemer converters	25	...	23
Martin works	23	...	26

The shipments during last year were as follows, as far as some of the more important articles are concerned, the figures for 1889 being added for comparison's sake:—

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	1889. Tons.	1890. Tons.	During 1890. Decrease. Tons.	Increase. Tons.
Pig iron	79,175	59,931	19,244	—
Ingots	8,530	8,060	470	—
Blooms	16,596	12,991	2,605	—
Other hammered and rolled bars	200,244	185,468	14,776	—
Ends of bars	5,924	3,978	1,946	—
Wire iron	4,166	4,971	—	805
Plate iron	5,717	6,982	—	1,266
Nails	2,167	2,461	—	294

ANALYSIS OF STATISTICS.—A proportionate share of the decrease in exports affects the last quarter of 1890. The aggregate decline in the shipments of the above articles during 1890, as compared with 1889, amounts to 36,676 tons. Of this quantity pig iron accounts for 19,244 tons, and rolled and hammered bars for 14,776 tons. Considering the larger production of pig iron and the smaller export one might naturally expect the stocks of this commodity to show an increase. Such increase has, however, been considerably discounted by the much greater production of steel. The increase in the manufacture of steel during 1890 over that of 1889 amounts to an aggregate of 24,799 tons, of which 11,633 tons are Bessemer ingots and 13,166 tons are Martin ingots. With regard to warrants, there is a decrease of 1,813 tons, as compared with the figures at the end of last year.

STAFF OF THE SWEDISH STATE RAILWAYS.—The Swedish State Railways have a staff at their various offices of fifty-seven men, their aggregate pay amounting to 141,840kr. annually. The "line" section comprises 1,671 persons, and their annual pay amounts to 1,079,740kr. The traffic section consists of 2,847 persons, with an annual aggregate pay of 2,791,280kr. The machine section comprises 1,077 persons, with an annual pay of 1,213,060kr. Altogether, the Swedish State Railways have in their employ 5,652 persons, with an aggregate annual pay of 5,225,920kr.

CHRISTIANIA, 7th February, 1891.

TEXTILE INDUSTRIES.—The wool industries in Norway have, on the whole, done well during 1890, and not only have several new works been commenced, but many of the older establishments have been materially extended. The result of the increased production, and of the keener competition from Sweden, where the textile industry is advancing very rapidly, was a duller tendency in cloth goods during the latter part of the year. In consequence sales rather dragged, and some little time will elapse before trade finds its proper level. Many small mills, which are chiefly intended for local requirements, have done well during the past year. The cotton industry is steadily progressing, and, although no large installation has been completed during 1890, several of the existing establishments have extended their business. The import of cotton has been somewhat larger during 1890 than during the previous year. The export of cotton goods has been larger during last year than during the previous year; it takes place to Denmark only. A quantity of coloured goods have been exported to Sweden.

COPENHAGEN, 7th February, 1891.

WATER WORKS AT COPENHAGEN.—The important extension of the Copenhagen Water Works comprises more efficient arrangements for obtaining water, and will give additional pumping installations to the town. The supply of water from the Söndersö lake will be increased to 130,000 barrels per diem by means of new borings. Several of the old bore holes have collapsed through the destruction of the iron pipes from rust and wear and tear, so that the daily supply of water has been reduced to some 40,000 barrels. The new borings comprise eight holes, made to 6in. wrought-iron pipes, in which 4in. cast-iron pipes are inserted. This arrangement, which has been made with a view to durability, will probably yield a great increase of water at a moderate outlay, and will allow of further extensions. If these extensions should be largely increased, it will, however, be necessary to enlarge the pumping station at Söndersö, and to increase the capacity of the pipes from that place to the town.

CONTRACT FOR STEEL RAILS.—A contract which was given out last month for the supply of 5,790 tons of steel rails for the Danish State Railways has been secured by an English firm.

MADRID, 9th February, 1891.

IMPORTS AND EXPORTS OF ORES AND METALS.—According to the Custom House returns for 1890, the imports of coals from England were 1,444,174 tons, which shows an increase of 108,745 tons over the previous year. Of coke there were 276,814 tons imported, which shows a decrease of 2,330 tons. The total export of iron ores was 5,648,811 tons, or an increase of 597,198 tons. The export of pig iron amounted to 67,446 tons, and the imports were only 34,324 tons. The imports of wrought iron and steel amounted to 69,261 tons, or about one-half of the total quantity used, which is very small relatively to the population. The export of copper ore, which consists almost wholly of pyrites, was 680,277 tons, or a decrease or 118,000 tons, but this is compensated for by the export of 38,934 tons of copper as metal, most of which was in the form of precipitate. The export of lead amounted to 140,661 tons. This result differs from that given by other technical journals, which from insufficient data stated the total production of lead as 120,000 tons.

TRAMWAY EXTENSION.—A concession for a new line of tramway has been granted to the English Company, which already owns the best lines in Madrid, and the work is to be finished without delay. The assistance rendered to the Government during the elections by the employés of the company is said to have procured the concession.

THE GENERAL PHOSPHATE COMPANY.—This company, which is a French concern, and owns extensive phosphate beds in the province of Caceres and in the neighbourhood of the capital of that name, is to be dissolved. The assets are said to be scarcely sufficient to pay the secured creditors. The largest creditors are the Portuguese Railway Company, to which a sum of £28,000 is owing for transport, and the Banque de Paris, to which a sum of £20,000 is owing. At the beginning of its history the company was very prosperous, and its dividends sometimes amounted to 20 per cent. The price of phosphates having fallen, the manufacture could not be carried on at a profit. The company then tried the manufacture of superphosphates, but the production was on too small a scale to be profitable. The company was thus obliged either to increase their superphosphate works by the issue of fresh capital to the amount of £25,000, or be dissolved. The latter course has been decided upon, and thus the shareholders will lose the whole of their capital.

ROME, 9th February, 1891.

ELECTRIC TRAMWAYS IN ITALY.—The Italian patent of Foote, of Von Buch, for series-running electric tramways has been purchased by Mr. Cattori, and the first line, by way of experiment, from Piazza del Popolo to Ponte Molle, in Rome, a distance of about two miles, has just been completed. Permission to erect the poles and overhead line was obtained in February, 1890, at which time the installation of the machinery was commenced. The plant consists of one Robey 30 nominal horse-power semi-portable type boiler; two simple high-pressure vertical steam engines of 60 indicated horse-power, with 120lb. steam pressure, supplied by J. G. Statter & Co.; and two series-wound continuous-current dynamos, 52 amperes 850 volts, from the same firm. These dynamos are fitted with a constant-current regulator. The engines and dynamos are in duplicate, one set only being worked at a time, while the other is kept in easy motion ready for emergency. The line, of No. 2 silicious bronze, consists of four wires placed at an elevation of 20ft. from the ground, running parallel with each other at about 6in. apart, and almost direct over one rail. This disposition was considered best, as the contractors were thus enabled to use shunt brackets—the tram line running all the way close to the footpath. The overhead line is divided into as many sections as there are turn-outs, and automatic switches are placed at the breaks to perform the operation of joining up the sections as required on the passage of the cars to ensure the continuity of the line and cars in series. The cars, three in number, are supplied with two motors of 15 e.h.p., each wound in series, this power being necessary to ascend a short hill of 1 in 13. The regulation of the motor is effected by the insertion of more or less resistance as a shunt across the field of the two motors. Thus, when no shunt is in circuit, the motor runs at full speed, this being equivalent to infinite resistance, and with a small resistance of about ·1 ohm the power is reduced to 3 or 4 horse-power, while with a short circuit of the field no power is received and the motors come to rest.

A ROMAN SHIP CANAL.—A commission met in the Prefecture Palace in Rome recently to consider a project which has been presented to the Italian Minister of Public Works regarding the construction of a ship canal from the coast to Rome.

NEW YORK, 31st January, 1891.

THE IRON AND STEEL TRADE.—The outlook for both iron and steel is not very encouraging. There is not a very great amount of business to be done, and as makers generally could take many more orders prices suffer in the competition. In pig iron, notwithstanding the large decrease in output which has been made, the demand is very light. Well-known brands sell with no difficulty in small lots, but concessions must be made on everything else. No. 1 foundry is selling from $17 to $18 per ton, No. 2 at from $16 to $17, and gray forge from $14·50 to $15. The outlook for manufactured iron is no better. The capacity is far in excess of present needs, and it is impossible for mills to get orders for the future. Prices suffer in consequence, but there is little inclination to curtail output, as it is hoped that business will soon improve. Little is doing in steel rails. Prices are maintained at $30 per ton. Many of the roads are holding back their orders in hopes of lower prices. Steel in other shapes has improved. While there is not a large amount being placed in orders, prices have advanced about $1 per ton. Mills have plenty of work, as most of the large consumers have placed their orders at old rates. The production of pig iron in 1890, according to the bulletin of the American Iron and Steel Association, shows an increase of over 21 per cent. over 1889. The total production was 9,202,703 tons of 2,240lb. each. The production for the second half of the year was slightly greater than that for the first, and would have been much larger but for the blowing out in December of many furnaces in the Alabama districts, caused by the strike of the coal miners, and for the financial stringency. The increase for the year was well distributed, Pennsylvania making an increase of 763,927 tons, and Illinois the next largest, of 184,204 tons. The production of Maine, Massachusetts, and Connecticut declined, and Washington made no pig iron in 1890.

TUNNEL UNDER GRAY'S PEAK.—The Atlantic-Pacific Railway Tunnel Company is driving a tunnel under Gray's Peak, sixty miles west of Denver, Col. The enterprise has been ten years in progress, and thus far the excavation, which is an 8ft. by 14ft. heading, has proceeded into the mountain on the east side a distance of 3,000ft., and on the west side a distance of 1,400ft. The total length of the tunnel will be 25,200ft. According to the *Engineering News*, the enterprise is carried on primarily to tap the mineral veins in the mountain, which are claimed by the projectors to be exceedingly rich in silver, lead, and gold. After the tunnel is completed, however, it is intended to enlarge it and open it for railway traffic, and an extension of the Utah Central Railway, to form a through line from Denver to Salt Lake City, is projected. It is claimed that this line will furnish a route from Denver to Salt Lake 200 miles shorter than any existing, and will afford a crossing of the main range of the Rocky Mountains 1,000ft. lower than the Union Pacific or the Denver and Rio Grande. Thus far, about a mile of tunnel, including side drifts, has been driven by hand power, but a plant of ten Rand drills, with Ingersoll air compressors, has just been put in, and an electric lighting plant is soon to follow.

THE DALLES BOAT RAILWAY PLAN.—This plan, for passing the obstructions in the Columbia River, has failed to pass the House Committee on Rivers and Harbours. The boat railway, with its hydraulic lifts, was estimated to cost $2,800,000, and $80,000 annually to operate it. The estimate for locks and canals was $3,754,355. The final outcome of the arguments before the Committee was the endorsement of a temporary portage railway around the obstructions, to cost $431,500.

COLORADO MINES.—The value of the production of Colorado mines for 1890 is $34,871,340, divided as follows: Silver, $25,259,906; gold, $4,512,136; lead, $4,749,852; copper, $349,446. There were 19,443,268 ounces of silver put upon the market, 218,295 ounces of gold, 53,448 tons of lead, and 2,378,139 pounds of copper.

PHILADELPHIA, 30th January, 1891.

THE COAL TRADE.—The anthracite trade is dull, partly due to the season and partly to the exceedingly bad weather, which has practically isolated the larger cities from each other for the past week. There will be a meeting of the representatives of the trade to-day to arrange February shipments, but it is not likely that any attempt will be made to alter prices. The capacity of the mines is now so large that some permanent method of controlling shipments should be adopted. In the census year the mines worked only two-thirds of the year, and even then produced more than the market would take, and it is expected that the production for the present year will reach 39,000,000 tons, or an increase of about 10 per cent.

MINE DISASTER.—An explosion in the "Mammoth" shaft of the H. C. Frick Company's mines near Mount Pleasant, Pa., resulted in the death of 107 miners. The mine had always been noted for the entire absence of fire-damp, and the ordinary open lamp was used. A search party found fire-damp in the shaft, and had to be withdrawn until the mine was well ventilated. All the men at work in that particular shaft were killed. The cause of the explosion is believed to be the opening of a gas pocket, as the fireman had made his rounds shortly before the men went to work.

THE EIGHT-HOUR DAY.—Plans have been completed for the coalminers' struggle for an eight-hour day, which is to be commenced on May 1st. About 150,000 men will be directly involved. At the Convention of the American Federation of Labour it was decided to support the miners for next May. The President of the United Mines Workers, in summoning the annual Convention in Columbus next month, lays emphasis on the same subject. The present agitation in the Connellsville region and the expression from other bodies show that the men are ready. An immense strike fund is being accumulated, and the labour leaders say that on commencing the strike they will have for immediate use nearly $1,000,000, and after that time regular levies will amount to about $50,000 per week.

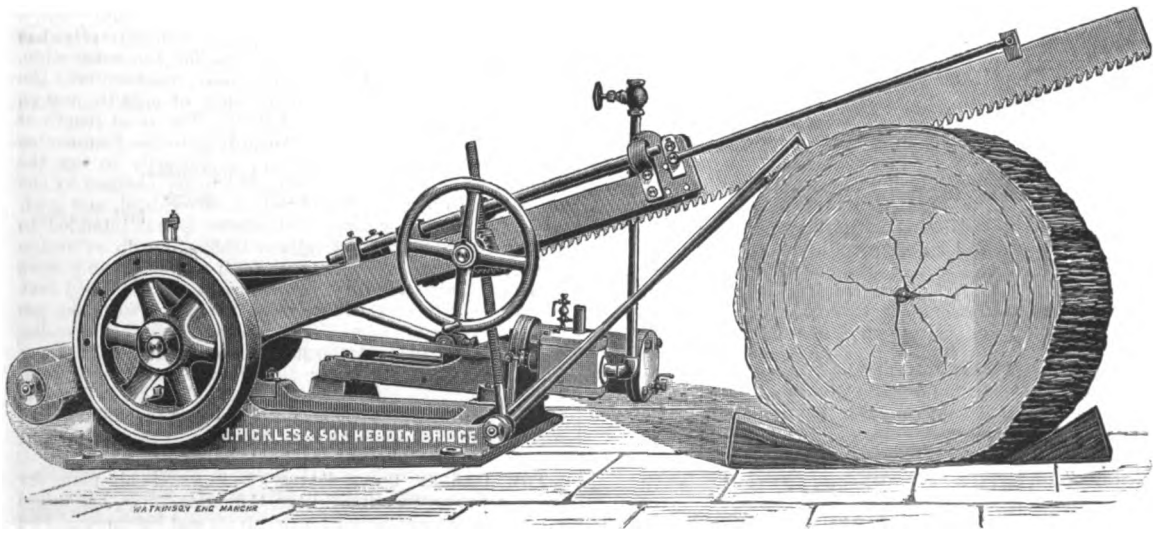
LOCOMOTIVE ORDERS.—The Baldwin Locomotive Works have received an order for fifty locomotives from the Government of New South Wales, another for thirty locomotives for the New York Elevated Railroad, and a third order from the Central Railroad of Brazil for thirteen locomotives.

FROM CHICAGO TO SEA BY CANAL.—About two years ago a company was formed to operate a line of steamships from some European port to Chicago, bringing out miscellaneous freight and carrying back dressed beef and dairy products. Nothing was done at that time, owing to the shallowness of the canals, but as more water is now to be had the project is being again revived. An agent of the company is now on a visit to the different lake cities soliciting freight by the new line, and is meeting with success enough to satisfy the company that plenty of freight can be obtained. It is proposed to run weekly steamers both ways, and a capital of $5,000,000 will be required to make the undertaking a success.

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STEAM POWER LOG SAWING MACHINE.

CONSTRUCTED BY MESSRS. J. PICKLES & SONS, ENGINEERS, HEBDEN BRIDGE.



STEAM POWER LOG SAWING MACHINE.

THE above illustration represents an improved machine, with steam engine combined, for cross-cutting large logs, and is made by Messrs. John Pickles & Son, Royd Iron Works, Hebden Bridge, Yorkshire. The advantage claimed for machines of this class is that they are available in situations such as forests, where the introduction of shafting and pulleys would be undesirable. The construction of the machine will be readily understood from the engraving. Fixed to a strong base-plate are a small horizontal steam engine and a saw frame, the latter being supported on trunnions. The timber to be operated upon rests on the ground, and is firmly secured by means of wedges and dogs, as shown. The saw receives a reciprocating motion from the steam engine by means of a strong crank and connecting rod, and the feed of the saw is adjusted by means of a hand-wheel and screw, as shown. The weight of steam used, we are informed, is exceedingly small for the work got through, and the name of the makers, who have had considerable experience in wood-working machinery, is a general guarantee for the quality of the workmanship.

CLYDE SHIPBUILDING FOR JANUARY.

THE output of new tonnage from the shipbuilding yards on the Clyde during the past month was, as is usually the case in January, much below the average. In all there were launched seven vessels, having an aggregate tonnage of 16,670 tons. Of this number four were steamers, representing 10,500 tons, and three were sailing vessels, with a total tonnage of 6,170. Nearly one-half of the total output was made up by the new State liner, "State of California," and the iron steamship "Lightning." The former is built of steel throughout to meet the requirements of the British Admiralty for transport service, and is a unique specimen of a Clyde-built cargo and passenger vessel. She has a cargo capacity of 5,300 tons, and is intended for service between Glasgow and New York. Her principal dimensions are as follow:—Length, 400ft.; breadth, 46ft.; and depth, moulded, 32·75ft. The hull is subdivided by eight water-tight bulkheads, each carried to the upper deck. Superior accommodation is provided for 260 first-class passengers, while, in addition, 750 steerage passengers may be berthed in the 'tween decks. Triple-expansion engines will be fitted, having cylinders of 34in., 55in., and 88in. diameter respectively, with a stroke of 54in., and will be supplied with steam from three steel boilers at a working pressure of 150lb. per square inch.

The contracts placed during the month amount to upwards of 20,000 tons, and nearly the whole of these orders were secured by builders at Greenock and Port Glasgow. The construction of two large steamers, each of 7,000 tons, has been entrusted to Messrs. Caird & Co., Greenock, by the P. and O. Company, London, and in addition the Messrs. Caird have secured the contract for lengthening the s.s. "Rome" and s.s. "Carthage," two of the same company's steamers; Messrs. Scott & Co., Greenock, are to construct a steamer of 3,000 tons for Messrs. J. Swire & Sons, of London; and Messrs. Russell & Co. and Messrs. Hamilton & Co., of Port Glasgow, each received an order for a large sailing ship.

The following are the particulars of vessels launched during the month:—

SCREW STEAMERS.

"Gurly," steel, twin-screw, 900 tons, built by Messrs. Murdoch & Murray, Port Glasgow, and fitted with triple-expansion engines by Messrs. Muir & Houston, Kinning Park, for the South American fruit trade of Mr. Jacob Christensen, Bergen.

"Julia," steel, 1,800 tons, built and engined by Messrs. D. J. Dunlop & Co., Port Glasgow, for the Sobrinos de Herrara of Havana, and intended for service between Cuba and Porto Rico.

"Lightning," iron, 3,300 tons, built and fitted with triple-expansion engines by Messrs. D. & W. Henderson, Partick, to the order of Messrs. Apcar & Co., Calcutta, and intended for trade between India and China.

"State of California," steel, 4,500 tons, built and engined with triple-expansion engines by Messrs. Alexander Stephen & Sons, Linthouse, to the order of the State of California Steamship Company, Glasgow, and intended for the Atlantic trade.

SAILING VESSELS.

"Melpomene," steel, 1,780 tons, built for Hamburg owners by Messrs. Charles Connell & Co., Scotstoun.

"Robert Duncan," steel, 2,000 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, for Messrs. Leitch & Mair, Greenock.

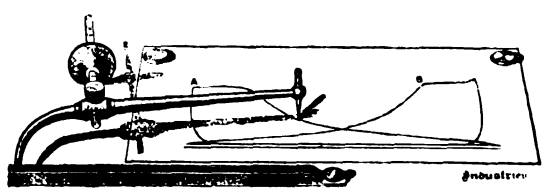
"Thistlebank," steel, 2,390 tons, built by Messrs. Russell & Co., Port Glasgow, for Messrs. A. Weir & Co., Glasgow.

SYNOPSIS OF LAUNCHES.

	Steamers. No.	Tonnage.		Sailing Vessels. No.	Tonnage.
Great Britain	1	4,500	...	2	4,390
Germany	—	—	...	1	1,780
Norway	1	900	...	—	—
India	1	3,300	...	—	—
Cuba	1	1,800	...	—	—
Total	4	10,500	...	3	6,170

A NEW PLANIMETER.

WE illustrate herewith a new planimeter which will be of interest to those who have occasion to take and compute indicator cards. None of the rough-and-ready methods for computing the area of cards are particularly simple in their application or accurate in results; and, therefore, a planimeter is a highly desirable instrument, and should be purchased as a necessary part of an indicator. The present instrument differs very considerably from those in ordinary use, and is possessed of some points of great convenience. As is well known to those who have occasion to use the planimeter an occasional source of trouble is the necessity of the recording wheel travelling sidewise. Of course it should accomplish this without revolution, but it does not always do so unless the instrument is very carefully managed.



The present integrating machine is designed for the special purpose of furnishing a ready means for measuring indicator diagrams simply and rapidly. From its construction, it will be observed that the slipping motion of the wheel in running over or on to the card is in a very large measure avoided. The recording wheel is knife-edged and free to move on its spindle, and indicates by the distance it has travelled along its axis, instead of with a vernier as is usual. In operating the instrument it is only necessary to slip the wheel against the shoulder which forms the zero point on the scale, and then trace the diagram with the pressure point from the upper left corner of each card, pressing in the direction in which the hands of a clock move. The scale engraved on the spindle gives, on completing the tracing, the number of square inches in the card.

This new instrument is said to work very satisfactorily for the purpose intended, and is highly recommended by Messrs. Hines & Robertson, of New York, who supply it. Its merits are simplicity, and the ease and rapidity with which it can be manipulated, without special delicacy in adjustment. For the description and illustration of the above we are indebted to the *Electrical World*, of New York.

SPRING FRAME SAFETY BICYCLE.

ONE of the most striking features at the recent Stanley Cycle Show, as mentioned in our report, was the duplex bearing spring frame safety bicycles and tricycles constructed by Mr. W. E. Roberts, of Bristol. The principle on which these machines are built is both simple and effective, and involves a divided outer bearing bolted together and surrounding the primary bearing carrying the pedal spindle—forming what is known as the bottom bracket. Arms or projections radiate from each bearing, those from the first or primary

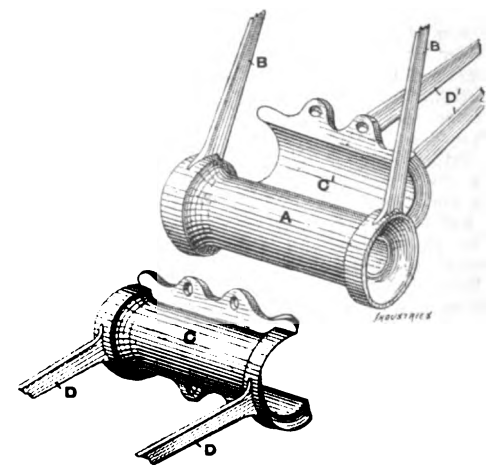


FIG. 1.

bearing being used to support or form the seat standard, which renders this bearing a fixed one, while the arms from the outer bearing, which oscillates, carry the axle of the driving wheel or wheels in one direction, and in the opposite a spring attached to the frame of the machine, so that obstructions in the path of the machine are easily surmounted by the driving wheel by reason of its oscillation upon the bottom bracket spindle. The front or steering wheel is ingeniously mounted upon one end of a short lever connected by a swivel to, and fulcrumed upon, the bottom of the steering fork; a

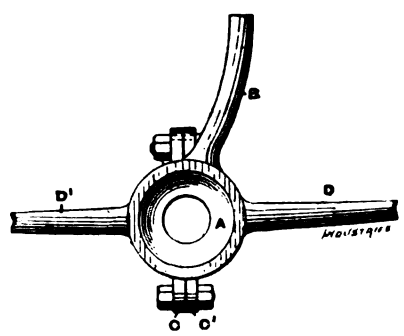


FIG. 2.

second fork fixed to this lever oscillates within the steering fork, and is connected thereto by a spring, so that the front or steering wheel rises over obstructions with the same ease as the driving wheel or wheels. Referring to the accompanying sketches (Fig. 1) A is the primary bearing with the arms B, C, and C', the

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outer bearing having arms D and D¹. Fig. 2 shows the same when the outer bearing is bolted together surrounding the fixed bearing. B is the seat standard, C and C¹ the outer bearing lugs, D the arms carrying driving wheel axle, D¹ the arms connected by a spring to the frame. The springs practically bear the weight of the driver, and as no seat spring is needed the distance between the driver and the pedals remains always constant, so that "slipping" the pedals is improbable. We are informed that these machines have been ridden over brick heaps, kerb stones, and every description of uneven road without causing any great inconvenience to the rider.

SHIPBUILDING NOTES.

On the 24th ult. Messrs. Richardson, Duck, & Co. launched from their yard a steel screw steamer, the "Sledmere," of the following dimensions:—Length, between perpendiculars, 270ft.; breadth, extreme, 36ft. 6in.; depth, moulded, 19ft. 1½in.; and a gross tonnage of about 1,930 tons. This vessel, which has been built to the order of Messrs. G. R. Sanderson & Co., of Hull, is classed 100 A1 at Lloyd's, and has been built under special survey. A cellular double bottom for water ballast is fitted fore and aft, the fore and aft peaks being also utilised as ballast tanks. The vessel will be supplied with four steam winches, large donkey boiler, steam steering gear, stockless anchors, double derricks, and all modern appliances for speedy loading, discharging, and manœuvring. The engines, which are by Messrs. Blair & Co., Limited, Stockton, have cylinders 20½in., 33½in., and 55in., with 36in. stroke and 100lb. working pressure.

On the 27th ult. Messrs. Ropner & Son launched a steel screw steamer, "Alton Tower," of the following dimensions, viz.:—Length, over all, 324ft.; breadth, 40ft. 6in.; depth, moulded, 23ft. 7in. She will be classed 100 A1 at Lloyd's, and carry 4,350 tons deadweight on Lloyd's summer freeboard. She is fitted with a cellular bottom for water ballast, and is built on the web-frame principle, with all the latest improvements for a first-class cargo steamer. Her engines are by Messrs. Blair & Co., Limited, on their improved triple-expansion principle, of 1,200 i.h.p., with two large steel boilers working at 160lb. The steamer has been built to the order of Mr. Charles Furness, West Hartlepool, for Messrs. F. Stumore & Co., London.

On the 27th ult. the s.s. "Dunbeth," built by Messrs. Craig, Taylor, & Co., Stockton-on-Tees, to the order of Messrs. Macbeth & Gray, Glasgow, and under the superintendence of Mr. J. Donaldson, ran her trial trip from Leith, where the vessel was completed, and which proved very satisfactory. The dimensions of the vessel are as follow:—300ft. by 37ft. 9in. by 21ft. 9in. She is built on the web-frame and cellular bottom principle. She has steam windlass by Messrs. Emerson Walker & Thompson Bros.; outfit of winches by Messrs. Clarke, Chapman, & Co.; and steam steering gear by Messrs. Alley & Maclellan. Her engines, on the triple-expansion surface-condensing system, are by Messrs. Dunsmuir & Jackson, Govan, Glasgow, with cylinders 22in., 34in., 56in., with 39in. stroke. She steamed under the Forth Bridge, and on a run of about 20 miles a mean speed of nearly 11 knots was obtained.

On the 29th ult. the twin-screw steamer "Iris," built and engined by Messrs. Blackwood & Gordon, was officially tried. The vessel has been built to the order of Messrs. Hill, Gomes, & Co., Manchester, and has been constructed to the highest class at Lloyd's. The speed was tested on a double run between the Cloch and the Cumbrae light. A mean speed of 13 knots was attained against the tide, a speed about a knot in excess of the guarantee. The engines are of triple-expansion type, and are fitted with Morton's patent valve gear.

On the 29th ult. the fine new steamer "Heighington," built by Messrs. William Gray & Co., Limited, to the order of the Hudson Shipping Company, West Hartlepool, went on her trial trip in Hartlepool Bay. The vessel is 324ft. long over all, 40ft. 6in. beam, and 23ft. 8½in. in depth, moulded, having a deadweight capacity of 4,350 tons, and is classed 100 A1 at Lloyd's. The engines are supplied by the Central Marine Engine Works of Messrs. W. Gray & Co., and are of the triple-expansion type, of 1,200 i.h.p., having two large steel boilers working at a pressure of 160lb. A speed of a little over 11 knots per hour was obtained.

On the 5th inst. the steamer "Patagonia," belonging to the fleet of the Pacific Steam Navigation Company, of Liverpool, which has just been refitted by the Naval Construction and Armaments Company, Limited, at Barrow, with a new set of triple-expansion engines, went out for her trial trip of 130 miles, when the new machinery worked with the utmost satisfaction.

On the 9th inst. there was launched from the yard of Messrs. W. Doxford & Sons, Limited, the largest sailing vessel yet built on the north-east coast. The registered dimensions are:—Length, 312ft.; breadth, 46ft.; depth, 25ft.; and gross register, 3,070 tons. The vessel is built of steel to Lloyd's 100A1. rules, with poop bridge and topgallant forecastle, has two steam winches, by Welford Bros.; donkey boiler of 80lb. working pressure, by Messrs. Riley Bros., of Stockton; and windlass by Messrs. Clarke, Chapman, & Co., with their latest improvements. The vessel has four masts, and is built to the order of Messrs. J. Joyce & Co., of Liverpool,

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, February 13th at 7.30 p.m. Students' meeting. Paper to be read: "The Cleaning and Deepening of Rivers and Canals by Means of the Transporting Power of Water," by Mr. W. H. Wheeler.

Physical Society.—Friday, February 13th. Discussion on Professor Minchin's paper on "Photo-Electricity." Paper to be read: "The Change in the Absorption Spectrum of Cobalt Glass Produced by Heat," by Sir John Conroy, Bart.

Balloon Society of Great Britain.—Friday, February 13th, at 8 p.m. Paper to be read: "Railway Servants' Hours of Duty," by Mr. Charles Jardine.

Royal Institution.—Saturday, February 14th, at 3 p.m. Lecture on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

NEXT WEEK.

Society of Chemical Industry.—Monday, February 16th, at 8 p.m. Papers to be read: "Incandescent Gas Lighting," by Mr. W. Mackean; "The Volumetric Estimation of Alumina," by Messrs. Cross and Bevan.

Society of Arts.—Monday, February 16th, at 8 p.m. Cantor Lecture I., on "The Electric Transmission of Power," by Mr. Gisbert Kapp. Wednesday, February 18th, at 8 p.m.: "Methods and Processes of the Ordnance Survey," by Colonel Sir Charles Wilson, K.C.B., F.R.S.

Royal Institute of British Architects.—Monday, February 16th, at 8 p.m. Sessional meeting.

Institution of Civil Engineers.—Tuesday, February 17th, at 8 p.m. Adjourned discussion on the paper by Messrs. Atkinson on "On Electric Mining Machinery."

Sanitary Institute.—Tuesday, February 17th, at 8 p.m. Paper to be read: "Sanitary Appliances," by Professor W. H. Corfield.

Royal Statistical Society.—Tuesday, February 17th, at 7.45 p.m. Paper to be read: "The Vital Statistics of Peabody Buildings and other Artisans' and Labourers' Block Dwellings," by Dr. A. Newsholme.

Owens College Union Engineering Society.—Tuesday, February 17th, at 7 p.m. Paper to be read: "Lessons from Boiler Explosions," by Mr. W. H. Oldham.

Royal Meteorological Society.—Wednesday, February 18th, at 7 p.m. Ordinary meeting.

Chemical Society.—Thursday, February 19th, at 8 p.m. Ordinary meeting.

PRICES CURRENT, 11th February, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 17 6	.....	7 7 6	London.
" Angles	7 0 0	.....	7 10 0	"
Crown Sheets	7 5 0	.....	7 15 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 0 0	"

METALS.

Spelter: Ordinary	£24	12	6	to	24	17	6
Copper: British Cakes and Ingots	57	10	0	,,	58	0	0
" Chili Bars, G.O.B.'s	52	15	0	,,	53	2	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	52	15	0	,,	53	2	6
" Manufactured (strong)	65	0	0	,,	66	0	0
Lead: Common Pig	13	10	0	,,	13	15	0
" English Sheet	14	5	0	,,	14	10	0
Tin: Straits	90	15	0	,,	91	5	0
" Australian	90	15	0	,,	91	5	0
" English Ingots	94	15	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues quiet, with small trade. Published statistics on January 31st show a decrease of about 4,700 tons in stock during the month. Chili bars are stronger during the last few days, values having advanced to £52 15s. to £53 2s. 6d. cash, with moderate business reported. Manufactured steady at £65 to £66, "strong," according to specification.

Tin has improved steadily during the week, to-day's quotations for foreign being 27s. 6d. higher than in our last report.

Lead: Inactive, with small business, values practically unchanged.

Spelter is advancing, owing to small stocks everywhere and an improving demand. Prices are higher on the Continent than in England.

PIG IRON.

Middlesbro' Warrants, No. 3.		41/9	Cash.
Scotch Warrants, m/n		47/-	"
Hematite Warrants, m/n		50/9	"
Stocks in Stores. Scotch	559,917—Dec. for week	6,431	Tons.
Middlesbro'	124,505—Inc. "	1,197	"
Hematite	212,168—Dec. "	693	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	...	.....	...	f.o.b.	Glasgow.
Gartsherrie	...	.....	...	"	"
Carnbrae ex Store	50/9	.....	50/6	"	"
Eglinton "	50/6	.....	50/-	"	"
G.M.B. "	47/6	.....	47/8	"	"

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.B. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

	£	s.	d.		£	s.	d.
Acid: Carbolic Crystals ..... lb.	.....		—		.....		
" " Liquid ..... gal.	.....		—		.....		
" Citric ..... lb.	0	1	8½	—	.....		
" Oxalic ..... "	0	0	3½	—	.....		
" Sulphuric ..... ton	.....		—		.....		
" Tartaric ..... lb.	0	1	3½	—	.....		
Alum: Lump (powder 10/- ex.) ... ton	5	12	6	—	.....		
Ammonia: Carbonate ..... lb.	0	0	3½	—	.....		
" Muriate (Grey) ..... ton	25	0	0	—	.....		
" " (White) ..... "	.....		—		.....		
" Sulphate ..... "	11	2	6	—	.....		
" Liquor ..... lb.	.....		—		.....		
Antimony ..... ton	.....		—		.....		
Bleaching Powder ..... "	.....		—		.....		
Bisulphide of Carbon ..... "	.....		—		.....		
Borax ..... "	.....		—		.....		
Benzole (90 %) ..... gal.	.....		—		.....		
" (50/90 %) ..... "	.....		—		.....		
Copper Sulphate ..... ton	17	0	0	—	.....		
Copperas ..... "	.....		—		.....		
Kieserit ..... "	.....		—		.....		
Lead: Nitrate ..... "	21	0	0	—	.....		
" White Sugar ..... "	.....		—		.....		
" Brown " ..... "	.....		—		.....		
Potash: Bichromate ..... lb.	0	0	3¾	—	.....		
" Caustic ..... ton	.....		—		.....		
" Carbonate ..... "	.....		—		.....		
" Chlorate ..... lb.	0	0	5½	—	.....		
" Prussiate (Yellow) ..... "	0	0	10½	—	.....		
" Sulphate (Basis 90 %) ..... ton	4	0	0	—	.....		
Precipitate: Red ..... lb.	0	3	6	—	.....		
" White ..... "	0	3	6	—	.....		
Salts: Epsom {Bags ..... ton	.....		—		.....		
{Casks ..... "	.....		—		.....		
" Glauber ..... "	.....		—		.....		
Sulphur: Sublimed Flowers ..... "	.....		—		.....		
" Recovered ..... "	.....		—		.....		
Soda: Ash ..... deg.	0	0	1¾	—	.....		
" Caustic (White 70%) ..... ton	.....		—		.....		
" " {" 60% ..... "	.....		—		.....		
" " {Cream 60% ..... "	.....		—		.....		
" Crystals ..... "	3	3	0	—	.....		
" Bicarbonate ..... "	.....		—		.....		
" Hyposulphite ..... "	.....		—		.....		
Solvent Naphtha ..... gal.	.....		—		.....		
Tartar, Cream of ..... cwt.	5	2	0	—	.....		
Zinc Sulphate ..... ton	.....		—		.....		

OILS.

	£	s.	d.
Cocoanut: Cochin ..... per ton	35	0	0
" Ceylon ..... "	29	0	0
Cottonseed ..... "	18	15	0
Cod ..... "	23	0	0
Lard ..... "	33	10	0
Linseed ..... "	21	17	6
Olive, Spanish ..... "	43	0	0
Palm, Lagos ..... "	25	10	0
Rapeseed: English ..... "	28	15	0
Seal: Pale ..... "	25	0	0
" Brown ..... "	.....		
Sperm ..... "	48	0	0
Whale ..... "	21	0	0
Turpentine ..... per cwt.	1	9	0
Coal ..... per gal.	.....		
Petroleum (Refined) ..... "	0	0	5 1/16
Spirit ..... "	0	0	8

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HOME INDUSTRIES.

LONDON, 12th February, 1891.

The Money Market.—A firmer feeling has pervaded the money market this week, the prevalence of a demand for gold for Germany helping to keep rates steady. The return of the gold borrowed from the Bank of France in November has not had much effect, as it had been taken fully into account before. But while rates have been steady there has been no great advance, and 1½ per cent. represents the limit quotation for call loans and 2 per cent. for the discount of three months' Bank bills. On the Stock Exchange business has been on a small scale, and the account dealt with at this week's settlement was very limited. A steadier tone is now to be noted in prices in nearly every department. Home railways have become distinctly firmer since the last of the dividends were announced, and there has been no disposition to sell. The ascendency of the "bull" interest in Wall Street has had a favourable influence on American railroad stocks here, and Canadian railways have been sympathetically firm. Foreign bonds keep well up, and Argentines have somewhat improved. Silver securities, after a considerable dip, have recovered, but the prospect for them is still very uncertain. There is a fair degree of activity in mining shares, without any pronounced feature. Industrial and miscellaneous shares are equally devoid of particular interest.

Great Northern Telegraph Company.—The traffic returns of this company show that the receipts in January, 1891, were £20,800, the receipts for the corresponding month of 1890 and 1889 being £19,600 and £22,400.

Royal Botanic Society.—A meeting of this Society was held on the 7th inst., at which the secretary, in announcing the gift to the Society of some seeds of the Parà rubber tree, stated that the growth of indiarubber and gutta percha was at the present time a matter of great importance. Gutta percha was imported into Europe in 1842, and was shortly afterwards used for the insulation of the first submarine telegraph cable. Up to the present moment no substitute has been found to take its place. In some interesting papers lately published in the *Electrical Review* it had been stated that from the "wholesale cutting down of adult trees," and the "reckless clearing and burning of the forests," the trees furnishing the most valuable kinds of gutta percha had become exceedingly scarce and in most localities utterly extirpated. This was also rapidly becoming the case with the trees which supply the many varieties of indiarubber, and, sooner or later, all natural vegetable products used by man must be artificially cultivated, as the natural supply never kept pace with the artificial demand. Some few attempts have been made to cultivate indiarubber, but as yet not very successfully.

The Junior Enginkeering Society.—The visit of this Society to the Trinity House workshops and steam vessel "Irene," took place on the 31st ult., permission having been obtained through the kindness of Sir James Douglas, F.R.S., Vice-President. Under the guidance of the officials, the members were shown through each department of the establishment. The work carried on includes repairs to machinery of the Corporation's steam vessels, of which there are ten; the illuminating and fog signal machinery and apparatus of lighthouses, light vessels, and lighted beacons and buoys; repairs to day beacons and buoys and conversion of worn chain cables from light vessel to buoy service. There is a gasworks for making oil gas and compressing it for buoy illumination. On proceeding to the docks the party were then shown over the "Irene," a vessel which was built last year by Messrs. Palmer's Shipbuilding and Engineering Company.

Association of Sanitary Inspectors.—On the 7th inst. there was held the eighth annual dinner of the Association of Public Sanitary Inspectors of Great Britain, Dr. B. W. Richardson, F.R.S. (President), occupying the chair. The President, in proposing the toast of "Success to the Association," spoke in high terms of the work which was being performed by the members of the Association throughout Great Britain. It resulted in the reduction of death, of disease, and of sorrow, and there could be no finer work than that for any man to perform. According to figures given by Mr. Wilson Noble, 125,000 deaths occurred every year in Great Britain which were preventable. There were thirty-nine cases of sickness for every death; each case of sickness lasted on an average 18½ days, which meant a total loss of 78¼ million days of labour for the year. That loss, computed at 2s. a day, meant that the sum of 7¾ millions sterling was lost every year. This computation did not include the extra cases of sickness which occurred among the working classes from exhaustion. If they took half the cases he had named they found that each year the work of 1,000 men for 100 years was lost by sickness.

Machinery Exhibition.—There is to be held at the Agricultural Hall, Islington, from 23rd April to 2nd May, the third annual international exhibition of machinery, manufactures, appliances, and inventions of interest to engineers, electricians, builders, and ironmongers. The manager is Mr. Harry Etherington, 43, New Oxford Street, W.C.

The Edison and Swan United Electric Light Company, Limited.—The directors of this company have decided to pay an interim dividend for the half-year ending 31st December, 1890, at the rate of 7 per cent. per annum upon the A shares, to be distributed in accordance with the articles of association.

MANCHESTER, 12th February, 1891.

Sewage Experiments.—The report of the committee appointed by the Salford Corporation to undertake experiments at the sewage works of that borough has been published. Four systems of purification were tried—the International, Electrical, Aluminoferric, and Barry. The first-named company, by their treatment, reduced the sludge very considerably as compared with the lime process, and the effluent produced was very clear, no decomposition arising after its discharge. The electrical treatment also gave very good results, and the sludge produced was less than that by any other system, the effluent also being very good. The other two systems were not so successful, but of the two the aluminoferric was the better. In this case there appeared to be some danger of decomposition of the effluent at a later stage. The committee recommend the adoption of either of the first two systems under certain guarantees.

New Factory Bill.—A Bill has been drafted by the cotton operatives, in which certain amendments to the Factory Acts are proposed. The principal features which are likely to be opposed are two clauses relating to the admission of air and to an allowance of time for cleaning. The first provides that not less than 600ft. of fresh air per hour shall be admitted into each room for every person employed. The second proposes a stoppage of the machinery half an hour earlier on Saturday to avoid accidents and give the workpeople time for cleaning. The proposals will probably meet with strenuous opposition.

The Ship Canal.—The proposal made by the directors of the above company that the Corporation of Manchester should join them in an application to Parliament for leave to assist the company financially has been favourably received. A special committee has been formed to investigate the matter, and Mr. Hill, the engineer of the city waterworks, has been asked to check the estimates of cost submitted. The proposal has met with much public favour, and the neighbouring borough of Salford is likely to assist the enterprise, one or two strong expressions in favour of the scheme having come from that district. It is suggested that a representative of the Council should join the board of directors, thus giving a semi-official character to the connection.

The Calico Printers' Union.—The negotiations with this object are beginning to take shape. Several firms of high repute have consented to join the Union, and although others decline to amalgamate, the market will be much strengthened by the adhesion of the remaining houses.

Civil Engineering Students' Dinner.—The Association of Manchester Students of the Institution of Civil Engineers held their fourth annual dinner on the 11th inst. Mr. J. Abernethy, past-president of the Institution, occupied the chair, and among the large number present were Professor Boyd Dawkins, Mr. R. H. Heenan, and Mr. E. Leader Williams.

The Linen and Jute Trades.—In order to carry out business, sellers have been obliged to reduce prices. Orders are often lost even by those willing to make slight sacrifices. Buyers are very careful in keeping down stocks to the lowest workable level, while producers, owing to the action of the Bleachers' Union in advancing prices for bleaching, find it more difficult than before to undertake orders. Unfavourable rumours regarding a well-known firm of merchants have been shown to be exaggerated, and there is a more cheerful feeling in the quarters that would have been affected. There is no truth in the report made by a shareholder that Messrs. J. S. Westhead & Co., Limited, will be wound up. The demand for coarse goods is fair. That for fine and fancy makes drags, the season having, so far, been unfavourable. In shipment there is no improvement.

GLASGOW, 12th February, 1891.

Minerals.—Business has now resumed its ordinary course after the paralysis of the six weeks during which the strike lasted. The pig iron furnaces are being relighted, and on the whole there is a more hopeful feeling in commercial and industrial circles than there was before the close of the year. The price of pig iron is still low, and there is but slender encouragement for the makers to resume production; but the stocks of special brands are practically exhausted, and the advisability of keeping their hold upon their customers and the prospect of an increased demand in the spring have made the relighting of the furnaces desirable. At the close of the year there were in Scotland only 6 furnaces in blast out of 140. On 1st January last year there were 88 furnaces in blast. There are at present 560,000 tons in store, a decrease since the beginning of the year of nearly 30,000 tons.

Speculation in Pig Iron.—The speech of Sir Richard Webster has caused some excitement in the iron trade, although his remarks were based on an evident misapprehension. It is quite clear that when he spoke of there being in circulation warrants for which there existed no corresponding quantities of iron, he meant contracts, and not warrants. Messrs. Connal very properly brought this unwitting mistake under the notice of the Attorney-General. It is thought probable that the Attorney-General will attempt some legislation on the subject of pig iron speculation.

The Recent Strike.—The blast furnacemen who have been on strike for seventeen weeks, during which the furnaces have remained closed, have been supported by subscriptions from the Cleveland districts. It has been alleged that the subscriptions from the English trade unions have been supplemented by persons who were interested in the Cleveland iron trade, and who hoped that the strike would benefit the Middlesbrough district at the expense of the West of Scotland. This explanation of the strike is, however, rather doubtful. The effect of such a movement, even if it were successful, could not be otherwise than temporary. As a matter of fact, the cessation of production has contributed to prevent the price of pig iron from falling, perhaps, to an unprecedented level. Meanwhile there has been plenty of iron for use, and, besides, it is only for certain purposes that Middlesbrough and Scotch iron compete against each other. Although, no doubt, such expedients have been tried, it seems absurd to charge the Cleveland ironmasters with deliberately inciting the Scotch blast furnacemen to revolt for the purpose of raising the price of production of iron in Scotland. It is to be noted, however, that the importation of Cleveland pig iron into Scotland has increased considerably. The importation for 1891 is already over 28,000 tons, as compared with only 16,000 tons in 1890. The effect of the cessation of production has been to run off about 100,000 tons of stock, and to this extent to strengthen the market. The Messrs. Dixon, who are preparing to relight their furnaces, have apparently resolved to employ only non-union men. They are adopting precautions against their employés being interfered with, and are, it is said, paying their men 30s. per week, with board.

Scottish Railways.—The arrangements as to the discussion of grievances by the North British Railway Company and their men have again been interfered with by the question of the "graded system." It is, however, almost certain that terms of agreement will be speedily arrived at.—The Amalgamation Bill of the North British and Glasgow and South-Western Railways has been withdrawn, the opposition of Sir John Burns, Bart., and of those who entrusted him with their proxies, having removed any chance of success.

Shipbuilding.—It is reported that Messrs. W. Denny & Bros., Dumbarton, have received an order for a vessel of 7,000 tons, similar in all respects to the "Scot" just built by them for the Union Company's South African Line. The "Scot" is expected to be completed in about two months.

(From our own Correspondents.)

LIVERPOOL, 11th February, 1891.

The Liverpool Overhead Railway.—The progress of the construction of this railway during the last twelve months has been disappointing, but the erection of the columns and girders is now proceeding rapidly. At the half-yearly meeting, held yesterday, Sir W. B. Forwood spoke very hopefully of the enterprise, and said that when the line was completed it would be the most valuable railway property in Lancashire. It is expected that the length from the northern terminus to St. Nicholas's Church, which contains some of the heaviest work, will be completed by next September or October. Tenders for the electric motors and cars have been invited, but no system has yet been definitely decided upon.

Liverpool Engineering Society.—At a meeting of the Society, held on the 4th inst., the President, Mr. Ferdinand Hudleston, being in the chair, a paper was read by Mr. Joseph Boult, entitled "Notes on the Phenomena of Tidal Rivers, with Special Reference to the River Mersey." The author dealt with the differences between tidal and non-tidal rivers, with the amount of tidal sea water entering the Thames and the Mersey respectively, and with the difference in tidal range between the West Coast of Britain and the East Coast of Ireland, and the cause of this difference. The various phases of the tides in the tidal channels at the mouth of the Mersey were next discussed, together with the numerous movements of the channels of the upper estuary.

LEEDS, 11th February, 1891.

The Iron and Steel Trades.—The iron and steel trades of this district have during the past fortnight been very quiet, and there is still little sign of a revival of activity. The tendency of buyers is to order only for immediate wants, in the hope of a favourable change taking place. Prices of manufactured iron and steel remain nearly stationary. The cause of the quietness in the market is ascribed to the present high rate of fuel, and there is no doubt that the manufacturers of steel and iron who have to purchase coal are placed at a disadvantage in giving quotations, as compared with firms who are able to obtain coal from their own pits.

The Coal Trade.—Business in the coal trade of West Yorkshire continues buoyant, and the whole of the pits are running full time. There seems no prospect at present for a reduction of prices. The tonnage of coal sent to Hull last month was slightly less than in the corresponding month of 1890, but this may possibly be owing to the fact that the waterways were frozen for a lengthened time.

The Engineering Trade.—One or two of the large firms have lessened the amount of overtime or put a stop to it altogether. The engineers are, perhaps, in a better position than the tool makers with regard to the future. The nail trade is dull, and agricultural implement makers are only fairly busy. A continuance of the present weather should, however, bring about a change in their favour.

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SHEFFIELD, 11th February, 1891.

Iron and Steel.—The iron and steel trades continue active throughout this district. The important part of the steel trade here consists of heavy work, such as shafts for marine work, heavy guns, and armour plates.

Trial of Armour Plates.—Messrs. Cammell have been very successful in a recent trial of one of their "Wilson" compound plates at Portsmouth on board the "Nettle." This plate was 8in. in thickness, and measured 8ft. by 6ft., and three Palliser chilled projectiles were fired at it from the new 6in. breechloading gun with 32lb. of E X E powder, developing a striking velocity of 1,566ft. per second. The shots were grouped in the centre of the plate at the points of an equilateral triangle. In no case did the indentation exceed 2in., and, with the exception of a few hair cracks through the hard steel face, the plate was comparatively sound. This plate was one forming part of the belt of the Chilian cruiser "Captain Pratt," and the effect of this trial will restore confidence in compound plates.

Railway Material.—In railway work there is a falling off in the home market, and prices have declined in consequence. It is expected that New South Wales will give out some large orders for rolling stock, and that a large part of the raw material will come from this district.

General Engineering.—The Yorkshire Engine Company is engaged in the construction of Fairlie engines for the nitrate fields, electric tramways for the Isle of Wight, and also some work for the Chignecto Ship Railway. Messrs. Henry Bessemer & Co., Ld., have made a profit of £38,000 during the year, and will pay a dividend of 25 per cent. The company have lately spent a large sum on new machinery and plant.

NORTH STAFFORDSHIRE, 11th February, 1891.

The Iron Trade.—Prices continue to decline, and the position of ironmasters is assuming a critical phase. Pig iron cannot be made at the present market rates, which have fallen to 42s. 6d. per ton at works for forge qualities; and there is no margin for profit in the price of bars at £5 15s. to £6 per ton at works. The cost of production of the raw material will have to be reduced or works will be closed.

The Coal Trade.—There is still a steady demand for house coal, but manufacturing qualities are being stocked, and there are signs that prices will shortly be weakened by competition amongst sellers.

BIRMINGHAM, 11th February, 1891.

The Iron Trade.—Dulness prevails in the iron trade generally, and the closing of several sheet and hoop works in the Bilston district has a disquieting effect. Messrs. Groncutt & Sons have just closed their Bankfield rolling mills, and the Bilston Iron Company have done the same, while Messrs. Hatton, Sons, & Co., of the Bradley Sheet Works, have partly stopped operations until their financial affairs are settled. About two years ago many sheet mills were restarted in the Staffordshire district, but a reaction seems to have set in. There is much underselling of sheets, and the employers are endeavouring to reconstitute the Association in order to regulate prices. Fuel continues very high in price, and wages are high, but pig iron has a downward tendency.

Steel Manufacture.—There seems to be ample demand for the steel made in this district. All the furnaces and converters are fully employed, and other furnaces have been added at Congreave's. The projected additions of steel furnaces and plant at Round Oak Works will be a great addition to the district.

Manufacture of Anvils.—The "best" anvils are now made at many works by stamping the top half and bottom half of the body separately in dies, and then welding them together, the steel face being afterwards welded on. A recent patented improvement on this practice is to make a body in one piece, cast to shape and of mild steel, in all parts but the bick. The bick is then forged to a point to consolidate it more, and the hard steel face is either cast or welded on.

Bolts and Nuts.—The Admiralty have placed a running contract for steel bolts and nuts with the Phœnix Nut and Bolt Company, Handsworth.

Boiler Making.—All the boiler makers of the district are very busy, chiefly, of course, on steel boilers, though there are still some made of the best qualities and brands of South Staffordshire iron.

LEICESTER, 11th February, 1891.

Wool Spinning and Yarn Trades.—The local wool market still maintains a very firm tone owing to the tendency to a hardening in prices at the London wool sales. English wools are very firmly held at the recent quotations, and in some instances a very small increase in price is demanded. Though it is thought quotations have reached their lowest limit there is an absence of speculative operations, and users are content to buy only for their immediate requirements. Skin wools are freely in demand, and there is a better inquiry for short wools and demi-lustres and lustres. Spinners are a little better off for business, but they are not as yet actively employed. The yarn market is brisker, and some large contracts are offered, but spinners are demanding a better price than has prevailed for some time past.

Hosiery Trade.—Business is healthy in this industry, but some of the branches have experienced a falling off in orders. In cashmeres there are large stocks, and, as the demand has not yet developed, the production is limited. The fancy department is showing signs of increased activity. On the whole the prospects for the spring trade are good.

SWANSEA, 11th February, 1891.

Tinplates.—There is a fairly active demand for ordinary sorts and sizes of tinplates, which have reached the satisfactory price of 18s. per box for Bessemer quality. Now that the strikes at the works seem to be over, labour difficulties at the docks put obstacles in the way of rapid shipment, so that last week only one steamer cleared with tinplates for the United States, as against an average weekly clearance of three. Prices in the New York market have again advanced on the improvement of 5c. per box made known last week, and buyers are eagerly taking all that is offered at our prices. Stocks in dock warehouses and vans amounted, on the 7th inst., to 258,326 boxes, as compared with 251,891 on the 31st ult., and 234,791 boxes on the corresponding date of last year. On the 7th inst. the Llwydarth Tinplate Works were re-started under a new proprietary at Maesteg. They will give employment to fully 150 men. The death is announced of Mr. Wm. Conway, of the Ponthir Works, at the age of seventy.

CARDIFF, 11th February, 1891.

Iron and Steel.—The pig iron trade continues dull. Many things seem adverse to the producer, but there is this week an opportunity of getting coal a little cheaper, and foreign ore is less expensive on account of low freights. It is evident that the production exceeds the demand, even with such a large number of furnaces out of blast. Steel tinplate bars (Bessemer) are quoted at £5 10s.

Coal and Coke.—The steam coal trade is naturally affected by the strike of dockers, which seems to be far from a settlement. Colliery proprietors are willing to accept reduced prices for immediate shipment and for inland consumption where their loaded waggons can be released at once. With this exception, prices have undergone no change, ruling prices for 1st quality being 15s. to 15s. 6d.; 2nd, 14s. 3d. to 14s. 9d.; 3rd, 13s. 6d. to 14s.; and 4th, 12s. 9d. to 13s. 3d. The demand for small steam coal has fallen off, current figures being at 5s. 6d. to 5s. 9d. Households are in fair demand, 15s. to 16s. being obtainable for No. 3 Rhondda. Small smiths' (best) realised 10s. 6d. to 11s., and No. 2, 7s. 6d. The coke trade is in a fairly satisfactory condition, prices having now reached a remunerative level. Furnace qualities realise 20s. to 21s.; foundry, 22s. 6d. to 24s.; best foundry, 25s. 6d. to 27s. Patent fuel is quoted at 13s. 9d. to 14s. 3d.

BARROW-IN-FURNESS, 11th February, 1891.

Hematite.—A quieter business has been done this week in hematite qualities of pig iron, and very little in forge and foundry qualities. The consumption of Bessemer pig iron has somewhat fallen off, but is expected to improve again shortly, as the Moss Bay Steel Works are soon to resume operations. Prices are easier at 51s. 5d. net cash for hematite warrants—a price at which makers are undersold, as they allege that they are unable to make pig iron at less than 53s. 6d. for mixed Bessemer numbers net f.o.b. with raw material at its present price. Stocks have again increased during the week to the extent of 276 tons, although another furnace has been blown out at Workington, leaving 43 out of 76 in blast. Another furnace is to be blown out next week at Maryport. Stocks of hematite warrants in hand now represent 213,397 tons.

Steel.—The steel trade is very quiet. Heavy rail sections are at £4 15s., light sections at £6, and colliery rails at £7 per ton. Steel shipbuilding material is quiet on general account, and there is little new business on local account, but makers hold a large number of orders. Both plates and angles are quoted at £6 2s. 6d. to £6 5s. per ton. Tinplate bars move slowly at £5. Billets are in fair demand at £4 15s. Blooms and slabs are quiet at £4 10s. to £4 15s. respectively. There is a good trade in hoops at £6 10s. The wire trade is quiet. Forgings and castings are in demand.

Activity in the Building Trade.—There is a very great demand for house property in Barrow. The great development of trade and the creation of new industries have shown the urgent want of dwellings suitable for artisans. If present prospects are realised, there will be required during the ensuing two years from 500 to 1,000 new houses.

MIDDLESBROUGH, 11th February, 1891.

Pig Iron.—There was a fair attendance on 'Change yesterday, and a cheerful tone prevailed, though there was a total absence of business, and few orders had been received. Sellers are holding back in the expectation that they will get better prices when the shipping season opens. Makers are not quoting for forward delivery, but merchants are quoting 42s. per ton for prompt f.o.b. deliveries of No. 3 G.M.B., and 42s. 3d. for deliveries up to the end of March. Buyers, however, would only pay 41s. 9d. for prompt, and would not quote for forward deliveries at all Middlesbrough warrants are 41s. 9d. cash sellers. Grey forge is in request for shipment to Scotland, and is 40s. 6d. per ton. Connal's stock is 124,143 tons, an increase of 899 tons from the previous week. Local hematite is 53s. 6d. per ton for mixed numbers.

Manufactured Iron and Steel.—There is no change to be reported in finished iron and steel, and trade in steel plates is so bad that some of the mills are likely to cease working until better times. Prices are: Steel ship plates, £6 2s. 6d.; iron plates, £5 15s.; steel angles, £6 5s.; iron angles, £5 12s. 6d.; steel rails, £4 17s. 6d., all less 2½ per cent. and f.o.b. Iron chairs are £3 5s.

NEWCASTLE, 11th February, 1891.

The Coal Trade.—Since the commencement of the strike at Cardiff there has been some improvement in the steam coal trade, owing to the diversion of a few orders to this district. On the 7th inst. a meeting of coalowners' and miners' representatives was held in Newcastle, when a discussion as to the further limitation of the working hours for boys took place. No settlement was arrived at on this question, and it is understood that it will be reconsidered at a future meeting. It was arranged, however, that a reduction in wages of 1¼ per cent., due to the employers under the last ascertainment of prices, should come into operation at once. The shipments of coal and coke at Tyne Dock during the week ending on the 7th inst. amounted to 105,857 tons, being a decrease as compared with the shipments for the corresponding week last year of 5,196 tons.

Engineering.—It is understood that Messrs. Hawthorn, Leslie, & Co., who already have a large amount of Government work in hand, have received from the Admiralty a further order for engines and boilers for two cruisers now being built in the Government dockyards. The Forth Banks Works of this firm are, like their St. Peter's establishment, extremely busy. A new siding to connect the works directly with the North-Eastern Railway system is now being carried out, and when completed will be of great utility in facilitating the delivery and despatch of goods.

Tyne Dock.—The contract for deepening the entrance to Tyne Dock, so as to admit vessels of the largest tonnage, has been given out, and the work will be proceeded with immediately. The construction of the new coal loading staiths is well advanced.

The Elswick Works.—The great ordnance factory of Sir W. G. Armstrong, Mitchell, & Co. is, for the moment, somewhat slack. Many orders were finished at the close of last year, and no large order has been received in their place. In some of the shops the pressure of work is therefore much lessened, and hands are being paid off. It is believed, however, that some new orders are in course of negotiation.

Geology of British Coalfields.—Mr. W. J. Potts, of the Atlas Works, North Shields, offers ten guineas for an approved original article on the geology of the coalfield or coalfields in any single county or group of adjacent counties of Great Britain and Ireland. Communications can be sent in up to the 1st April.

Electric Lighting.—Messrs. Clark, Chapman, & Co. have just fitted a complete electric lighting installation in the large steamship "Hawkes Bay," built for the colonial meat trade by Messrs. W. Doxford & Sons, Sunderland. The firm have several other important installations now in hand.

DUNDEE, 11th February, 1891.

Jute and Flax Trades.—There is little change to be reported in either branch of the local trade. A fall in the Exchange has caused a slight decline in the price of jute, and while there is comparatively little doing prices are in favour of buyers. In Calcutta there is no change in the rupee price, sellers being firm, and "M" in a double triangle being quoted at 21 rupees per bale of 400lb. Jute yarns are fairly steady in value, and there is an average amount of business. The demand for jute goods is quiet, and makers are disposed to meet sellers. In the New York market prices are unaltered, burlaps 40in. 10½oz. being quoted at 4 1/16c. per yard and light weights at 4⅜c. The flax market is quiet, with prices in favour of buyers. Spinners are complaining that the market for yarns is unsatisfactory and the tendency of prices disappointing. Orders for linens show some improvement, but stocks of canvas are said to be increasing.

Launch of a Steamer.—Last week Messrs. Gourlay Bros. & Sons, Dundee, launched for the General Steam Navigation Company, London, a steel screw steamer, 220ft. long, 30ft. 6in. in breadth, 15½ft. in depth, and capable of carrying about 900 tons gross. She has cellular double bottom for water ballast. The machinery is to be put on board the steamer at London.

Improvement of the City.—A proposal has been submitted to the local police commission for the clearing away of a number of old buildings in the centre of the city, in order to make room for a People's Palace or Winter Garden. In the area proposed to be included the average death-rate for a period of eight years has been 39 per thousand, and one year the rate was as high as 74 per thousand. For the whole town during the eight years the rate was 20 per thousand.

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FOR THE JAPANESE GOVERNMENT RAILWAYS.

(*For description see page* 148.)

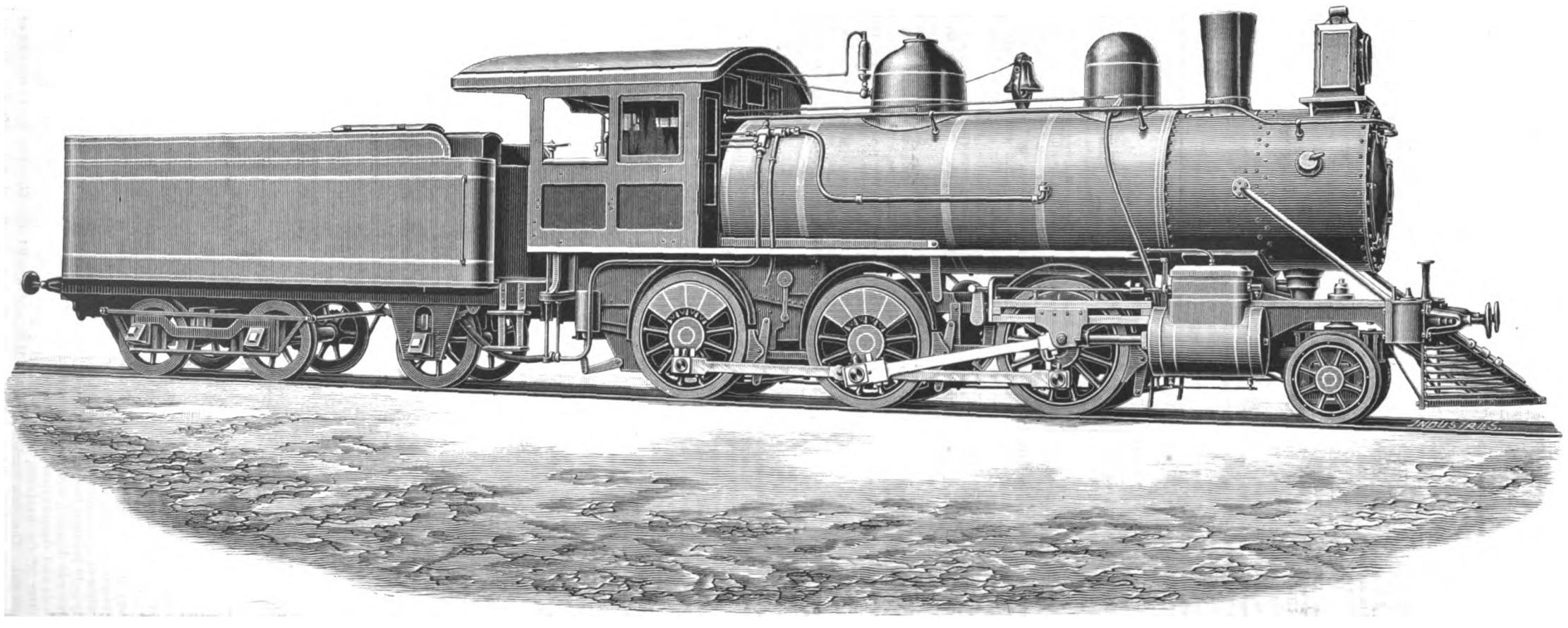


FIG. 5.—GENERAL VIEW OF ENGINE AND TENDER.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, *358, Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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70, Market-street, Manchester.
93, Hope-street, Glasgow.

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(Mr. G. N. Hennessey is Sole Agent for Ireland.)

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 13TH FEBRUARY, 1891.

THE TENDENCIES AND PROSPECTS OF LABOUR.

ONE of the most perplexing questions that manufacturers are called on to face in the present day is that of how far they can further cheapen the cost of production, and still leave a fair margin of profit. The great demand of the world nowadays is for cheap commodities, and the nation that can furnish these in the greatest abundance, all other things being equal, will assuredly win in the race. But, to produce cheaply, there must be a combination of favourable circumstances, of which the command of moderately cheap and highly efficient labour is not the least important. This advantage has been peculiarly the privilege of Great Britain for a long series of years; but it is often questioned whether we enjoy the same superiority of labour, as compared with other countries, that we formerly did—whether, in point of fact, the labour of other countries is not excelling that of England in the matter of efficiency when compared with price. The question is often asked—Is the average result brought out by a given amount of labour, as measured by time, as good now as it was formerly? There is no reason to doubt that the average efficiency of labour, as measured in terms of the net yield of a given period of labour, is decidedly higher to-day that it ever has been. This is a matter that may be submitted to a very simple and convenient test, for the materials are at hand whereby it may be settled with almost mathematical precision in at least two of our most important industries—viz., mining and textiles.

Take, first of all, the case of the mining of iron ore in the district of Cleveland. This is one of the best tests that could be applied, inasmuch as the conditions of work have not varied much as between one period and another. The hours of labour are much the same, as are also the system of working and the character of the deposits, which are regularly defined horizontal strata, of fairly uniform composition and depth, and not, as in the case of the ores of the West Coast, liable to vary in their mode of occurrence. If there is any material difference to be taken into account, it is the difference due to the men having to journey for longer distances in proceeding from and returning to the bottom of the shaft, so that it is a difference that would presumably tell against the likelihood of a larger individual output. Bearing these facts in mind, it is a little startling to find that the average output per employé in the mines of Cleveland has advanced from 551 tons in 1874 to 784 tons in 1878, 808 tons in 1880, 889 tons in 1886, and 890 tons in 1889. In other words, as between the first and the last of these dates there has been an increase of about 80 per cent. in the productiveness of the men employed, for the same number of hours worked. The question naturally occurs—To what is this great difference due? In the case of mining, it is no doubt partly due to the increased area opened out in the mine, to the greater facility for handling the materials provided in the mine, and to the introduction of machines and other new features tending to improved methods of working. But it is chiefly due to the greater experience and efficiency of the workers, who have become more expert in their business, and have been constrained, by depression of trade, to do much work for comparatively little pay.

The advance made in the productiveness of coal miners has not been quite so conspicuous as that found in reference to iron ore mining in the Cleveland district. In the great northern coalfield, which is contiguous to the iron ore mines of Cleveland, with which there is a certain amount of interchange of labour, the men are more experienced, plodding, and steady than almost in any other. In this locality, however, there have been very striking differences in the individual industry of the men employed. In the four years ending with 1867, when the total output of the great northern coalfield was between 24 and 26 million tons a year, the average annual output per man was about 417 tons; in the next four years the average fell to about 385 tons; and in the four years following the introduction of the Coal Mines Regulation Act of 1872 the average had fallen to about 310 tons. It must, however, be remembered to the credit of the miners, that they had become demoralised during the last-named period by the inflated prices and wages that became the order of the day in 1872, and continued more or less until 1875. After the latter year the men began to do better work, and by 1880 the output had risen to 360 tons per head per annum. Since 1880 the annual average has varied between 330 and 370 tons, but it has never reached so high as it did in the period previous to the adoption of the Mines Act of 1872. No doubt this fact is at least partly due to the restrictions which that measure brought into force, and this cause should never be lost sight of in dealing with a question of this kind. Parliamentary interference with industrial operations may be necessary, and even beneficial, in the interests of the public, but it is calculated to introduce disturbances and dislocations that are often overlooked in comparing one period with another. There is another disturbing element in the case of the great northern coalfield that does not equally affect some others, and that is the fact that many of the collieries in that district, and in Northumberland especially, having exhausted the best seams of coal, are now working the minor and thinner seams, which, of course, are more difficult to mine. The difference due to this circumstance may be traced in the figures that illustrate the progress of the much less explored Yorkshire coalfield over the same period. In 1864 the average output per miner in the latter field was 270. It fell below that average for several succeeding years; but about 1869 it began to rise again, in 1880 it was 280 tons, and in 1887 it had advanced to 306 tons. For the whole period between 1880 and 1887 it was creeping upwards, and, if it has fallen away a little since then, that is only a result that almost invariably accompanies a revival of trade and a higher range of wages. Scotland, the next range of coalfields to the great northern on the one side, as Yorkshire is on the other, exhibits a more pronounced advance of efficiency than either of the other two. The highest individual annual output in any year between 1860 and 1872 was 329 tons, and this figure was reached in 1871. In the following year the output fell to 303 tons, due no doubt to the Mines Act, and in the year 1873 to 288 tons, due again to the Mines Act and the coal famine, which gave very

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high wages to the miners, but from 1882 the Scotch miners began to exert themselves, and in 1880 they produced an average of 344 tons per man, which was increased to 347 tons seven years later. It has been the same throughout the country generally. The average productiveness of the miners of nearly all districts in this country has been increased within the last few years, so that the wages cost of a ton of minerals has, on an average, been less than formerly. It is, however, to be observed that this increased efficiency is most prominently displayed when business is dull and wages are low.

The textile trades are capable of furnishing another valuable indication of the extent to which the efficiency of labour is being increased or diminished in our own and other countries. Whether we measure these industries by the test of the number of spindles and looms provided per operative employed, by the number of pounds of cotton, wool, or other textile materials worked per spindle and per operative, by the total quantity and value of our textile exports per operative, or by any other reliable standard, the result is that we find an increase of efficiency in the individual product. This is, of course, not always due to the merits of the workers, but it is often, and it may be generally, owing to the great improvements introduced in textile machinery by our mechanical engineers and manufacturers. But the net gain is the same, however brought about; and but for this gain in results it is manifest that we could not, in this country, have maintained for so long our superiority as a manufacturing nation. It is true that we have no monopoly of improvements. But we have hitherto, at all events, had a very good start in the race, and if our recent progress has been slower than before we have still made progress, and, in some directions, not a little.

The hours of labour exercise a most material influence on the extent to which a mine, a furnace, or a factory can be made to pay or the reverse. The employer finds that if he can work his factory for twelve hours per day, instead of eight, he will have a very much larger output of whatever commodity he may be engaged in producing. If it is a factory or workshop in which the work is performed automatically—as, for example, a cotton factory, in which the looms and spindles are worked uniformly at the same rate of speed throughout the day—the net result must be a third more work with the same capital expenditure. If it be a factory, on the contrary, where the work is mainly done by manual labour—as, for example, a puddling forge—it has been calculated that the same rate of efficiency is not kept up during the last three hours of the day as in the earlier part, the workmen showing a diminished energy, which is reflected in the reduced value of their output. But as the modern factory system is based on the employment of machinery that is uniformly self-acting, there is not much danger of the production being reduced as in the case last supposed. What is most to be feared in our industrial horizon is the danger that we may be reducing the hours of labour, and increasing the earnings of our workmen, to a larger extent than the increase of efficiency just alluded to will safely permit. The proposal to introduce a general Eight Hours Bill is not unlikely to be mischievous from this point of view.

THE PRESENT POSITION OF THE ALKALI TRADE.

At the statutory meeting of the United Alkali Company, held at Liverpool last week, Mr. T. Robinson, of Widnes, is reported to have said that the wisdom of the whole alkali trade in this country was embodied in its members, and, as the directors have just issued an appeal to the public for the remainder of the authorised capital in this undertaking, it may be of interest to our readers if we devote a little space to considering the present position and prospects of this ponderous undertaking. It is well known that on the termination of the Bleach Association the various makers of soda and allied products by the Leblanc process began a ruinous competition by cutting rates, which had the effect of reducing the market value of their products to a very great extent, and thus caused the closing of many of the smaller works and the partial cessation of others.

In the early part of last year overtures were made by the leading alkali firms in this country to effect an amalgamation, which finally took shape in what is now well known as the Chemical Union. Its present position was summarised by Mr. John Brock, the chairman of directors, in his speech at the statutory meeting of the company last week, and, being official, we may take this statement as fairly representing the position from the promoters' point of view. The authorised capital of the undertaking in capital and debenture stock is £8,500,000, and of this amount the vendors have taken, in part payment of the property turned over by them to the company, stock and shares of the value of £5,391,200, and applications from friends and those interested in the undertaking have already amounted to £1,774,250, making together £7,165,450, and leaving £1,334,550 still to be raised by the public appeal which has been circulated this week. The property acquired consists of forty-five chemical works and three salt works. The company further controls the Leblanc departments of five others and has working agreements with several more. Mr. Brock stated that the plant in the majority of the works was of the most modern construction, and that fifteen of them were now equipped with Chance's sulphur recovery plant. A glowing description of the accessories to the works acquired in the shape of railway stock, fleet, quarries, land, houses, and cottages for workpeople, was also given by the chairman in his address.

So far we have endeavoured to give a sketch of the present position of the undertaking, as gathered from the official statements of the managing director, and have now to consider what the company proposes to do, and the prospects which may be reasonably expected to attend such a scheme. In the prospectus just issued we notice that the directors expect satisfactory returns to the shareholders, not only from the profits on the various manufactures, but from the avoidance of competition, the reduction of transit, economies of management, and increased efficiency of all the manufactories. Moreover, this desirable end is to be achieved without advancing prices unduly—in fact, by maintaining them at such moderate limits as will yield a fair return. We believe that the gist of the whole matter rests on the interpretation of the meaning of the expressions "without advancing prices unduly" and "yielding a fair return," and we would like some information on the meaning which the directors themselves attach to these words. As no goodwill nor promotion money has been paid by the company, and the vendors have valued their own works and been invited to sell their undertakings to the company, not for cash, but for shares and stock in the new company, we can fairly assume that the amount of money which it is proposed to obtain from the public, together with that already supplied by friends of the trade, represents the difference between their own estimate of the value of the property transferred and that which it is supposed to be worth under the new conditions of combination. This difference amounts to upwards of £3,000,000 out of the total capital of £8,500,000, or, in other words, what the manufacturers themselves value, by their own action, at £5,500,000, is to be more than 50 per cent. more valuable now that combination has been effected. It is unfortunate that there are no details as to the profit made by the several undertakings before amalgamation when the old prices ruled. With such data it would have been possible to estimate what would be a fair market value for the products which would give a reasonable rate of interest on the increased capital of the undertaking. The only guide which the prospectus gives us on this point is that the goodwill of all the businesses has in no case been taken into account. We should have imagined that the goodwill of such businesses should have been taken into account, not only by the vendors in transferring their undertakings to the company, but also for the information of the public who are invited to subscribe for the amalgamated business, as it would be a measure of the prospects of "the profits to be derived from the various manufactures enumerated.' It is, perhaps, not for the want of such data that the directors have abstained from predicting what dividends may be forthcoming on the capital of the company.

It is not, however, the financial aspect of the case which especially concerns us, and we do not propose to further criticise the scheme in this direction. Our views on trade combinations of this kind have been expressed on many occasions, and in our recent review of the chemical industries of last year we gave at some length our opinion on the effects that an increase in prices would have on the paper trade and many industries in this country in which the products of the Alkali Union play so important a part.

The effect of the combination on the industry itself must, however, be considered. The United Alkali Company, as we have seen, own forty-five chemical works, and control others making a total of fifty. The Chief Alkali Inspector, in his annual report, states that there are eighty works in England and Scotland manufacturing alkali. There must, therefore, be thirty works outside the Union. Many of these, doubtless, are very small, but they naturally will be in a position to favourably compete against the combination when loaded with its large additional capital. Among the works outside the Union are, however, Messrs. J. C. Gamble & Son and Messrs. Brunner, Mond, & Co., both of which firms are in a position to offer very strong opposition, and we understand that the latter company are already making a very considerable extension to their present large works. With such opposition the new company will have some difficulty in controlling their products at their own "*duly* advanced prices," and at the same time return to their shareholders a satisfactory dividend. They can, it is true, maintain the price at any point by limiting the output, and, if our information be correct, the directors have already decided to take this step, and are reducing the decomposition of salt by 25 per cent., or, in other words, are already admitting that one quarter of their whole plant must remain idle. We are curious to know whether this may not be one reason for not stating the goodwill of certain portions of their works.

One other point, and we have done. Fifteen of the works have been fitted with Chance's sulphur recovery process, and, as is well known, the Leblanc manufacturers have invested practically the whole of their remaining capital in this new venture. The apparatus is exceedingly costly, and, we understand, has taken much time to perfect, and it may probably be estimated that this part of the plant acquired by the company has cost a quarter to a half million sterling. The sulphur recovered by this process, it was hoped, would find a ready sale in America, which country has been importing considerable quantities from Sicily. The McKinley Tariff Act has, however, caused a very serious decline in this trade, and the company will find it difficult to dispose of their 1,000 tons weekly.

In conclusion, we may add that we have purposely abstained from discussing the relative commercial values of the Leblanc and ammonia soda processes, and refrained from speculating on the effect of the introduction of new bleaching agents in the place of bleaching powder, as we wished to put before our readers as fairly as we can the present position of this new trade combination. Mr. Brock let in one gleam of sunshine as to possibilities in the future for the company, when he stated that the directors had determined to open a central laboratory, where they would employ a staff of highly qualified chemists to advise the board on technical matters, and to devise and develop new processes by which the shareholders in the future may eventually benefit. In our recent review we pointed out that the Union could only succeed in one way, and that was by completely revolutionising its means of production—in fact, by gradually transforming its old plant and remodelling its manufactures on the lines of modern progress. We refer again to the Alkali Inspector's report:—"The number of alkali works in which the Leblanc process is carried on still diminishes. Quite recently an old-established work on the Tyne side has been closed. The struggle between the old and the newer process is no longer doubtful." The Leblanc process is dying, and the United Alkali Company, even with its £8,500,000 of capital, cannot prevent it.

THE TAXATION OF MACHINERY.

The opponents of the Bill which has been before Parliament for a considerable time, and has for its object the exemption of machinery from rating, are very active, and are appealing for pecuniary support, both for the purpose of carrying on litigation and for the promotion of legislation which will place the matter beyond dispute, The committee of the National Society for Procuring the Exemption of Machinery from Rating, which was founded some time ago, state that the views and motives of users of machinery have been much misrepresented, and they think it desirable to again explain, by means of circulars and otherwise, the real merits of the question, and to point out the broad grounds upon which manufacturers rely for a successful result to their appeal to Parliament for that redress which the courts of law have so far denied them.

They deny that there is any wish to avoid a fair share of local taxation, but they object to one species of personal property being rated when all other kinds remain exempt. The ground on which the question will be ultimately decided, however, will be the desirability or otherwise of taxing productive machinery. Such a tax acts in restraint of the trade of the country, and by increasing the cost of production hampers English manufacturers in their competition with those of other

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nations. They maintain that the arguments for Free Trade, and the examples of other nations, are all against the practice of taxing machinery, and they give illustrations from the cases of France, Austria, and the United States. In Austria-Hungary, for example, a law was recently passed to encourage the establishment of factories of all kinds. The advantages offered include the exemption for periods of fifteen years from all local rates, from the house-tax, the mining-tax, and from the taxes on all undertakings compelled by law to publish their accounts, from Chamber of Commerce fees, and from all general additions to the income-tax; also from all fees and local rates on the transfer of factory plots or buildings, from stamp duties and fees on all agreements relating to the founding of companies and on the capital employed by them. The bearing of recent legislation in the United States is also pointed out, as well as the efforts which are now being made for the purpose of inducing English manufacturers to remove their factories to America, for which purpose great facilities are being offered, including exemption from taxation.

COAL DUST IN MINES.

In our issue of the 9th of January (page 36) we directed the attention of our readers to a Minute of the Secretary of State for the Home Department which had been forwarded to Her Majesty's Inspectors of Mines, on the effect of coal dust in causing explosions. The Minute was founded on experiments made by Mr. Hall, one of Her Majesty's Inspectors of Mines, who had come to the conclusion that a blown-out shot may, in the presence of coal dust, and in the entire absence of fire-damp, cause explosions of great violence, often accompanied by volumes of rushing flame travelling considerable distances, and possibly so far as the supply of coal dust continues. He, however, did not think that any fresh legislation could be usefully attempted until the subject, both of the danger which coal dust may cause, and of the means by which that danger can best be met, has been fully investigated by competent scientific men. The Home Secretary has promptly followed up the Minute by arranging for the appointment of a Royal Commission "to investigate and to inquire into the effect of coal dust in originating or extending explosions in coal mines." Mr. Chamberlain has been appointed chairman, and, although he cannot lay claim to special scientific training, he has great business capacity, which is really what is wanted in a chairman. The scientific and practical aspects of the questions involved will lie in the hands of Lord Rayleigh, Sir William Lewis, Professor Dixon, Mr. Emerson Bainbridge, and Mr. Fenwick, M.P. The recent Royal Commission on Accidents in Mines investigated the subject to a certain extent, and had some experiments carried out, and their conclusions were embodied in the Act of 1887. The terrible explosions which occurred last year at the Llanerch and Morfa Collieries, and the experiments by Mr. Hall, however, have shown that there are still many aspects of the problem of explosions in coal mines which require investigation, and that further precautions require to be taken beyond those which are required at present by law. To these the attention of the present Commission will be directed, with the result, we hope, of considerably diminishing the number of explosions. Fortunately, for some time past existing regulations have had this effect; for, although the deaths last year were exceptionally high on account of several severe explosions, during the past ten years there has been a very considerable decrease, the numbers being 1,646, as compared with 2,656 during the previous ten years. For the two decades before that, taking us back to the time when mines became subject to Government supervision, the numbers were 2,267 and 2,441 respectively, so that recent improvement has been very marked. We trust that the work of the Commission may be the means of continuing that improvement.

THE EIGHT HOURS BILL.

The Bill which has been introduced into Parliament by Mr. Cuninghame Graham and other members of his way of thinking, for the purpose of restricting the hours of labour in all trades and industries to eight per day, is one of the most extraordinary measures ever brought before the British Legislature. Its general object and scope will be gathered from its opening clause, which is as follows:—"On and after the first day of January, one thousand eight hundred and ninety-two, no person shall work, or cause or suffer to work, on sea or land, in any capacity, under any contract or agreement, or articles for hire of labour, or for personal service on sea or land (except in case of accident) for more than eight hours in any one day of twenty-four hours, or for more than forty-eight hours per week."

We have on many occasions shown our sympathy with the working classes in their endeavour to shorten prolonged working hours and to effect a general improvement in their conditions, but the measure we have mentioned is so extreme and ill-considered that we feel almost inclined to say, "An enemy hath done this." The proposals are so absurd that they are certain to be laughed out of court. We have faith in British common sense, and we cannot believe that the measure will receive more than very limited support, and that only from the ignorant, or the unscrupulous who take advantage of the working classes. We hope it will be found that the Bill has been so badly drafted that it does not convey the real intentions of its framers, for the meaning which is on the face of it is an insult to the intelligence, not only of men who are expected to frame laws for the country, but also of the great masses of the working classes.

To imagine it either possible or desirable to restrict the hours of labour of all classes, so that, by the beginning of next year, no one will be allowed to work more than eight hours in one day, shows an utter want of economic and industrial knowledge, or a deliberate attempt to throw ridicule on the whole movement. Not only is it forbidden to all to work or cause to work more than the stipulated time, but if any one "suffers" longer hours to be worked he comes in for a share of the penalties. If this means anything at all, it means that when any person finds any other person working more than eight hours per day, he will either by his own influence, or by reporting him to the authorities, cause him to limit his hours. A healthy public opinion on the subject of the hours of labour would no doubt be most effective, but such an effect as that indicated would result in unbearable tyranny. Any measure which proposed to limit hours in those industries which are injurious to health, or where the public safety requires that the workers should always be in good condition, might receive some attention, but one which by a stroke of the legislature attempts to settle the matter for all trades, and for all sorts and conditions of persons, does not even deserve to be seriously considered. The various trades must organise, and, above all, educate public opinion, not only in this country, but also in those countries which are our industrial competitors, and, unless we wish to sacrifice, not only our industrial supremacy, but even our industrial existence, each case must be decided on its own merits, and according to its own conditions. We would only add further, that if the working classes showed a greater desire to fully utilise the leisure they at present have, they would better strengthen public opinion in support of their demands for more.

THE NEW ROUTE TO AUSTRALIA.

Commenting on the new line of mail steamers from England to Australia *viâ* Canada, Vancouver, Honolulu, Fiji, and Moreton Bay, the *Sydney Daily Telegraph* of 31st December, just received, says:—"On the face of it the project seems to have much to recommend it to careful discussion by the Governments concerned. The advantage of an alternative mail route to England, in case of interruption through war or any other cause, to those already in use should be obvious. Such an advantage is, of course, problematical; but the advantage in direct gain of time in the delivery of international mails is certain, and this alone is worth a good deal. With a mail service alternate with those now in operation, and perhaps more rapid, we should be kept in more full and frequent communication with England, to the facilitation and increase of business. But it is in another direction that the greatest gain to ourselves might be confidently looked for. There is a growing desire on the part of the Dominion of Canada to extend her trade to the Australian colonies—a desire which the passing of the McKinley Tariff Act has considerably stimulated. It would be impossible that a line of fast steamers such as has been proposed could travel between Vancouver and these colonies without bringing into existence a great deal of altogether new trade, and developing sources of employment at present almost unknown. It seems to us that the only question to be considered by the Australian Governments in connection with this matter, is whether the probable gain to them by the establishment of the new service would repay the subsidies asked for. No new legislative principle is sought to be introduced, as we already grant subsidies to existing mail services, an arrangement which is admittedly a direct public gain, and has contributed enormously to the development of such magnificent services as we now possess in the P. & O. and Orient lines. Lately, also, the Government of the United States has granted subsidies with a lavish hand to their mail lines, on the ground that the Republic is hereby a gainer, and, although it would not be safe for us to imitate everything which American legislators do under that plea, this case might prove an exception. To subsidise a new line of steamers, which would render us valuable service in opening up new industries and establishing trade relations, would only be an expenditure of State funds similar to that undertaken when railways are built to afford additional convenience to internal production." The pioneer of the connection from Vancouver to China and Japan, the twin-screw s.s. "Empress of India," left Liverpool on Sunday last with a full complement of passengers for her maiden trip around the world, after which she goes on her station on the Pacific.

Letters to the Editor.

CYANIDE OF POTASSIUM AS A SOLVENT OF GOLD AND SILVER.

To the Editor of "Industries."

Sir,—I did not try to prove, as Mr. MacArthur mildly put it in your last week's issue, that his process has been known since 1806.

I claim, on the contrary, to have proved that what Messrs. MacArthur and Forrest call their discovery of the properties of cyanide of potassium as a solvent of gold has been known for many years, and has been described by chemists, electricians, and metallurgists, not only in England, but in France, Germany, and America, and has been the objects of several patents.

Mr. MacArthur complains that, as a scientific and industria periodical, *Industries* ought not to have published such revelations. But if the facts of the case were not known before the publication of my letter, the disclosure I made must be interesting, and *Industries* renders good service in making known the properties of cyanide. Dr. Gore did not mention these properties in his paper, read at the Royal Society, on "Cyanogen as a Solvent," and Professor Crookes, in his last specification, published a few days ago, speaks disdainfully, of cyanide of potassium stating that it has a very feeble solvent action on gold.

I may claim to have elucidated a point of history—viz., that Messrs. MacArthur and Forrest—who speak of the discovery they made after three years of researches and experiments on all sorts of chemicals—have not discovered anything at all.

I did not discuss the validity of their patents, as there is no patent or patentability where there is neither invention nor novelty. Not only did they not discover the properties of cyanide of potassium, but they patented its use for extracting gold from its ores in the same manner as Simpson used it, and for precipitating the gold from its solution, just as Price did—*i.e.*, by means of zinc in a state of fine division.

When Messrs. MacArthur and Forrest and the Cassel Company have refuted my arguments, and proved what they profess, *i.e.*, that cyanide of potassium as a solvent of gold and especially of sulphuretted gold, was not known, and used as such before their discovery, I may give a few more quotations, on the use, years ago, of cyanide in gold and silver mines. For the present Messrs. MacArthur and Forrest and the Cassel Company have enough to do if they try to make researches to demonstrate that I am wrong in my criticism. I do not say that Messrs. MacArthur and Forrest were not *bonâ fide* in believing that they were the first and true discoverers of the affinity, as a solvent, of cyanide of potassium for gold and silver, but after I had substantiated the real facts, as I did in your issue of the 30th ult., it would have been wise to keep silent, instead of indulging in recriminations.

The great point is to use cyanide of potassium as a solvent in a new and original manner, in a new and original apparatus, and to separate the gold from its solution, not only in an efficient, rapid, and cheap manner, but according to a new and unassailable method. I plainly say that I do this by aid of electricity, but if ever the Cassel Company finds that, what I claim to be my invention, is only an infringement or plagiarism, I assure you I will not protest as Mr. MacArthur has done. The Cassel Company has been very unfortunate. At first they took out many patents for a process which everybody knows was not good; and not long ago one of the highest authorities in the metallurgy of gold told me that he had followed the experiments on the old Cassel process, but had never seen one ounce of gold extracted.

Now the Cassel Company has taken out again many patents for extracting gold from its ores, and, this time, the process may be good—I will even say that it is good; but it is based on the extraction and separation of gold by cyanide of potassium, which, I assert, is common property.

Yours, &c.,
Emile Andreoli.

62, Loughborough Park, London, S.W.,
9th February, 1891.

To the Editor of "Industries."

Sir,—Your correspondent, Mr. MacArthur, in his letter last week on the above subject takes exception to the discussion in your columns commenced by Mr. Andreoli in the previous issue. I am not in a position to decide as to which of your correspondents is right in the matter under dispute, but I must differ from Mr. MacArthur in his opinion that a scientific and industrial periodical is scarcely the place in which to discuss the validity of patents. He seems to forget that Mr. Andreoli's letter was prompted by the report in your columns of the discussion which took place at the meeting of the Society of Chemical Industry, at which the process under dispute was subjected to much discussion. As I was present at the meeting I may state that the discussion was apparently taken down in full, and I have received from the official reporter my own remarks thereat, so that I presume that the journal of the Society in its February number will publish the general discussion which then took place on the validity of the patents as hinted by Mr. Vautin and refuted by Mr. MacArthur himself (I believe).

I fail to see the difference which exists between the correspondence in your journal, and the discussion which will appear

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THE TAXATION OF MACHINERY.

	GROSS ESTIMATED RENTAL.		PROPERTY TAX.		RATEABLE VALUE.		LOCAL RATES—*i.e.*, POOR, BOROUGH, AND DISTRICT, &c.		Total Increase in Property Tax, Poor, Borough, and District Rates.	Increase per Cent.
	At Present.	If Machinery be Rated.	Now at 8d. in £.*	If Machinery be Rated at 8d. in £.	At Present.	If Machinery be Rated.	Taken at 5s. 8d. in £ on Basis of Rating at 30th June, 1886.	Taken at 4s. 7d. in £ on Basis of Reduction Effected through Increase of Rateable Value.		
	£	£	£	£	£	£	£	£	£	
1. (*a.*) Cotton spinning mills in Bolton, purely spinning..... (*b.*) Cotton spinning mills, having weaving mills, &c., adjoining..... (*c.*) Cotton spinning, silent small doubling, &c., and where number of spindles could not easily be ascertained, are omitted. Rateable value of (*c*) only £1,529, therefore unimportant.	69,603	153,126	2,320	5,104	56,409	124,100	15,983	28,436	15,237	83
2. Cotton weaving, &c., mills, in Bolton	11,709	24,881	390	829	9,556	20,306	2,707	4,651	2,383	77
3. Iron foundries, machine works, &c., in Bolton	18,668	35,319	622	1,177	15,107	28,557	4,280	6,550	2,825	57
£	99,980	213,326	3,332	7,110	81,062	172,963	22,970	39,637		
Memo., on effect of rating machinery now exempt: No. 1 would be increased 120 per cent. No. 2 would be increased 112½ per cent. No. 3 would be increased (except two large works for which allowance is made in calculations) 125 per cent. Property tax would of course be paid on gross increase.			Increase in Property Tax, as above shown, would be equivalent to a 1s. 5d. in the £ tax on present gross estimated rental.				The increase on local rates thus shown would be equal to a 9s. 9d. in the £ rate on present rateable value. That is to say, "rating machinery now exempt" would have the further effect of increasing the mill and works owners' local rates by 4s. 1d. in the £.			

* NOTE.—This Summary was prepared in 1887, when the Property Tax, now 6d. in the £, was then 8d.

The above Table is a summary of a paper prepared for the use of the Select Committee of the House of Commons on the Rating of Machinery, and appended to their Report. This Table takes Bolton as an illustration of the effect which the taxation of machinery, as carried out in the Chard Mills case, would have upon users of machinery in the manufacturing districts of the North of England and elsewhere if it were adopted by the Assessment Committees of those districts.

The Report of the Select Committee above referred to (No. 231) can be obtained from Messrs. Eyre & Spottiswoode, London, price 1s. 6d.

in due course in the Journal of the Society of Chemical Industry. There is, however, a precedent on this very subject, as for some time past the *Engineering and Mining Journal*, of New York, has thrown open its columns to correspondence on the same subject, and Mr. Cuno, who is the chemist of the Gold and Silver Extraction, Mining, and Milling Company in the United States, which owns the exclusive rights to the MacArthur-Forrest process in that country, has himself written a letter on the subject, and thus violated the rule which Mr. MacArthur wishes to introduce.

It seems to me that it would be, in many cases, advantageous if the merits of rival patents could be discussed in a public way in scientific and industrial periodicals, not only as it would afford opportunities for the public to form its own opinion on the points at issue, but in many cases might save the patentees many solicitors' letters, and possibly legal expenses, of a ruinous nature. If a patent is a good one, surely the greater the publicity given to it the better for the patentee.

Yours, &c.,
SAMUEL RIDEAL.

London, 9th February, 1891.

THE TAXATION OF MACHINERY.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Will you be good enough to find space, if possible, for the above table, showing, in a typical instance, the effect on the industries of the country if the new principles of rating premises containing machinery, which have lately been adopted in some parts of the country, were to become universal?

It is most important that the industrial classes, both employers and wage earners, should realise what is in store for them, unless the Legislature can be induced to define more clearly than at present what the law of rating is really intended to include when applied to industrial premises, and, if necessary, to amend the existing ancient Act. The increased burden, as shown by this table, would be intolerable, and manufacturers of all kinds, engineers and others, should at once look into this question, and by every means in their power support the Bills which have been introduced into the House of Commons to avert such disastrous results as are here foreshadowed.

Yours, &c.,
W. H. HOULDSWORTH.

House of Commons, 7th February, 1891.

THE LONDON SMOKE AND FOG PLAGUE.

TO THE EDITOR OF "INDUSTRIES."

SIR,—In answer to Mr. Thomas Fletcher's letter in your last issue, let me say that I do not think his argument will hold water. He says that the difficulty is that asbestos cannot be blackened, because no permanent black is known. I never proposed to blacken the asbestos, but to use a black radiator such as iron, which gets coated with oxide. The appearance may be poorer, but I cannot agree that the efficiency would be less. Black is a better radiator than white, so a given surface will radiate more heat at a given temperature, hence the superiority of gas stoves with iron "fires" compared with those of asbestos. With the same radiating surface the iron radiates more heat, and the burned gases go off at a lower temperature.

As to draught, most gas stoves are provided with no regulators at all. Even if regulators are supplied, it is better to abstract as much of the heat as possible and to radiate it, or even to let it heat the external air by convection or "warm air" arrangements. I have a little gas stove in my office, and I have arranged it with 6ft. of iron flue along one side of the room. This flue gives off nearly as much heat as the stove itself, and the end near the stove is not much hotter than the other, so most of the heat even then passes away in the used gases. If the stove had been connected to an ordinary fireplace, not only would the heat I get from the flue be lost, but there would be a powerful draught up the flue and through every crevice and cranny in the sheet-iron covering of the fireplace.

In conclusion, I must plead that I have had some practical experience with gas stoves, as well as with other industries connected with coal gas.

Yours, &c.,
"LONDONER."

London, 9th February, 1891.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

TO THE EDITOR OF "INDUSTRIES."

SIR,—Allow me to express my appreciation of the thoroughly exact and judicious statement on this subject contributed by Mr. G. R. Bodmer in your issue of the 23rd ult.

The question "Is the study of heat mechanics useful to engineers?" is very much like the other, "Is the study of the habits of growth and the vital forces of plants of use to the gardener?" In any path of life, if you get hold of a *wrong* theory, and allow it to dominate your action, it may lead you very far astray. The other question, "Are the theoretical laws of thermodynamics, as at present understood and taught, true or false?" would be intelligible, and perhaps it might be a useful challenge. But if anything be found wrong in the ordinary teaching, if it be shown to be inconsistent with observed facts, surely that is not a good reason for abandoning the study; rather is it the best of all reasons for devoting ourselves to the study with renewed energy and renewed determination to learn the truth. Even the proof of the incorrectness or incompleteness of the present teaching must necessarily be the result of study of the subject. It would be puerile to dispute the importance to engineers of knowing the truth about the mechanical action of heat—even of knowing it completely. Let us then apply ourselves to the study of this all-important subject, remove all existing errors, and find out the whole truth about it.

It is also ungenerous in those who may have, by the help of our present more advanced knowledge, discovered mistakes in the applications of thermodynamic law (or even in the theory itself) made by the last generation, to sneer at and blame those who made such mistakes. The science was in its infancy, and no doubt mistakes and confusions have been made. We have inherited an immense amount of useful knowledge from these pioneers; it would surely be ungracious to be severe upon them for passing down to us a few misconceptions. What we have to do is to clear these away, if there be any, and above all to *complete* our knowledge of heat actions in the infinite variety of circumstances in which they are clearly of practical importance.

It is a dishonest and contemptible device of the enemies of scientific technical education to assume that engineering professors pretend to turn out "complete engineers" from their colleges. I never met any professor who pretended to do anything of the sort. I believe that we are all conscientious in explaining to our pupils that a formal or informal apprenticeship in works is necessary in addition to the college training. I make this clear to every pupil, and to his guardians as well, before he enters upon the course at Mason College.

Yours, &c.,
ROBERT H. SMITH.

Mason College, 9th February, 1891.

Books Received.

Transactions of the American Society of Engineers, October and November, 1890.

Spons' Engineers' Diary and Reference Book for 1891. London: E. & F. N. Spon.

Reviews.

APPLIED GEOGRAPHY. A Preliminary Sketch. By J. Scott Keltie, Librarian to the Royal Geographical Society. London: GEORGE PHILIP & SON. 1890.

This little book differs from the text-books of commercial geography which have appeared in recent years, and will be found to be useful and instructive to a larger number of readers, as its object is to show what are some of the bearings of geographical knowledge in its application to human interests, to the course of history, and more especially to industry, commerce, and colonisation. The first chapter appeared as an article in the *Contemporary Review*; the other four chapters formed a course of lectures given during the past year at the Bankers' Institute, by request of the council of that body, and were in part re-delivered before the

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Society of Arts and the College of Preceptors. The first two chapters deal with general data and methods, which are illustrated in the following chapters, with special reference to Africa, the British Empire, and some of the chief commodities of commerce. Mr. Keltie's book will be most useful in giving an idea of the modern methods of teaching geography, and of the wide significance and importance of its study. Ever since Ritter's time a specially human turn has been given to the subject by his countrymen; it has been recognised that the ultimate task of geography is to study the earth as a dwelling-place of humanity. Mr. Keltie points out the bearings of the subject, not only in connection with its wider interests, but also with the more restricted ones of commerce and colonial enterprise. As regards the latter, he shows how foolish were the fears expressed in Britain regarding French and German annexations, and points out the necessity for our public men making themselves better acquainted with applied geography. Mr. Keltie's book will be most useful to such men in at least indicating some of the things they ought to study, but it will also be read with interest by educationists, and, in fact, by all intelligent persons.

Spons' Engineers' Diary and Reference Book for Engineers, Machinists, Contractors, and Users of Steam for 1891. London: E. & F. N. Spon.

This diary, which is printed on good paper, and is well arranged, contains a large number of tables of reference and other useful information. It is prefaced by a report on the engineering trades for the past year, and, besides articles on the amount of work produced by men and by animal power, it contains a properly classified catalogue of recent technical literature, and much information with regard to examination of seagoing engineers, engineering schools, and engineering scholarships.

Asbestos, Its Properties, Occurrence, and Uses. By Robert H. Jones. London: Crosby Lockwood & Son. 1890.

In 1888 Mr. Jones issued, in a pamphlet of seventy-six pages, an account of the Canadian asbestos mines. Believing that in the future there will be few branches of industry in which asbestos will not find a place, he has noted the new uses which are continually suggested. By a careful study of the literature of the subject he has succeeded in giving a synopsis of all that is known of this singular mineral. The literature of asbestos is confined to blue-books, pamphlets, and articles in technical journals. The most comprehensive paper on the subject is inaccessible to English readers, as it was published in the Russian *Mining Journal* in 1886. With this paper the author does not appear to be acquainted.

Mr. Jones divides his subject into thirteen chapters, dealing respectively with the nature and properties of asbestos, its varieties and qualities, the present sources of supply, Italian asbestos and the Italian mines, Canadian asbestos, the Canadian quarries, output and cost of production, deposits in Newfoundland and Norway, application of asbestos to engineering purposes, to military and fire-preventive purposes, and to miscellaneous purposes. The last two chapters are devoted to slag wool and other substitutes for asbestos, and to a description of fibre spinning. The work covers 236 pages, and the text is elucidated by means of some fifty illustrations, many of which are excellent photogravures.

Asbestos, which the author unscientifically describes as a "mineralogical vegetable," is a fibrous variety of hornblende, and differs materially from the so-called asbestos of Canada, which is a fibrous form of serpentine. Its incombustible nature appears to have been known since the time of Moses, and the author gives numerous interesting references to Pliny and other ancient writers, who describe napkins woven of this mineral. Asbestos is chiefly found in the form of veins in metamorphic rocks, and is widely distributed throughout the world, though the finer qualities and richer veins are by no means common. Asbestos of good quality is not found in the United States, and the supplies of crude ore are almost exclusively derived from Canada. Indeed, out of a total export from the Dominion of 3,936 tons in 1888, no less than 3,612 tons was taken by the United States. In Italy mining for asbestos is carried on with greater difficulty than in Canada, and the supply of the mineral, if more abundant, is much more uncertain. When the Canadian mines were opened many mistakes were made, arising mainly from inexperience. Much valuable ground is now covered by waste heaps, which will unquestionably have to be removed when the land is wanted for working, and the cost of this will be enormous. The author points out that this want of foresight will eventually lead to serious trouble at several of the Canadian mines. From the peculiarity of the work there is evidently no other class of mining which so absolutely necessitates the services of a mining engineer to mark out the land in the first instance for mining and for the waste heap. The author anticipates the opening of new mines in Canada, for it has been proved that mining for asbestos, when properly conducted, shows a more steady return for the money invested, with less elements of risk, than mining for any other mineral.

Within the last ten years the use of asbestos in the arts has greatly extended. Its fibre has a strength ranging between that of flax and silk. It is a bad conductor of heat and electricity: it is insensible to the action of most acids and to that of the caustic alkalies, and its specific gravity is low. The preparation of asbestos cloth is rendered difficult on account of the fibres being smooth and free from the irregularities which characterise fibres of animal or vegetable origin. Space will not permit us to enumerate the long list of purposes for which asbestos is used. Whether for closing the breeches of big guns or for rendering cigarette papers incombustible, all the proposed uses of asbestos are fully described by the author. His style tends, perhaps, to be somewhat discursive, and, from the point of view of the general reader, it is to be regretted that the author invariably quotes foreign authors in the original language. It would surely have been better to translate the passages into English. It seems absurd to give the results of an analysis of Canadian asbestos in Italian, as the author has done, merely because he happened to have had the analysis made in Italy. These criticisms are, however, trifling matters. On the whole the work deserves unqualified praise. It is the first English book on the subject, and as a clear description of asbestos and its varied uses cannot fail to make more widely appreciated the useful qualities of a mineral of which very little is known outside the domain of science.

L'Acier. Historique—Fabrication—Emploi. Par L. Campredon. Paris: B. Tignol, Editeur. 1890.

This interesting little book forms one of the series in the "Bibliothèque des Actualités Industrielles," published by M. Tignol, Paris, and a perusal of it shows that it is well worthy of a place among those which have preceded it. A letter to M. Campredon from M. E. Fremy, Member of the Institute, expresses the opinion that the book will bring the author great credit. It certainly gives in a very moderate space a great deal of very useful information about steel, and will be found interesting even by general readers. The first part of the book is taken up with a history of iron and steel from the earliest to the present time. In the second is examined the general properties of metals, and especially of iron and steel, while in the third is given a succinct account of the manufacture of cast and malleable iron. The last and most important part of the work, occupying as it does three-fourths of the book, is exclusively taken up with the study of the manufacture of steel, and with the enumeration of its principal uses. This part will be found thoroughly practical, as it not only describes the main methods and processes of the manufacture, but also gives very good drawings of the furnaces and apparatus used, analyses of the different products, and the properties and uses of the finished materials. A supplement gives an account of the exhibits of steel at the Paris Exhibition of 1889, which, the writer remarks, was a veritable metallurgical panorama, and especially a triumph of iron and steel. On the whole, we agree with M. Fremy that the book is a most creditable production, and will be found useful to a large variety of readers.

A Manual of Public Health. By A. Wynter Blyth M.R.C.S., L.S.A., &c. MacMillan & Co. 1890.

There is no more evident sign of the increased attention which is being given to preventive medicine than the number of text-books which have recently appeared on this subject, and on the various branches of it, and it will soon require some justification when a new manual of hygiene comes out. We may safely say that such a justification exists in the case of the present volume. The chapters on trade nuisances, disinfectants, and infectious diseases would in themselves amply vindicate the author. It is true that these are for the most part compilations from contemporary sources, but they are judiciously selected, and they fill a recognised gap in books of public health. In the section dealing with tuberculosis we miss an account of the well-known fact that light is a powerful agent in the destruction of the spores of tuberculosis. The effect of light in destroying putrefactive organisms was first clearly demonstrated by Dr. Downes, now an Inspector of the Local Government Board. His observations were subsequently extended by other inquirers to individual diseases. It is manifest that this fact has an all-important bearing on the sweeping away of ill-lighted houses in narrow streets, and on the building of the future. It is also a powerful argument for causing smoke from the chimneys of manufacturing establishments to be consumed as far as practicable. We also miss an account of Coenet's valuable researches into the continuance of tuberculous infection in houses and wards. Further, we consider that the evidence relative to the infectivity residing in the flesh of tuberculous cows is not so presented as to lead to unbiassed conclusions. But, in spite of such minor strictures, we think that these matters are, on the whole, fairly presented. We could wish, however, that the names of foreign authors were more correctly given. In other respects the book is well written, and is not loaded with useless material. Another good feature of the book is the list of practical examples given showing how to make calculations, draw up reports on various subjects, make bye-laws, &c. This is deserving of special commendation.

It is, of course, extremely difficult to make such selections from the vast amount of work which has recently been done in connection with the bacteriology and prevention of infectious disease, as will satisfy at once the requirements of every reader, and the dimensions of the present volume. Our reason for criticising this portion of the book is that we regard it as specially valuable, and specially well executed.

Amongst other things which deserve mention we may notice the chapter on the chemical examination of water, Dr. Wynter Blyth's investigations into the action of the halogens as disinfectants, and the well-written little chapters on the inspection of food and on the diseases of animals most frequently met with. On the whole this work is well arranged, very well illustrated, and contains a wealth of material not found in the standard books on public health.

Neuere Wasserwerksmaschinen. Von A. Riedler, Professor au der Königl. technischen Hochschule zu Berlin. Berlin: Verlag von Julius Springer. 1890.

This is a reprint from the *Zeitschrift des Vereines deutscher Ingenieure*, and, like so many of the papers which are read before that institution, it is characterised by German thoroughness, and gives in a comparatively small space a great amount of information about the newer forms of pumps and pumping engines, especially those of German design and manufacture. Its arrangement is descriptive rather than systematic—that is to say, instead of entering into the theory of pumps and pumping engines, it selects specimens and gives descriptions, not only of their general arrangement, but also of their details. The designs which are given are all to scale, and, in fact, could be used almost as working drawings, and thus would be found most useful, not only to students, but also to manufacturers. We do not, however, suggest that students should sit down and deliberately copy them, but rather that they should study them carefully, and observe the good points in them, so that they may be able to incorporate them in any special designs which they may require to make. We have much pleasure in recommending Professor Riedler's contribution to the history of pumps and pumping engines to the attention of those of our readers whose work or studies are connected with these departments of engineering.

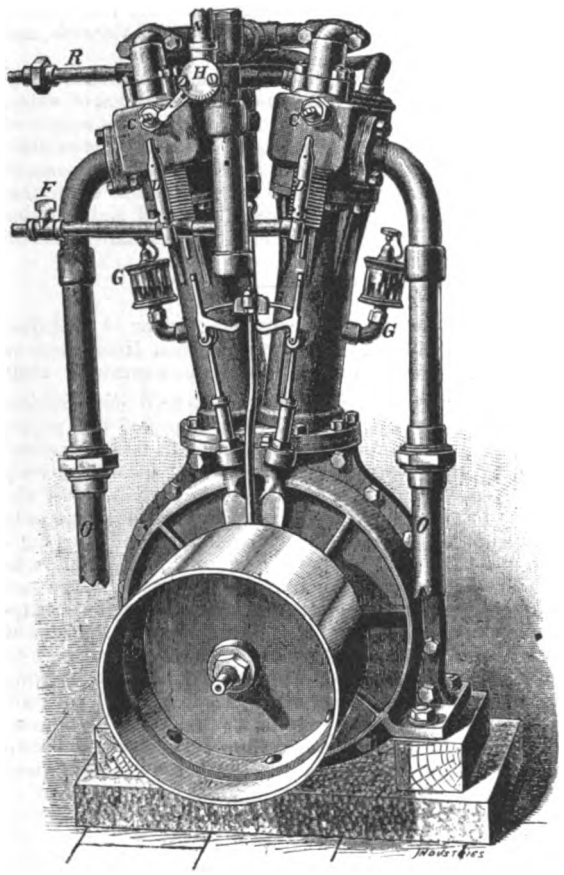
Practical Blacksmithing. Compiled and edited by M. T. Richardson. Vol. III. New York: M. T. Richardson. London: Kegan Paul, Trench, Trübner, & Co. 1890.

This is the third volume of a series of books which are made up of articles contributed at different times by skilled workmen to an American publication, entitled *The Blacksmith and Wheelwright*, and covering nearly the whole range of blacksmithing, from the simplest job to some of the most complex forgings. The first volume of the series was devoted to a consideration of the early history of blacksmithing, together with shop plans and improved methods of constructing chimneys and forges. The second was for the most part given up to the consideration of tools, a great variety of which were described and illustrated. The volume before us also takes up the subjects of tool in its first two chapters, after which it is devoted chiefly to a description of a great variety of work, and shows how the tools which were previously described are used practically. We need not attempt to enter into an account of the different kinds of work explained; it is sufficient to say that they cover a very wide field, although special attention is paid to the lighter descriptions. There is to be another volume to complete the series, in which, possibly, the heavier class of work will be described. Although, of course, we do not for one moment believe that blacksmithing is to be learned from books, still there can be no doubt that books can give a great deal of useful information about it. The series we have been considering is possibly the most complete on the subject that has as yet been published, and will be found most useful to a considerable class of readers.

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THE "DAIMLER" GAS AND PETROLEUM MOTOR.

Now that gas engine patents are expiring, engineers will naturally turn their attention to the perfection and reduction of price of these motors. For many purposes a high speed is very advisable. It permits of small floor space, less first cost, and for driving high-speed machinery, such as lathes or dynamos, it saves countershafting. For electric lighting, on a small scale, high speed is also very important, as it prevents the flickering due to the explosions, which are often annoying in the case of engines running at about a hundred and fifty revolutions per minute. The slow speed engines also frequently give trouble by shaking, and the foundations have to be very carefully designed to avoid vibration of neighbouring buildings.



The "Daimler" engine, for the illustration and description of which we are indebted to our American contemporary, the *Electrical World*, is specially designed for high speeds. Our illustration represents one of the latest type. It is a 2 horse-power motor, and is only 3ft. 2in. in height; its weight is 300lb., and the normal speed 500 to 600 revolutions per minute. The driving pulley, which is shown in front, is 10in. in diameter, and has a 7in. face. The small floor space which it occupies makes it very suitable for the driving of small dynamos in situations where a larger engine could not be used on account of the limited space. It is used with ordinary gas, or petroleum, as desired, and requires very little attention while running. It is claimed that it can be made ready to start in less than one minute. Engines of this type are manufactured by the Daimler Motor Company, at Steinway, on Long Island, U.S.A., and are coming into extensive use for driving dynamos and for propelling small pleasure boats. The machines are built in 1, 2, and 4 horse-power sizes. In Stuttgart a street car is worked by a 10 horse-power engine of this kind.

THE CHELSEA SYSTEM OF ELECTRICAL DISTRIBUTION.*

THE Chelsea system may be described as follows:—(*a*) Charging the accumulators at high pressure, and discharging for distribution at low pressure, and effecting the changes necessary to the same by special automatic arrangements placed in each storage station; (*b*) supplementing the main supply by means of continuous-current transformers; (*c*) distributing by means of mains laid down in a network; (*d*) maintaining a constant pressure by means of the introduction into the discharge circuit from the storage stations of counter e.m.f. cells; (*e*) the use of underground conductors throughout, laid so that the cables can be drawn in and out, and renewed or repaired whenever necessary, without disturbing the ground.

The arrangements and connections of the charging units, batteries, and transformer motors are as follow:—First, there are three of these plants in series charging one of the half batteries in each of three storage stations, the lighting being maintained by the other, or second half, battery; and the pressure in the distributing mains being regulated by cells which give a counter e.m.f. Second, the three plants are charging the second half batteries. Those which having been previously charging are now discharging to the distribution system. Regulation is still maintained as in the first position. Third, there is a cessation of charging, and the two half batteries are discharging together in parallel. Regulation is maintained as before. Fourth, continuous-current transformers, run by the same units, are supplying current to the system in parallel with both halves of the batteries.

The apparatus for effecting the various transpositions of the secondary batteries in the storage stations, and for maintaining the pressure constant in the mains, is automatic. The movable portions are worked by the energy which would otherwise be wasted in the counter e.m.f. cells, which are used for regulating the pressure in the distribution system. All the actuating portions of the apparatus require current at an e.m.f. of only 4 or 5 volts.

As regards the charging of the accumulators at high pressure and discharging for distribution at low pressure, and effecting the changes necessary to the same by the special automatic arrangements placed in each storage station. The system has worked uninterruptedly in each of the four storage stations now in actual use.

The supplementing of the main supply by means of continuous current transformers is a portion of the system of which our year's experience has gone far enough to show that it is an efficient and reliable way of providing for the increase in demands for current which the full discharge of the distant storage stations would be incapable of meeting; and that the economy arising out of the employment of the generating units, during otherwise idle hours, compensates for the loss in conversion.

During the fifteen months ending with the 31st December, 1890, the growth of the demand has increased up to 19,000 watts. This growth has been accompanied by a variation in the demand according to the season. This variation in the anticipated demand has also been marked by its inequality in various parts of the same district. To provide for such contingencies as this, in the first instance, would have entailed a first outlay in insulated copper, and a consequent idleness of capital, which prudence forbade.

In one case, after eighteen months' full use, it was found, from tests made by the manufacturers, that one-third of the active material of the positive plates had been exhausted. During the latter six months of the same period—which may be considered a good example of normal rate of waste—the peroxide which has scaled off and fallen to the bottom of the glass cell and been removed has averaged half a pound per month from 15 plates, or half an ounce per plate. The general conclusion come to is that under the normal circumstances of charge and discharge of the Chelsea system the life of the brown plates can be calculated at three years at least. The possible leakage from accumulators has been laid some stress on by critics, but, with precautions adopted, the tests on an average show an insulation resistance to the earth of about 50,000 to 100,000 ohms.

As regards the economical aspect of the case, practice shows, in any comparison, that, where a small section of copper in each conductor in the same line only is required, other conditions being alike, it is much cheaper to use insulation of the character of bituminous compound, in ducts, or "ways," of a small size and economical material, than to look for insulation to non-conducting supporting surfaces, with a large surrounding of air space subsisting in a subway of which the minimum first cost must be represented by a substantial figure. It is in connection with large mains that the engineer who has first adopted the use of a dielectric material to surround his copper first turns his attention to bare copper, with a view to obtain a saving in construction. The size of these mains is controlled by the distance between the points of "source of supply" for a given demand in a given area. Obviously, if these points can be placed nearer or further apart, according to what may be called the density of demand, there can be found a fairly definite limit to the size of the largest mains.

But where the "source of supply" is a large generating station, distributing at low pressure direct into a network of mains over a large area, say three-quarters of a mile a side, then I regard the adoption of a system of underground construction, such as that known as Mr. Crompton's, and used in part of Kensington, as unavoidable, owing to the necessity of using stems or feeders of large capacity. Indeed, such a system is the natural outcome of the conditions under which running machinery is the primary, and accumulation is the secondary, source of supply, with low-pressure distribution from one source. On the other hand, when these conditions are reversed, the proximity of the "sources of supply" reduces the section of copper required for feeding the distributing network, and, as I have said, the cost of the underground works is by its simplification much reduced. Also, the position of the generating station is a matter of comparative indifference. Accumulators used in connection with any system which virtually distributes direct from the dynamo at low pressure can be regarded only in the light of auxiliaries, and in no sense as a main force of supply. So far as the author had observed, they act as little more than regulators, and are generally charged and discharged at the same time, and therefore not really fairly treated, and cannot be expected to have an average life.

In Chelsea they had come to the conclusion that, out of five lamps installed in private houses, two represent the maximum number in use at one time, and that we cannot expect that the gross earnings of each lamp installed will exceed 8s. 6d., with the added fact that seventy is the average number of lights installed in private residences. This gives twenty-eight in use at one time, at a cost of a little under £30 per annum at 8d. a unit. The author said this compares unfavourably with such districts as St. James's, but Chelsea is an average residential district, and St. James's is simply the cream of the world.

To help in economising copper, the Board of Trade, in the rules lately issued, prescribe that undertakers shall maintain a standard pressure, which may be different for different portions of a distributing main, and shall declare to any consumer the constant pressure at which they propose to supply energy at his own terminals. Obviously, it is directed that, once declared, that pressure shall not be altered or departed from without authority, except within prescribed limits. These rules go further, however, and say that before using a distributing main the amount of such pressure (which, to meet an obvious condition, may be different for different portions of a main)—*i.e.*, the amount of those pressures—shall be determined, and given to the local authority. Now, with great deference to the Board of Trade, the daily experience in Chelsea shows that this rule, made with the best intention as a help, may be used to bear hardly on a supply company, if enforced to the letter. For instance, take a compulsory street, say with thirty houses along one frontage: a main is laid along it, calculating on a demand, say, from one-third of the houses, and an estimated maximum consumption in each. We don't know really how to proceed under the rule. At first, two houses, at irregular intervals, require current. What are we to declare to them and the local authority before letting them have it? Suppose we declare—what we know will be the case even if five or six houses require a supply—the same pressure throughout. Suddenly the owners of six more houses require current. This demand will at once cause a curve in the line of pressure; and, failing substitution of fresh figures in the declarations to some of the houses, near the centre of the street, which may be those that first came on—a change of intention that would not be easily allowed—or a substitution of a larger conductor, a state of dilemma is produced which neutralises the beneficent effect of this rule, designed for an almost completed system, and not a growing one.

However much a company may desire not to avail itself of the apparent relief afforded by the permission to declare differing pressures, in practice they must do so at points at or near their frontiers. Here we see the effects of Parliament trying to legislate without previous experience.

As regards the comparative cost, generally speaking, if the section of copper in a pair of conductors is 1in. and under, then a main constructed with insulated cables in separate "ways" is cheapest—increasingly so with small conductors. Between 1in. and 1¼in. the comparison varies according to circumstances. Over 1¼in. of section, then uninsulated copper in conduits bears away the prize for economy. Experience in Chelsea enabled the author to give an example of the actual cost of a three-2in.-way line laid in one of the squares. Its length is 613 yards. The cost of supplying and laying the casing, including vestry charges and an allowance for engineering profit, was at the rate of 6s. 6d. a yard. For purposes of comparison, the cost of the surface boxes must be added to the above. Allowing draw-boxes for large angle changes of direction, and one small service box for every two houses, we must add 2s. 3d. per yard, or a total of 8s. 9d. per yard. On the three-wire system—for which provision was, he believed, always made in Mr. Crompton's mains—the three ways in the above example can receive two bitumen high-insulation cables of 61/12, having an external diameter of 1·71in., and one 61/15, with an external diameter of 1·40in. The section of copper in these three cables is 1·335in., and their cost per yard *in situ* is 31s. per yard, giving a total cost of the completed line at less than 39s. 9d. per yard, or if the section was 1·25in., about 39s. This line is sufficient to convey current to all the sixty houses which are situated along the route. If provision need be made for half the houses only, then the cables will cost 17s. a yard, or at a total of 24s. 9d. for the completed main per yard. In actual practice, 324 yards is an unusual length for a distributing main, and the ends of the stems being nearer to one another, the section of copper to supply thirty houses would be actually less.

* Abstract of a paper read on January 22nd, 1891, by Major-General Webber, before the Institution of Electrical Engineers.

ELECTRICAL STANDARDS.

THE following draft resolutions, with others, dealing with the practical measurement of power, whether developed by unvarying or alternating currents, will be submitted to the Electrical Standards Committee for discussion at their next meeting, which will take place on Friday, the 20th inst.:—

1. That it is desirable that new denominations of standards for the measurement of electricity should be made and approved by Her Majesty in Council, as Board of Trade Standards.
2. That the magnitudes of these standards should be determined with reference to the centimetre as unit of length, the gramme as unit of mass, and the second as unit of time, and that by the terms centimetre and gramme are meant the standards of those denominations deposited with the Board of Trade.
3. That the standard of electrical resistance should be denominated the ohm, and should have the value 1,000,000,000 in terms of the centimetre and second.
4. That the resistance offered to an unvarying electric current by a column of mercury of a constant cross sectional area of one square millimetre, and of a length of 186·3 centimetres at the temperature of melting ice, may be adopted as one ohm.
5. That the value of the standard of resistance constructed by a committee of the British Association for the Advancement of Science in the years 1863 and 1864, and known as the British Association unit, may be taken as ·9866 of the ohm.
6. That a material standard constructed in solid metal, and verified by comparison with the British Association unit, should be adopted as the Board of Trade standard ohm.
7. That for the purpose of replacing the standard, if lost, destroyed, or damaged, and for ordinary use, one or more copies should be constructed, which should be periodically compared with the standard ohm and with the British Association unit.
8. That the standard of electrical current should be denominated the ampere, and should have the value one-tenth (0·1) in terms of the centimetre, gramme, and second.
9. That an unvarying current which, when passed through a solution of nitrate of silver and water containing from 15 to 20 parts by weight of nitrate of silver in 100 parts of water, deposits silver at the rate of 0·001118 of a gramme per second, may be taken as a current of one ampere.
10. An alternating current of 1 ampere shall mean a current such that the square root of the time average of the square of its strength at each instant, in amperes, is unity.

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11. That an instrument constructed on the principle of the balance in which, by the proper disposition of the conductors, forces of attraction and repulsion are produced, which depend upon the amount of current passing, and are balanced by a known weight, should be adopted as the Board of Trade standard for the measurement of one ampere, whether the current be unvarying or alternating.

12. That the standard of electrical pressure should be denominated the volt, being the pressure which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere.

13. That the electrical pressure at a temperature of 62° F. between the poles or electrodes of the voltaic cell, known as Clark's cell, constructed and used in accordance with the specification attached to these proceedings, may be taken as not differing by more than (?) parts in one thousand from a pressure of (?) volts.

THE RECOVERY OF HYDROCHLORIC ACID FROM WASTE PRODUCTS.

The accompanying illustrations represent a side elevation and sectional plan of a hydrochloric acid recovery plant which Messrs. W. J. Fraser & Co., 98, Commercial Road East, London, are erecting under the patents of Mr. Thomas Turner, of Sheffield, for the recovery of acid from waste "pickle." The process is based on the well-known fact that ferric chloride, when heated with air and steam, is resolved into oxide of iron and hydrochloric acid gas. It will be seen that the plant consists of three parts, a specially constructed wasting and evaporating furnace A, a series of cooling and condensing pipes B, and a condensing tower C for collecting the rest of the acid gases. The waste liquor is allowed to run in a continuous stream into the furnace, and is there decomposed, hydrochloric acid gas being given off and oxide of iron being left on the hearth of the furnace. The latter is raked out of the furnace from time to time, and is used for fettling in the puddling process, and for other purposes. The acid condensed is generally of the same strength as that originally used for pickling, and can be used over again for galvanising without any additional treatment. The consumption of fuel is small, being about 4 cwt. per ton of waste liquor treated, and one man is sufficient to attend to the working of even a large plant. The apparatus is constructed chiefly of firebrick, but, as the temperature is never high, the cost for repairs or renewals need not be heavy. Messrs. Walker Brothers, of the Staffordshire Galvanising Works, Walsall, have had a plant capable of treating 10 tons per week in work for upwards of a year with very satisfactory results, and have recently erected a similar and larger plant capable of treating 25 tons per week at the same works, and one for treating 20 tons of waste pickle at Netherton. From their experience of the process, they estimate that 1 ton of hydrochloric acid suitable for re-use in pickling can be recovered at a cost of 8s.

THE INSTITUTE OF CHEMISTRY.

I.

The inception, development, and growth of the Institute of Chemistry is of no contemporary interest, and may be left for the delight of some future biographer. Though originally incorporated under the Companies Act of 1867, the present governing body of chemists in the United Kingdom was of no great importance until it obtained a charter of incorporation in June, 1885, and attained a position approximating to that which is its due. It is with the Institute thus reconstituted that we propose to deal.

It is matter for speculation what proportion of the 780 Fellows and Associates now upon the register have taken the trouble to read critically the charter upon which the Institute of which they are members is based. To those who have not, a careful perusal may be recommended. The weightiest clause therein—but one which, though accepted without comment by all, has scarcely received the attention which it, as indicating the primary object of the existence of the Institute, merits—is to be found on page 6 of the copy of that document, which is supplied to every member on his election. It reads as follows:—

"The profession of analytical and consulting chemistry is one of great importance to the public, and, having regard to the rapidly increasing application of chemistry to legal investigations, to public health, to the adulteration of food (!), to agriculture, and to the arts and manufactures, it is desirable that persons practising the profession of analytical and consulting chemistry should have both a practical and scientific knowledge thereof."

We may parenthetically remark that the "increasing application of chemistry . . . . to the adulteration of food," though undeniable, seems a scarcely sufficiently meritorious practice on which to base a petition for a Royal charter. Having made this remark, we can find no other fault with the tenor of this curious paragraph. It is eminently desirable that analytical and consulting chemists should be professionally competent, and the first business of the Institute is to secure that very essential requirement. It will be seen, both by the phraseology of the quotation made above from the charter, and, by any who cares to look, by reading passages in the rest of the charter, that the whole concern of the Institute of Chemistry is with analytical and consulting chemists as distinct from collegiate and scholastic chemists. It is greatly to be regretted that the title of the Institute was not framed to embody and emphasise this idea. Possibly the clumsiness of a really accurate designation such as "The Institution of Analytical and Consulting Chemists" proved a bar to its acceptance, but, whatever the reason, the less distinctive though broader title has been adopted, and the wisdom of any alteration is disputable. In spite of this verbal defect, the clearness of the intention of the charter is unimpaired, and it remains to be seen in what manner the promotion of the welfare of the profession of analytical and consulting chemistry is to be effected.

After winnowing facts from verbiage, it becomes evident that the institution of a standard of competence with which candidates for membership must comply, the provision of some common meeting place with such adjuncts as a laboratory and library, the endowment of chairs and scholarships, and the establishment of a code of professional morality are the main means by which the character of the profession is to be raised and the standing of its members improved. That the personal behaviour of members, so far as it affects the profession, is a matter coming under the supervision of the Institute, is further shown by the wording of the declaration which each Fellow or Associate has to sign before admission, the last portion reading, "That I will demean myself honourably in the practice of my profession, and to the utmost of my power maintain the dignity and welfare of the Institute."

The foregoing facts bring into prominence the ideas that found expression in the constitution of the Institute of Chemistry, as laid down in its charter, and also indicate its legitimate aims. As to the executive provided for the discharge of its functions, we may be supremely concise: It is the Council. Much is implied by that simple and most ordinary arrangement. As the charter and the bye-laws founded thereon are read, there sinks into the mind of the reader an impression of the immense preponderance of the power of the Council over that of private members. There is, of course, provision for the latter being heard, but the machinery is somewhat cumbrous, and its inertia, together with the apathy that is the besetting sin of the private member everywhere, effectually prevent recourse being frequently had to it. Thus something approaching an autocracy in place of an autonomy results. This is by no means necessarily a disadvantage, but the recognition of the extensive powers of the Council naturally leads to the deduction that any alteration that may be desired in the conduct of the Institute is best effected by exercising the rights of nomination and voting which each

THE RECOVERY OF HYDROCHLORIC ACID FROM WASTE PRODUCTS.

PLANT CONSTRUCTED BY MESSRS. W. J. FRASER & CO., LONDON, E.

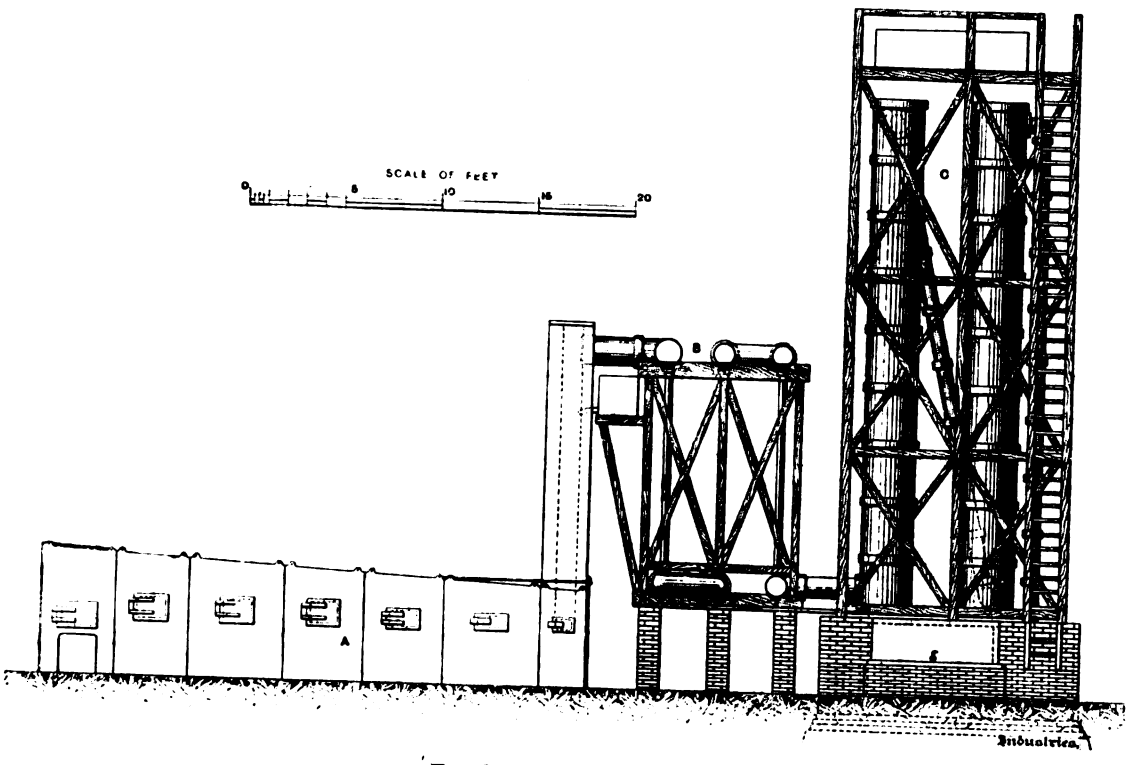


FIG. 1.—SIDE ELEVATION.

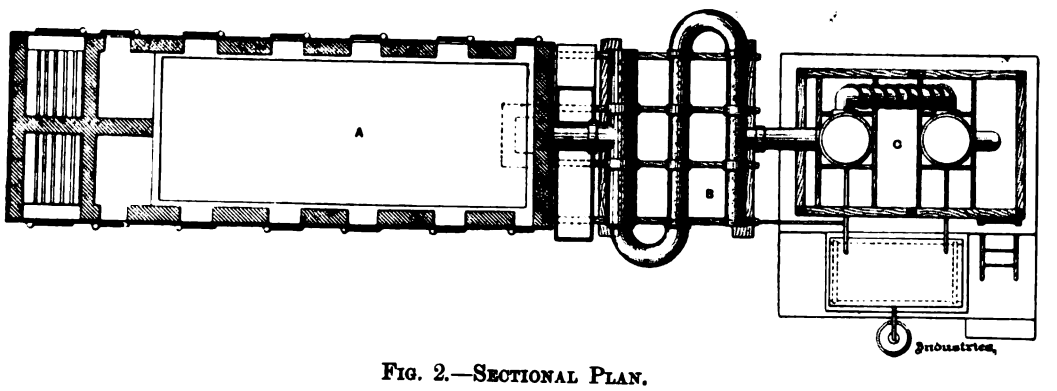


FIG. 2.—SECTIONAL PLAN.

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member possesses to bring about a change in the ranks of the Council itself. This point cannot be elaborated here, as it is intended to serve as a text for our second and concluding article.

It is now our duty to examine the present condition and policy of the Institute of Chemistry, in order to ascertain how it has adhered to the ideas and fulfilled the aims upon and for which it was founded. A critic who is in the habit of judging value by utility might be disposed to stigmatise the one as comatose, the other as peddling. We fully recognise the movements which, though scarcely to be termed strides, may be perceived by the careful observer to be distinctly of a progressive character, which have been made within quite a short period of time. The close and sympathetic scrutiny with which we have regarded them has informed us also of their number and variety, and enabled us to conceive an idea of their importance—an importance sufficiently adequate, and which we trust is not exaggerated by the bias of membership which it is difficult for the most impartial to correct. General meetings have been held and adorned with presidential addresses of conciliatory tone, recording the somewhat mild method of progression at present in vogue, and occasionally broaching such weighty topics as the establishment of a widows' fund. Such projects, though eminently benevolent, hardly fall within the province of the Institute, being, indeed, expressly excluded there from by the terms of the charter. Besides these, the Council has sat with much persistency, and achieved some remarkable successes in devising ingenious methods for excluding from the practical examination for the Associateship all those who fail to give evidence of having duly slumbered in the lecture rooms of certain approved colleges.

The members have probably acquired considerable readiness in debate since the recent introduction of a good fighting minority of persons imbued with the idea that the Institute was founded for the benefit of the profession of analytical and consulting chemistry, and not for the indirect subsidising of sundry educational establishments by giving them the monopoly of the training of the coming generation of chemists. Beyond these important achievements there is little to chronicle. The Institute has issued "proceedings," of somewhat meagre and dingy aspect, as often as three times a year, but expenditure in the direction of a journal has been wisely deprecated. Overtures have been made to the Society of Public Analysts to allow itself to be absorbed into the larger body, and thus attain that annihilation which is the ideal of the Esoteric Buddhist, but its Council considered that the reciprocity of the arrangement would be too one-sided to warrant its entertaining the proposal. The most tangible result of the existence of the Institute has been left as an appropriate coping stone to the goodly structure. Subscriptions and entrance fees have been regularly collected, and the salary of the secretary and his clerk punctually paid: *finis coronat opus*.

Notes.

THE CHIGNECTO SHIP RAILWAY.

In our recent articles on the Chignecto Ship Railway we stated that four locomotives of unusual weight and power were being constructed, two of which will be able to move the heaviest ship at a speed of ten miles per hour. We now give some particulars of these tank locomotives—taken from our American contemporary, *Engineering News*—which are being built by the Canadian Locomotive and Engine Company, of Kingston, Ontario. These engines will have eight coupled driving wheels 47in. diameter, and no truck; the total weight in working order will be 180,000lb.; cylinders, 22in. by 26in. The boiler is of the straight top type, 59in. diameter, and contains 256 tubes 2in. diameter. Heating surface of tubes, 1,741 square feet; of firebox, 137 square feet; total, 1,878 square feet. The grate area is 29 square feet. The capacity of the tender tanks will be 3,000 gallons.

RAILWAYS IN ASIA MINOR.

For several years Smyrna, the principal commercial point on the coast of Asia Minor, has had two railway companies who have slowly but steadily extended their lines from that city into the interior. Since last year, states the *Railroad Gazette*, one of these, the Ottoman Railway Company, has opened 117 kilometres of new road, part of this being a prolongation of the main line from Kizil Kaklik to the temporary terminal at Dinair, and the remainder a branch line from Sutledsch to Chivril. The total mileage of this road is now about 280 miles. With the exception of the section between Smyrna and Paradies the roads have only a single track. There are now under construction 30 kilometres of road between Balatschik and Sokia, and between Gondscheli and Denizli, both of which sections are nearing completion. The main line reaches the highlands after leaving Saraiköi, these reaching an elevation of several thousand feet. The present terminal, Dinair, is an insignificant Turkish village of 800 inhabitants, but its good location, it is thought, gives promise of its early development. The other railway, owned by the Smyrna-Cassaba Company, has since last year opened the 54-mile branch from Magnesia to Sorna, and its total length now amounts to 265 kilometres. It is pointed out as a somewhat remarkable circumstance that notwithstanding this growth of the railway systems of the country the caravan traffic has, of late, gained in extent. This is explained by the comparatively high rates, which considerably exceed the cost of camel transportation.

HOWDEN'S SYSTEM OF FORCED DRAUGHT.

We have several times referred to Howden's system of forced draught, and to the advantages claimed for it by its inventor. These advantages are evidently being clearly recognised by steamship owners, as we understand that during last year engines with a total indicated horse-power of 125,520 were fitted with it. In the case of two Allan liners, for example, it was found possible to get the same power from fewer boilers, and the space gained thereby and added to the length of cargo holds was in one case about 65ft., and in the other 70ft. In Messrs. Smiths' line of steamers the system has been largely employed, and with very great advantage and economy, and we understand that now the Inman and International Company have arranged to have the "City of Paris" fitted with Howden's system instead of the closed stokehold as hitherto. This can be done in a comparatively simple manner, involving only some additions and alterations to the front of the boilers. This will be the first high-speed vessel fitted with the system, and it will be interesting to observe the results. The system has now been in operation for some years, and we think the inventor should now come forward and state in a public manner the advantages he claims, and show, from the results of experience, that these are fully justified.

ELECTRICITY IN MINING.

The advantages of the use of electricity in mining operations are gradually becoming recognised in this country, and the most recent instance of its employment for such purposes is to be found in Lancashire, where Messrs. Mercier, Corlett, & Co., of Wigan, have carried out an important lighting installation for Messrs. Richard Evans & Co., Ld. The plant has been laid down for lighting Golborne Colliery (both above and underground), and Golborne Park, where the managing director lives. It is also intended to light the Edge Green Colliery, which also belongs to Messrs. Evans. A Mordey alternator of 2,000 volts and 12·5 amperes is employed, belt-driven from a horizontal engine. For lighting the engine-rooms, shops, and screens, glow lamps of 16, 32, and 50 c.p. are used, while in the yard and sidings there are four 200 c.p. and two 400 c.p. "Sunbeam" lamps. There will be about 100 16 c.p. glowlamps in the two pits. At Golborne Park glowlamps of a total of about 2 400 c.p. have been fitted. The house, stables, offices, and a quarter of a mile drive are furnished with glowlamps. Current is taken from the colliery to the park mainly by overhead wires; but, in passing three streets, the mains are carried underground, and are also underground for about the last half-mile.

ENGINEERING AT CABUL.

An Indian contemporary refers to the work in Afghanistan of Mr. Pyne, an English mechanical engineer, who entered the service of the Ameer in 1887, when his Highness formally asked the Government of India that permission should be accorded to the engineer, whose services he had engaged, to visit Cabul. Leave was granted to Mr. Pyne to go on the distinct understanding that he was proceeding at his own risk. He left Peshawur without any European companions, trusting entirely to his Afghan escort. He was ignorant of the language and customs of the people, but he fared well at Cabul, and the Ameer made known to him, through interpreters, his desire to establish workshops for various kinds of manufactures. Estimates, drawings, and photographs of machinery were accordingly placed before his Highness, who examined them critically, and showed greater knowledge than might have been expected regarding mechanical details. He selected various plants of machinery, including every important essential for the formation of engineering workshops and a foundry. Plant for making rifles and munitions of war, and also such labour-saving appliances as minting machinery, soap and candle machinery, &c., were not overlooked. The Ameer, with characteristic shrewdness, stipulated that nothing should be purchased which Mr. Pyne could not undertake to land safely in Cabul. Hence it became necessary to devise means whereby the heavy machinery could be built up in many small parts, as camels were the only transport means for a great part of the way. The Ameer's workshops are now in full working order under the management of the two English mechanics who went up to Cabul two years after. The mint is turning out a new silver coin of handsome appearance at the rate of fifty a minute, and the cartridge factory has produced a few thousand solid-drawn Martini-Henry cartridges, which are but little, if at all, inferior to those supplied to British troops. The cartridge machinery is not yet in complete working order, but in a year's time it will be finished, and the rate of production will then reach several thousand rounds of ball ammunition per day. Mr. Pyne speaks in the warmest terms of the kindness and liberality with which he and his assistants have been treated by the Ameer.

THE SWEDISH STATE RAILWAYS.

In the course of the year 1889 82 kilometres of fresh line were added to the Swedish Government railways, which, with this addition, reach a total length of 2,613 kilometres. The gross traffic receipts for the year 1889 amounted to 22,201,302kr. (£1,233,405), from which 14,645,166kr. (£813,620) must be deducted for working expenses. The debt incurred in the construction of railways, on which interest was paid for the year 1889, amounted to the sum of 286,390,996kr. (£15,910,611); about 2,000,000kr. of this amount, however, is sunk in lines which are still in course of construction. If this last-mentioned sum be compared with the net receipts for the year 1889 it will be found that they amount to 2·64 per cent. of the total capital. The rolling stock of the State railways consisted at the beginning of the year 1889 of 362 locomotives, 821 carriages for passengers, 63 prison and mail vans, 189 military baggage waggons, 8,603 goods trucks, and 2 waggons mounted with cranes. During the year 11 locomotives, 12 passenger carriages, and 17 goods trucks were added to the already existing stock. The entire number of passengers during the year 1889 amounted to 4,340,222, who travelled an average distance of 45 kilometres per person. The total receipts for passenger traffic were 7,196,790kr. (£399,822), which showed an increase of nearly 97,000kr. (£5,389) on the previous year. The total number of passengers showed an increase of 260,000 in round numbers.

INTERNATIONAL NIAGARA COMMISSION.

The Cataract Construction Company, having invited various firms to send in projects for the utilisation of about 125,000 horse-power at Niagara, and its distribution, partly to an industrial district in the neighbourhood of the Falls, and partly to the town of Buffalo, appointed an International Commission to adjudicate on the plans sent in. This Commission consisted of Sir William Thomson, F.R.S., president; Dr. Coleman Sellers, Professor of Engineering Practice at the Stevens' Institute of Technology, Hoboken, N.J.; Professor E. Mascart, Membre de l'Institut, Paris, and Directeur du Bureau Central Météorologique; Colonel Th. Turrettini, Directeur des Travaux d'Utilisation des Forces Motrices du Rhone à Genève. After a careful examination of a large number of projects sent in, in accordance with the letter of invitation of the Cataract Company, the Commission have awarded the following prizes:—Projects combining the development of power and its distribution.—First prize: Not awarded. One second prize: To the project of Messrs. Faesch & Piccard, Geneva, and Messrs. Cuenod Sautter & Co., Geneva. Four third prizes: To the projects of Mr. A. Hillairet and Mr. Bouvier, Paris; Mr. Victor Popp, Paris, and Professor Riedler, Berlin; Professor L. Vigreux and Mr. L. Levy, Paris; the Pelton Water Wheel Company, San Francisco, Cal., and Norwalk Iron Works Company, S. Norwalk, Conn. Projects for the hydraulic development of the power.—First prize: To the project of Messrs. Escher Wyss & Co., Zurich. Two second prizes: To the projects of Messrs. Ganz & Co., Budapest; Professor A. Lupton, Leeds, and Mr. J. Sturgeon. Projects for the distribution of the power.—No prize awarded.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

26th January, 1891.

1378. Webb, F. W. ..... Steam valves and casing for engine cylinders.
1380. Morrison, J. ..... Looms.
1385. Haigh & Thewlis..... Apparatus for drying animal or vegetable fibres.
1387. Anderson, R. W. ..... Lubricators.
1389. Douglas, J..... Valves and valve gear for steam engines.
1391 Wild, J. ..... Steam traps.
1410. Woodward, J. ..... Machinery for charging and drawing gas retorts.
1414. Croasdell & Hall ..... Friction clutches.
1418. Lanz, H. ..... Thrashing machines.

27th January, 1891.

1436. Frazer & Cosford ..... Reversing gear for steam engines.
1437. Wilcox, S. ..... Compound steam engines.
1447. Weatherhogg, G. W. ... Gas and hydrocarbon engines.
1463. Atkinson, F. A..... Railway points and signals.
1467. Dawson, Dawson, & Stott ..... Inking apparatus of letterpress and lithographic printing machines.
1478. De Benjumea, J. D..... Steam boilers.
1485. Greenhough, J..... Rotary engines.
1496. Dureya & Barker ..... Type-setting machine.
1497. Flohr, O..... Automatic railway couplings.
1498. Flohr, O..... Friction clutches.
1502. Sutton, J. ..... Pumps.
1509. Lake, H. H..... Filtering apparatus (*Knight*).
1520. Böttger & Zeunert..... Apparatus for removing waste from carding machines.
1521. Lake, H. H..... Filtering apparatus (*Knight*).

28th January, 1891.

1536. Duke, A. ..... Tramcar stopping and starting gear.
1540. Webb, W. H. ..... Compression pumps.
1551. Noton, W. ..... Spinning and doubling machinery.
1558. Birch & Lowe ..... Lathes.
1570. Worsdell & Threlfall Balanced slide valves.
1581. Haddan, R. ..... Engine governors (*Passburg*).
1586. Schlepitzka, A. ..... Rock drilling machines.

29th January, 1891.

1598. Thomson, Sir W. ..... Turbine water wheels.
1601. Whittaker, T. ..... Presses for making bricks and other analogous articles.
1609. Ellison, J. ..... Self-acting loom feed.
1610. Broun, J. E. ..... Excavating scoops.
1630. Winchester, J. C. ..... Piston rings or piston valves.
1633. Jackson, W. ..... Winding and spooling machines.
1636. Foot, E. M. ..... Stored explosive power machine.
1653. Robson, R. ..... Steam boilers.
1655. Murgatroyd & Murgatroyd ..... Looms.
1662. Edwards, D., Jun. ..... Lifts or hoists.
1675. Reynolds, E. ..... Apparatus for moving and turning heavy forgings.

30th January, 1891.

1689. Lanchester, F. W. ..... Igniters for gas engines.
1690. Taylor, Taylor, & Taylor ..... Loom picking apparatus.
1694. Clerk, D..... Starting gear for gas engines.
1696. Harbinger, W. ..... Marine boilers.
1698. Duffield, C. ..... Tunnelling machines.
1717. Oxley & Sellars ..... Pressure filters.
1719. Russell, E..... Railway signalling apparatus.
1720. Rowland, T. ..... Cranes.
1721. Munns, W. H. ..... Railway car brake (*Zimmermann, Jun.*).
1723. Weckauf, J. ..... Roller mills for grinding paint, &c.
1724. Landiss & Jenner ..... Thrashing machines.
1735. Fletcher, B. M. ..... Means for governing steam engines.
1744. Lake, H. H..... Steam boilers (*Lorillard*).
1746. Società per l'applicazione dell' aggancia-tore automatico Prada Pietro Prada & Co..... Car coupling.
1756. March, L. R. ..... Liquid meters.
1757. Herzog, C. ..... Liquid meters.

31st January, 1891.

1756. Vickerman, J. ..... Weft stop motion for looms.
1762. Wallis, J. E. ..... Machine for pecking and loosening the surface of roads.
1770. Cockshott & Holden ... Stop-rod mechanism of circular box looms.
1780. Clerk, D..... Gas engines.
1784. Richardson, H. W. ..... Friction clutches.
1787. Taylor, R., Jun. (of the Firm of Asa Lees & Co., Ld.) ..... Cone driving mechanism.
1805. Lishman, T. G. ..... Steam boiler furnaces.
1867. Horn, W. W. ..... Car coupling (*Ventress*).

ELECTRICITY.

26th January, 1891.

1390. Boehm, E. ..... Incandescent lamp.
1396. Newton, F. M. ..... Arc lamps.
1425. Boult, A. J. ..... Storage batteries (*Roberts*).

27th January, 1891.

1432. Bollé, C..... Manufacture of carbon filaments for incandescent lamps (*Keen*).

29th January, 1891.

1680. Tavernier, A. E. ..... Manufacture of wire for transmitting electric currents.

30th January, 1891.

1741. Howard, H..... Apparatus for electric welding.

31st January, 1891.

1779. Hartnell, W. ..... Motors and dynamos.
1804. Redfern, G. F. ..... Electric motors (*W. Lahmeyer & Co.*).

CHEMISTRY.

30th January, 1891.

1737. Imray, O..... Colouring matters (*Die Actiengesellschaft für Anilin Fabrikation*).
1742. Pitt, S..... Manufacture of a new amidonaphtolsulphonic acid and colouring matters therefrom (*L. Cassella & Co.*).

31st January, 1891.

1785. Meyer, E. ..... Production of aluminium.
1818. Winder, J. B..... Preparation of soluble bichromates and sulphuric acid for use in voltaic batteries.
1824. Lifschütz, I. ..... Production of cellulose and oxalic acid from vegetable fibrous substances.
1825. Lake, H. H..... Manufacture of carbonate of soda, carbonate of potash, hydrochloric acid, and chloride of lime (*Letellic*).

MISCELLANEOUS.

26th January, 1891.

1401. Hunter, E. S..... Chain pipe wrench.

27th January, 1891.

1455. Bohm, W. D. ..... Pipe coupling.
1466. Asbury, J. ..... Adjustable screw wrench.
1505. Elliott, Blackstock, & Blackstock ..... Nut locks.
1514. Cooke, W. ..... Nut lock.

29th January, 1891.

1629. Earp, W. R. ..... Boiler anti-incrustation compounds.

30th January, 1891.

1703. Fraser, W. ..... Hose pipe connection.
1704. Warrington, H. ..... Kilns for burning bricks, &c.
1747. Bowles, J. ..... Saws.

31st January, 1891.

1782. Tapscott, R. L..... Lock nuts.
1791. Richardson, J. C. ..... Nut locks.
1819. Summerskill, C. W..... Automatic fire-extinguishing sprinkler.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

17627. Lake (*Emmens*).

1890.

115. Potts.
1343. Gray.
1800. Hackett.
1897. Fahrig.
2224. Rendle.
2293. Akester.
2471. Sharp.
2538. Acock.
2828. Friend.
2945. Laurent-Cély & Timmis.
1296. Berry & Symons.
1713. Green.
1806. Conley & Lancaster.
2223. Rendle.
2261. Slater.
2416. Guy.
2526. The Borax Company, Ld. (2nd October, 1889.)
2876. Walter.
2973. King.
3056. Murrie.
3086. Uncken.
3130. Thomas.
3183. Allsop.
3249. Le Messurier.
3303. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
3596. Wing & Feldman.
3602. Reynolds.
3778. Hart.
3788. Lindemann.
3889. Delany.
3897. Dowler.
3936. Copus.
3967. Stevenson.
3985. Möller.
4117. Rhodes, Rhodes, & Rhodes.
4321. McMillan.
4580. Huntington.
4623. Wahlin, Lundstrom, & Collins.
4668. Selowsky.
4679. Kayser.
4738. Haslam.
4785. Stalker & Daye.
4821. Orach.
4842. Francis.
4853. Berry & Shuttleworth.
4894. Van Ollefen.
4900. Roberts.
4910. Brewster.
4961. Redfern (*Defraiteur & Maron*).
4991. Gay & Hammond.
5007. Nunan.
5024. Redfern (*S. L. Allen & Co.*).
5157. Noble & Stuart.
5589. Charageat & Charageat.
5790. Patton.
5899. Robinson.
5950. Freeman.
6815. Zimer.
6874. Johnson (*Badische Anilin & Soda Fabrik*).
8835. Marshall.
9995. Andreasen.
11893. Fitton & Fitton.
13414. Dale.
14319. Walsh.
14678. Lane & Hiscock.
15672. Wortman. (3rd March, 1890.)
16499. Bruce.
16941. Hans.
17491. Sloggett.
17616. Mitchell.
17825. Fey, Fey, & Goll.
18190. Gisborne (*Keeley*).
18669. Flohr.
19127. Blackburn, Patton, & Coffman.
19370A. Scholes & Scholes. (28th November, 1890.)
19664. Lovegrove & Hurt.
19743. Saltzkorn (*Nicolai*).
19838. Gerlach & Böhn.
20094. Dewey.
20109. Benedict.
20162. Lawson & Owen.
20190. Harness.
20251. Trevisan.
20374. Allen.
20425. Von Dolivo-Dobrowolsky & The Company Allgemeine Elektricitäts Gesellschaft.
20507. Hessing.
20526. Festin.
20655. Gillies.
20725. Harman.
20889. Longdon.
20840. Legge.
20907. Bristol.
20964. Thompson (*Williams*).
21042. Islip.
21103. Bascaran.
21144. Kötter.
21175. Lindsay & Lindsay.
21209. Martinot.
21231. Ensigner.
3123. Rose.
3156. Butler & Kendrick.
3213. Challis.
3301. Samuel & Samuel.
3351. Wier.
3414. Légé & Jor.
3511. Campbell.
3601. Scott.
3605. Brewster.
3786. Larrouy.
3803. Barton.
3891. Smith.
3908. McLennan.
3960. Wood.
3978. Mackenzie.
4016. Davies.
4197. Müller & Adkins.
4233. Gillbanks (*Rospini*).
4324. Kelman.
4619. Rowley.
4632. Busby.
4640. Fox.
4672. Barr.
4718. Govan.
4769. Lake (*Wertheimer*).
4810. Brunton & Brewster.
4827. Pearse.
4844. Wilson.
4886. Thompson (*Willford*).
4890. Colligan.
4895. Cucco.
4906. McKeone, Thame, & Sanguinetti.
4963. Reixach & Bracewell.
4967. Claringburn.
5005. Baxter (*Holst*).
5039. Kemp & Rollason.
5042. Ryder.
5123. Birchenough & Wood.
5180. Witt.
5723. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5901. Ponting.
6006. Scillitoe.
6818. Fleming.
8185. Campbell.
8211. Walker & Greenwood.
10893. Pzillas.
12449. Weatherburn.
14117. Von Skoda.
14612. Fell (*Roop & Werner*).
15455. Thompson (*Coffin*).
16144. Hamilton & Hamilton.
16216. Davis.
16545. Lake (*Peck*).
17454. Worms & Zwierzchowski.
17672. McNicol & Bernheimer.
18560. Revel.
18751. Schulz.
19189. Keith.
19272. Carpenter. (10th May, 1890.)
19663. Lake (*Covell*).
19670. Clark (*Cohn*).
19799. Bielefeld.
19972. Ford.
20096. Ball.
20111. Lake (*Roberts & McGraw*).
20177. Thiemt.
20279. Altshuler.
20424. Von Dolivo-Dobrowolsky & The Company Allgemeine Elektricitäts Gesellschaft.
20496. Lewis.
20512. Lake (*Blickensderfer*).
20536. Bennetts, Hatch, & Lewis.
20828. Beaumont. (20th May, 1890.)
20870. Bartz.
20959. Brisheim, Pattberg, & Pattberg.
21074. Larkin.
21142. Rhodes.
21155. Dewepper.
21197. Carpenter.
21215. Woodruff.
21248. Dowell & Dawson.
21290. Watkin.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Machinery for Charging Gas Retorts.—*J. C. Chandler, London.*—The invention relates to apparatus for charging inclined gas retorts, and is constructed as follows:—At a suitable height from and in the same vertical plane as the charging end of the gas retorts are fixed two rails, on which run wheels supporting a framework for carrying the charging apparatus. This charging apparatus is in the form of a hopper, provided with a gas valve at each end, the lower end of which is shaped to fit the charging mouth of the retorts. The hopper is so fixed in the framework that it can be moved transversely and raised and

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lowered so that its lower end can be caused to enter the charging mouth of the retort in the following manner:—At each end of the framework is fixed a rail at right angles to the rails on which the wheels of said frame run. Running on these rails are two grooved rollers revolving on suitable studs at each side of the hopper. These studs are fixed eccentrically on two discs carried on a spindle passing through and supporting the hopper. The grooved rollers may thus be caused to revolve on their studs, so moving the hopper transversely, which hopper may then be raised or lowered by revolving the supporting spindle by means of a lever-handle, as will be understood. To charge the retorts the upper valve of the hopper is opened and the hopper charged with coal. This top valve is then closed and the hopper brought over and its lower end inserted in the charging end of the retort. The valve at the lower end of the retort is then opened, as also is the valve in the end of the retort. The coal is thus allowed by gravity to descend into the retort. Four claims are made.—No. 9394. June 17th, 1890. 8*d*.

NAIL MAKING MACHINERY.—*J. W. Ells, Pittsburg, Pennsylvania, U.S.A.*—The invention relates to the production of "hob-nails," or those having large protuberant heads. Fig. 1 in the accompanying illustrations is a plan, Fig. 2 a sectional elevation, and Fig. 3 is an enlarged section of the mechanism for forming the nails. Mounted in bearings upon a frame A is a transverse driving shaft B having two cranks C C^1, the latter of which has the greater "throw." Connected by connecting rod D to C is a slide E, working in a suitable slide way, in which is fixed the male die F. In a central hole in F is a stationary rod F^1 (Fig. 3). Opposite E is a head G, in which works a female die H, behind which is a slide I capable of a slight movement. This slide I is of a T-shape, and one arm I^1 is connected by a rod J to the slide E. Working through H and I is a rod K fixed to the end of a rod L running in suitable bearings and normally held forward by a helical spring M. Fixed to L is an arm L^1 which works in a slotted rod N actuated from eccentric C^1. Fixed also to L^1 is a rod O having a notch in its under side, which, when the rod L is forced backwards, so compressing the spring M around it, the

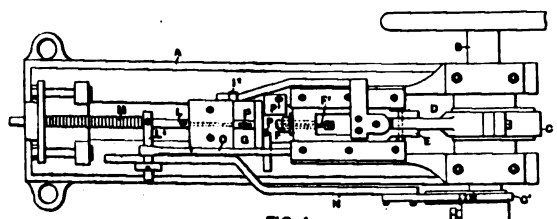


FIG. 1

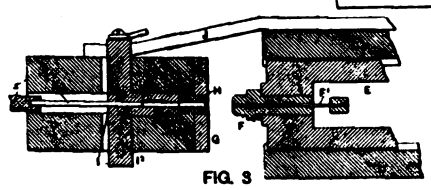


FIG. 3

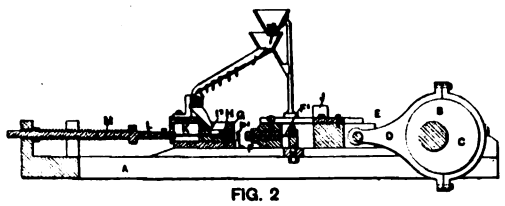


FIG. 2

notch embraces the arm I^3 of I, so holding L until I commences to move backwards when it is released. The action is as follows:—The hot bar of metal is fed between the two dies, being regulated by two stops P P^1, and as F moves forward a piece of metal is cut off sufficient for the head of the nail to be formed. This metal is forced into the female die H, which is then caused to recede, so releasing L, which had previously been forced backwards. L and K are consequently forced forward by the spring M, and passing through I and H, force a shank which has been previously formed and fed into a slot I^3 in I by a suitable apparatus (Fig. 2) nearly completely through the head previously pressed. The whole of the parts then return to their normal position, the nail thus formed being released by the action of the rod F^1. Twelve claims are made.—No. 16547. October 17th, 1890. 8*d*.

PRESSURE GAUGES.—*W. E. Heys, Manchester. (Schäffer & Budenberg, Buchau, Magdeburg, Germany).*—Steam pressure gauges constructed according to the present improvements contain a concentrically corrugated diaphragm, as in the ordinary "Schäffer gauge," but this, instead of being placed horizontally as hitherto, is arranged vertically, so that the steam may have access to the back thereof. In front of this diaphragm is pivoted, in a slot in the casing of the gauge, a bell-crank lever, one arm (in the form of an adjustable screw) of which bears upon the centre of the diaphragm. The other arm (also in the form of an adjustable screw) passes through a slot in a sliding bar, one end of which is connected to a crank pin secured upon the index-finger spindle. Consequently the motion of the diaphragm is communicated through the bell-crank lever, the sliding bar, and the crank pin to the index finger. In front of the sliding bar is fixed a bar having a longitudinal slot in it, in which slot that end of the bell-crank lever which passes through the sliding bar works, and which so prevents the lateral motion in the bell-crank lever. A helical spring, one end of which is fixed to a fixed hook in the framework, and the other end to a hook or sliding bar, tends to keep the latter in its lowest position. Claims: (1) A pressure gauge constructed and arranged as described; (2) in a pressure gauge having a vertical diaphragm, the combination and arrangement of an angle lever provided with an adjusting screw, a sliding bar operated by the angle lever, and a crank pin mounted upon a plate fixed to the index finger and connected to the sliding bar as described.—No. 19896. December 6th, 1890. 6*d*.

GOVERNORS FOR HIGH-SPEED ENGINES.—*J. Wild, Oldham.*—Fig. 1 in the accompanying illustrations is a vertical section of a governor constructed according to this invention, Fig. 2 being an improved method of gearing. The standard A supports a hollow pillar B, revolving on which is a block C having fixed on its under side the gear wheel D. This wheel gears with the wheel E, actuated as shown. Formed on C are two ears C^1, to pins passing through which the lower ends of the rods F F are pivoted. The block C is prevented moving longitudinally on B by means of a flange B^1 on the latter. On the upper end of B, free to revolve and slide up and down, a threaded nut G is placed; upon this nut a cap H is screwed, having lugs H^1, to pins passing through which are pivoted the upper ends of the rods F^1 F^1. The opposite ends of the rods F F and F^1 F^1 are hinged together and carry between

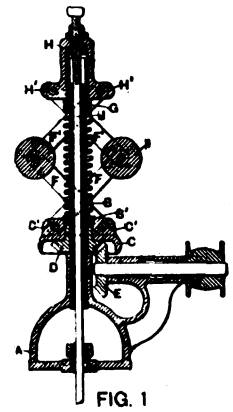


FIG. 1

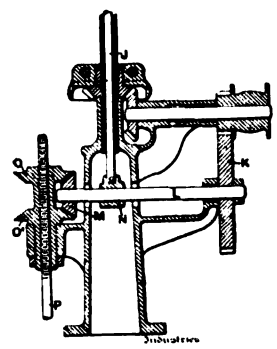


FIG. 2

them balls or weights I as shown. Between the blocks C and nut G, and encircling the pillar B, is placed a suitable spiral spring. Screwed into the top of G, and passing downwards through B and A, is an adjustable rod J, which is connected to the valve regulating the supply of steam to the engine. When very steady running is required the gearing K (Fig. 2) is employed to drive the shaft L and with it the bevel friction M. The rod J is then connected to the sleeve N, so that when the governor rises or falls the bevel friction gear M is brought into action, thereby causing the whole to revolve in one direction or the other, thereby raising or lowering the screw P which may be connected either to the throttle valve or cut-off motion of the engine to be governed in any convenient way. Claims: The crossing of the bottom pairs of arms; the employment of a regulating nut or bush; the screwed spindle and lock-nut and ferrule; the employment of friction gear for the purpose and in the manner described and illustrated, and the general arrangement of governors for steam or other motive power engines.—No. 448. January 10th, 1890. 8*d*.

CRANK BENDING MACHINERY.—*C. Cousins, Broadgate, & H. Clarke, North Scarle, both of Lincolnshire.*—In the annexed illustrations Figs. 1 and 2 are elevations showing the parts respectively in their raised and lowered positions, and Fig. 3 is a horizontal section of the improved apparatus. A is the solid block which is shaped to the form of the crank required to be produced, and to each side of this block a guide plate B is rigidly secured by bolts and nuts B^1. C is the upper block capable of being moved vertically up and down by steam or hydraulic power, and guided in its movements by ribs C^1, formed on both of its sides, which enter and work in grooves formed in B D are the adjustable rectangular blocks carrying pins D^1, which project into and work in the slots B^2 formed in the guide plates. To each of these blocks a pair of links E are pivoted at E^1, and the other extremities of the links carry adjustable rollers or rolling blocks E^2, working in slots E^3. When a bar or rod is to be cranked, the upper block or crosshead is first raised and the adjustable blocks D are turned by means of a suitable tool, inserted through the

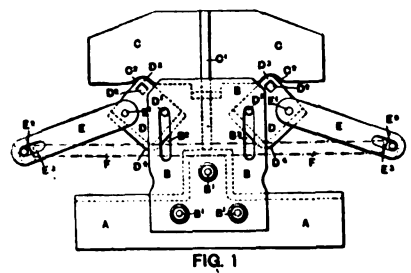


FIG. 1

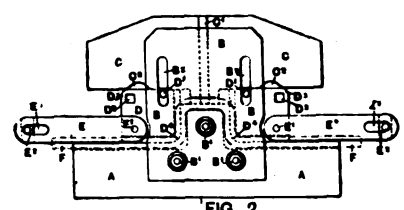


FIG. 2

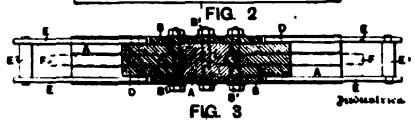


FIG. 3

holes D^2, so as to bring their rounded corners D^3 into the depressions C^2 formed in the upper block. The bar F, having been previously made hot, is placed in the machine in the position indicated by dotted lines (Fig. 1), and the adjustable rollers E^2 are then caused to press firmly against the ends of the bar. The upper block or crosshead is now caused to descend, and the lower corners D^4 of the adjustable rectangular blocks are pressed against the bar F, thereby gradually bending it to the required shape. These adjustable blocks during their descent also turn about their pins D^1, and thus keep the rollers carried by the links E held against the ends of the bar or rod during the early part of the bending operation. Two claims are made, embracing the method and machine for bending cranks substantially as described.—No. 3435. March 4th, 1890. 6*d*.

ORE CONCENTRATORS.—*P. M. Justice, London. (J. S. Brownell, San Francisco, California, U.S.A.).*—This invention relates to ore concentrators in which an endless travelling belt having raised flanges or edges is used. Such belts travel around drums and rollers so as to form a constantly moving bed or plane on which the washing of ores is effected. The object of the invention is to prevent the flanges of such belts when passing around such rollers from becoming cracked owing to the strain thus put upon them. This the inventor effects by employing a fluted or waving line or fulness of flange, which, in passing around a roller, simply straightens out somewhat, and without causing any undue tension or stretching of the material composing the flange. Claims: In a travelling belt having flanges—(1) The employment of a greater length or fulness of material in the upper edge of the flange than in the lower; (2) a flange having a waving, scalloped, or channelled outline; (3) a flange of greater total length than the sides of the belt to which it is attached, as described.—No. 11177. July 17th, 1890. 6*d*.

LEAD PRESSES.—*C. C. Tracy, Brooklyn, U.S.A.*—The invention relates to the dies of lead presses designed more particularly for covering wire with lead, and for making S traps. In the annexed illustrations Fig. 1 is an elevation of an ordinary hydraulic press, the improved die being in section; Fig. 2 is a sectional plan thereof, Fig. 3 being a detail. Mounted on the ram A is the die block B. In a curved seat B^1 in B is fitted the tubular die C formed with side openings C^1, and at one end with a shoulder C^2 and with the conical core D. The tapered end of D is coincident with the die ring E held by the shoulder C^3, the exterior diameter of D being slightly smaller than the interior of E to allow of the passage of the lead. If wire is to be covered D should be hollow, but if piping is to be formed it must be solid, as shown in Fig. 3. Over the tubular die tube C is

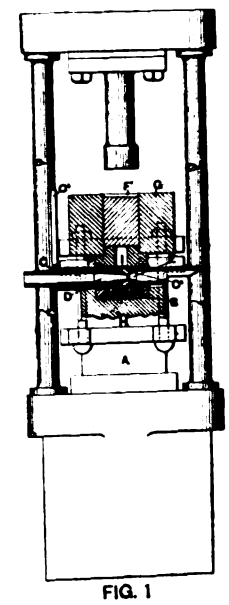


FIG. 1

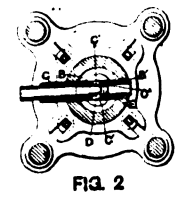


FIG. 2

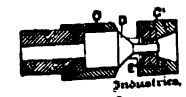


FIG. 3

placed a cap F, centrally apertured at F^1 to coincide with the openings C^1, upon which is placed the hollow top block G, held in position by bolts engaging slotted lugs thereon, and in base block H. The die C is adapted to be turned axially in its seat by a lever C^3 to shift the division piece or bridge I to the right or left to increase or to diminish the flow of lead at either side of the tips to prevent "buckling" or to form a curve as required. Ten claims are made, embracing the arrangement as described, with modifications.—No. 10147. July 1st, 1890. 8*d*.

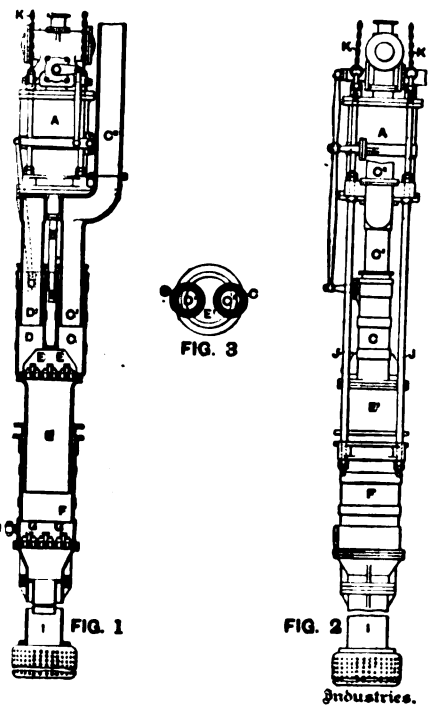
TOOL HOLDER FOR LATHES.—*H. B. Lee, London.*—The holder constructed according to this invention consists of a bar or tube of steel, or other suitable metal, of a square or round cross-section, and having formed in it a longitudinal hole extending nearly through the whole length thereof, one end, however, being left solid. Through this solid end, and passing through the end of the longitudinal hole, are cut holes or slots of a similar section to the cutters used, and in a direction diagonal or at right angles to the bar, and obliquely in the vertical plane. These holes are cut from both sides of the holder, so that cutters may be inserted from either side. At the rear end of the holder a screw thread is formed in the bar, into which is fitted a set screw. This screw presses upon the end of a loose bar, placed in the longitudinal hole; the other end, which is cut obliquely, presses against the cutters placed in the diagonal slots, so that the cutters may be rigidly fixed by tightening up the set screw. A small pin, fixed to the bar in the longitudinal hole in the holder, works in a longitudinal slot in the latter, so preventing the bar from revolving. Three claims are made, embracing the general construction and arrangement of a tool holder for lathes, planing, and similar machines, substantially as described.—No. 16525. October 17th, 1890. 8*d*.

JACQUARD MACHINES.—*F. & A. Mortimer & W. Wright, all of Gomersal, near Leeds.*—The invention relates to the counterpoise harness in jacquard machines where the bottom or "hole" board of the machine is depressed at the same time that the lifting knives or "griffe" is raised. The "griffe" is connected by a suitable rod to the ordinary lifting lever. Pivoted at each side of the machine near the top thereof are two levers of the first order. The outer ends of these levers are connected by means of suitably bent rods to the bottom board, and the inner or opposite ends are connected to the rod connecting the "griffe" with the ordinary lifting lever. Each end of the "hole" or bottom

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board slides in grooves inside the frame of the machine. By the above arrangement it is obvious that as the "griffe" rises the bottom board will descend and *vice versâ*, and so one portion of the harness will balance the other. To prevent the loom recoiling or turning back on being stopped a cam is placed on the driving shaft thereof on the surface of which slides a catch pivoted to the side of the loom. Claims: (1) The raising and depressing of the bottom board of the jacquard machine in the manner described; (2) the arrangements and combinations as set forth.—No. 2807. February 21st, 1890. 6*d*.

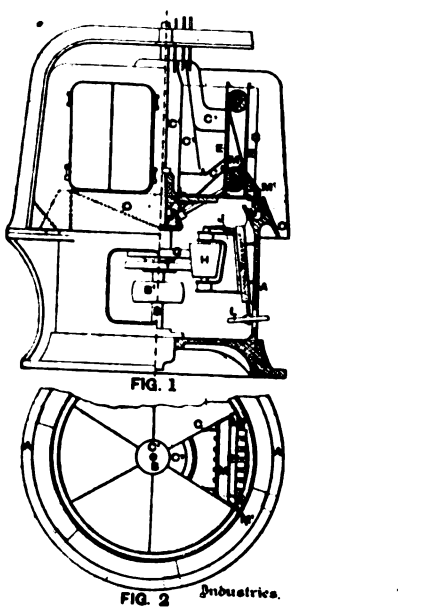
PUMPING ENGINES.—*W. H. Bailey & G. Lindemann, both of Salford, Manchester.*—The invention relates more particularly to those pumps in which a ram in combination with a steam cylinder is used such as in sinking pumps. Fig. 1 in the annexed illustrations is a sectional elevation, Fig. 2 an elevation of a pump for well sinking to which the invention is applied, Fig. 3 being a sectional plan. A is the steam cylinder, in which works the piston rod B, and to which are secured the pump barrels or cylinders C and D, having the hollow ram E^1; E are the lifting valves; C^1 and D^1 are hollow pistons or guides secured to or near to the bottom of the cylinder A; the piston C^1 forms part of, or is connected to, the discharge pipe C^2, and the piston D^1 forms an air vessel; the pump barrels C and D slide on the pistons or guides C^1 and D^1, which together constitute well-balanced guides and enable the pump to work smoothly and without side strain. F is the pump cylinder in which the ram E^1 slides; H is the snifting valve and G are the lifting valves at the bottom of the cylinder F; I is the inlet pipe, J are tie rods which connect the pump cylinder F to the steam cylinder A, and K are chains by which the pump is suspended. The mode of operation is as follows:—When steam is admitted to the cylinder A the piston B moves downward and carries with it the pump barrels C and D and the hollow ram E^1, the valves E lifting; when the piston B, barrels C and D, and ram E^1 rise, the valves E are closed and some of the water above the valves E is discharged through the pipe C^2.



The snifting valve H admits air into the pump barrel F as usual, and a portion of the said air finds its way to the air chamber in the hollow piston D^1. Claims:—(1) In pumps and pumping engines the combination with the hollow piston or guide which forms part of the discharge pipe and on which the pump barrel slides of an additional guide on which the pump barrel also slides; (2) the combination with the hollow piston or guide which forms part of the discharge pipe and on which the pump barrel slides of a hollow piston or guide which forms an air chamber and on which the pump barrel also slides, as and for the purposes described.—No. 1192. January 23rd, 1890. 6*d*.

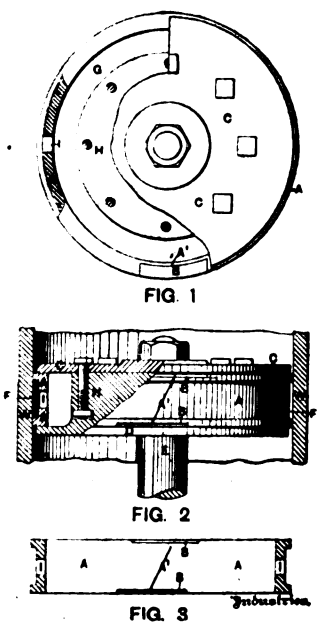
CUPOLA FURNACES.—*C. A. Sahlström, London, & A. F. Hill, West Brighton, Sussex.*—According to this invention, which relates to furnaces in which hydrocarbon fuel is used, the lower portion of the furnace is enlarged, and made with a dome-shaped roof, through which, and at about the centre thereof, the flue or upper portion of the fire chamber, arranged at an angle of 60° or 45°, communicates. The top of this angular portion is in communication with a flue, preferably vertical, in which is arranged a coil of steam pipes to superheat steam to be utilised for the supply of the hydrocarbon burners, which are inserted in the enlarged portion of the fire chamber and project downwards therein. The burners are capable of adjustment in these tubes, so that they may be kept at such a distance from the metal in the furnace that the fuel may be converted into vapour before striking said metal. There is a charging door at the top of the angular fire chamber, with sight hole and a platform for facilitating feeding and attending. The brickwork of which the cupola is constructed is cased on the outside with iron, and on the front side there is an air space or chamber between this brickwork and iron casing, to which air is admitted at the upper part, which, being caused to circulate through the said chamber, is utilised at the base for the hydrocarbon burners. Four claims are made, embracing the general construction and arrangement of cupola furnaces, as described.—No. 2070. February 8th, 1890. 8*d*.

CENTRIFUGAL MACHINE.—*J. Imray, London.* (*La Société Nouvelle des Raffineries de Sucre de St. Louis, Marseilles, France*).—Fig. 1 in the annexed illustrations is a half part sectional elevation, and Fig. 2 a plan of an apparatus constructed according to this invention. Running in bearings in a suitable framework A is a vertical shaft B driven from B^1, and carrying the centrifugal casing or revolving drum. The casing is divided into six or more compartments C (Fig. 2). At the front or outer edge of these compartments are placed the rollers D D^1, over which runs a filtering web E, being driven by means of a gearing F fixed to a loose collar G on B. This loose collar gears with a conical drum H, which in its turn gears with a wheel I keyed on B. The wheel H is carried in a frame J sliding on a slide K set



at an angle as shown, so that although H and J may be raised or lowered by means of screw L in the ordinary manner to alter the speed of E as desired, H will always be in gear with G and I. Inside E is a casing M connected by pipe M^1 to an annular groove N in A. The inner side of M is perforated. The revolving drum compartments C are each divided into four divisions C^1 C^2 C^3 C^4 (Fig. 1). To the top of C^1 C^2 C^3 are connected pipes which supply respectively water, the material to be treated, and steam thereto. The water passes down C^1 through openings in the bottom thereof into C^4, and so against and through E into M and away. The material is fed into C^2, and passing down, it strikes a reflector as shown, so striking E, and is washed by the water from C^4, which is carried up so far by E before passing through it. The material is then carried upwards by E, and, after being acted upon by steam supplied to C^3, is thrown against a casing surrounding the drum, and escapes through an opening O. Claims: (1) The centrifugal machine, having for its filtering surface a vertically travelling web, against the inner face of which is projected the matter to be treated, and also, if necessary, cleansing liquid and vapour, and from the outer face of which the solid portion of the matter treated is projected into an outer casing, whilst between the faces the strained-out liquid is collected and run off; (2) in a centrifugal machine, such as is above referred to, the gearing for driving the travelling filter web at suitable and adjustable speed, consisting of the roller D^1, the spindle B and its bevel pinion, the wheels F, the conical drum H adjustable in position, and the wheel I, substantially as described.—No. 2774. February 20th, 1890. 8*d*.

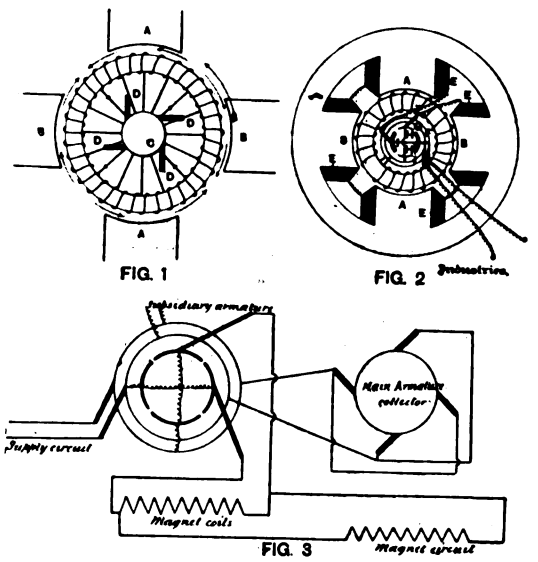
STEAM ENGINE PISTONS.—*G. Twigden, Cardiff.*—Referring to the accompanying illustrations, Fig. 1 is a plan, partially in section, of a piston arranged and fitted in accordance with this invention, Fig. 2 is a part elevation and part section, and Fig. 3



is a section of the piston ring. The piston packing ring A, split diagonally at A^1 and provided thereat with tongue pieces B, is contained between the junk ring C and the flange D of the piston. The ring A, which has play between the junk ring C and the piston flange D in the line of the axis of the piston rod E, is flanged at top and bottom. The flanges bear against the interior of the cylinder wall W (Fig. 2), and an annular space F, closed at top and bottom by the flanges, is thus obtained between the body of the ring and the cylinder. Communication between the space F and the space G existing between the body H of the piston and the internal face or back of the packing ring A is established by an aperture or apertures I in the body of the ring A. The ring A being free to move axially, as aforesaid, it follows that when the piston is moving, say, in a downward direction, the ring is, by the pressure of the steam behind the piston, kept away from the junk ring, and, consequently, an opening is left all around between the junk ring and the packing ring, by which opening steam has access to the space G. Thence by the aperture or apertures I in the ring A the steam is admitted to the space F. On the reverse stroke of the piston the ring A is forced against the junk ring, and thereby an opening for the steam is presented between the ring A and the piston flange D. Thus it will be seen that the ring A is acted upon at all times by steam pressure from within and without, the steam in the space G tending to expand it, and the steam in the space F tending to contract it. Claims: The arrangement as described.—No. 16152. October 11th, 1890. 6*d*.

ELECTRICITY.

ALTERNATE CURRENT MOTORS.—*L. B. Atkinson, London.*—The inventor's object is to construct an alternating current motor which is self-starting and can run at any speed, independently of the number of alternations per second of the supply current. For this purpose a Gramme or drum armature, the winding of which is continuous, is used, connection being made between a collector of ordinary construction in the usual manner. The brushes of this collector are mounted on a carrier and revolved by a small independent self-starting synchronising motor. Referring to the annexed diagrams, Fig. 1 is that of the main motor armature and collector, Fig. 2 that of the synchronising motor, and Fig. 3 that of the complete connections of the motor. The main armature is surrounded by a four-pole magnetic field A B. The armature is wound continuously and connected to collector C in the ordinary manner. Each pair of the four brushes D of C are connected in parallel. These brushes are revolved by the auxiliary motor at such a speed as to bring the brushes—and thus the polar points—to the position shown at the time of maximum



current. The laminated magnetic field is made up of thin plates of the form shown, the internal poles being surrounded by coils E. In the centre is a laminated armature, having four coils corresponding to the four poles, each alternate coil being wound oppositely, the coils being connected in series, and the ends of the series brought to collecting rings F G, connected by brushes to the supply. On the same shaft is also a four-part commutator, having the opposite sections H I connected, one pair being connected to F and the other to G. On this commutator the brushes press, the ends of which are connected to the magnetising coil E, connected to the main motor. Claims: (1) In an alternating current motor the combination, with a fixed magnetic field, of a continuously wound armature and commutator, having a rotating brush frame and brushes, revolved by a subsidiary self-starting synchronous motor, so as to cause the polar points of the armature to revolve synchronously, independently of the speed of the motor; (2) the combination, with a fixed armature of a continuously wound revolving magnetic field, having a commutator or distributor and coils forming consequent poles, in connection with a rotating brush carrier and brushes, revolved by a subsidiary self-starting synchronous motor, so as to cause the resultant magnetic poles to revolve synchronously, independently of the speed of the motor; (3) in an alternating current motor, the brushes revolving with the commutator in combination with a double wound armature having two circuits connected to alternate commutator sections; (4) the combination and arrangement of parts and connections of an alternating current motor, substantially as described and illustrated.—No. 135. January 3rd, 1890. 8*d*.

MAGNETIC SEPARATOR.—*G. W. Elliott, Heeley, Sheffield.*—The apparatus is for the purpose of separating iron or steel from other materials, and consists of a cylinder of wood or other non-magnetisable material supported between two pairs of rollers, and revolved by means of a suitable driving band passing round it. This cylinder carries, at equal distances apart, four or more electromagnets, the ends of which project through the cylinder and are connected to iron plates fixed to the inside thereof. The circuit through the coils of the electromagnets is supplied by means of a fixed insulated metal ring embracing the cylinder, and against which press four brushes, fixed to the cylinder and connected to the winding on the magnets. This ring is cut away at its upper part, so that, as the magnets pass this part, they are

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short circuited. The return is formed by means of a metal ring fixed to the cylinder and in connection with the magnets, and a fixed brush pressing thereon. A suitable inclined tray is fixed inside the cylinder, but so that it does not revolve therewith, to receive the iron or steel as it is dropped by the magnets as they become short circuited. The cylinder is also slightly inclined, so that the material, as the cylinder revolves, always tends to travel in one direction. Three claims are made.—No. 1555. January 29th, 1890. 8*d.*

ELECTRICAL DISTRIBUTION.—*F. Van Rysselberghe, Brussels, Belgium.*—The method adopted by the inventor to reduce the electric transport to a minimum is by establishing on a uniform electric canalisation a great number of generators actuated by hydraulic motors supplied from a second canalisation with water at a high pressure. In the accompanying illustrations Fig. 1 is a

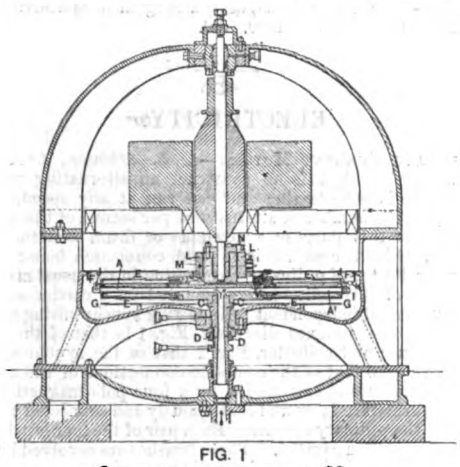


FIG. 1

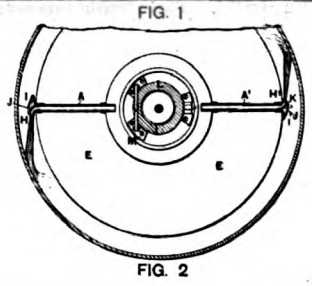


FIG. 2

vertical section, Fig. 2 a horizontal section, and Figs. 3 and 4 details of a combined hydraulic motor and an electric generator arranged according to this invention. The motor comprises two straight tubes A A^1, having at their outer extremities lateral apertures B B^1, through which the water escapes and, striking against the framework, causes the tubes to revolve around their common axis C, through which the water is supplied and which runs in a suitable step bearing D. A cylindrical casing E is arranged around A A^1, and shields F G are arranged as shown (Fig. 1) to prevent undue friction with the waste water. For the purpose of regulating the speed of the dynamo, governors are used, which consist of two obturators (Figs. 3 and 4). These obturators H H^1, arranged at the ends of A A^1, are movable around their respective axes I I^1, and are connected together by a single rod J, a mass K upon the side of which tends, by centrifugal force, to close the obturators, but whose action is partially counteracted by a weight L pivoted to the axle M, and which acts upon J in an opposite direction to K. The movement of L is limited by set screws, and its movement proportionally regulated by a spring N. Claims: (1) A system of hydro-electric distribution, which consists in combining an electric canalisation with a hydraulic canalisation and with hydro-electric generators, the latter being fed by the hydraulic conduit and feeding in their turn the electric conduit; (2) the combination of an electric canalisation of uniform sectional area, with any number of hydro-

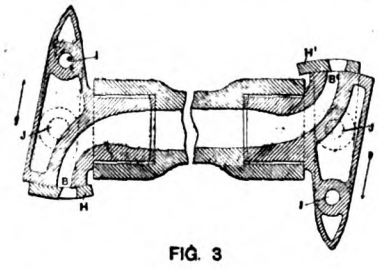


FIG. 3

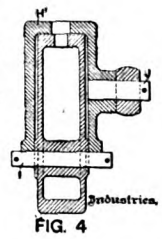


FIG. 4

electric generators; (3) the combination of a high-pressure hydraulic canalisation with an electric canalisation having uniform, but comparatively small sectional areas, and a large number of hydro-electric generators of the type described above, the number of generators to be established varying in accordance with the consumption of electrical energy.—No. 20994. December 31st, 1889. 8*d.*

GALVANIC DRY ELEMENTS.—*C. Smith, London.* (*W. L. F. Hellesen, Copenhagen, Denmark*).—The invention relates to dry manganese elements in which the exciting liquid is mixed with a small percentage of a slimy substance, such as tragasanth slime mixed with plaster of Paris. The dry element consists of two receptacles, one within the other, the interior receptacle being made of zinc and provided with ventilating holes. The space between these two receptacles is filled with sawdust or a similar substance. The carbon used is hollow, covered on the inside with a depolarising substance, its interior being filled with a substance capable of absorbing a large amount of moisture. Outside the depolarising substance is a doughy or similar substance containing the electrolyte. Above this is a porous layer such as plaster of paris covered over with a very close compact layer, such as pitch, so that the escaping gas must pass through the plaster of paris layer, thence through the ventilating holes placed opposite this in the zinc receptacle, and finally pass out through air tubes close to the bottom of the outer receptacle. Claims: The improved galvanic dry element constructed substantially as described.—No. 1306. January 24th, 1890. 6*d.*

ENAMELLING METALS.—*A. E. Robinson, Wolverhampton, & W. H. Wheatley, London.*—The inventors, instead of heating metal plates and other articles to a high temperature in a "muffle," after having thoroughly cleaned same, heat them by a current of electricity from a dynamo or other suitable generator. The article is connected at its opposite ends to suitable clips or terminal pieces which are connected to the two poles of the generator, so that the said articles form the principal resistance in the circuit. The current is regulated to suit the different fusing points of the various enamels employed. Claims: (1) The method of heating plates during the process of enamelling consisting in subjecting them to the action of an electric current which can be regulated according to the temperature required; (2) enamelling metal plates substantially as described.—No. 1894. February 4th, 1890. 6*d.*

TELEPHONIC CIRCUITS.—*E. Gwosdeff & H. Bunge, both of St. Petersburg, Russia.*—The object of the inventors is to prevent any disturbing action in long circuits, so that telephonic communication can be carried on over a greater distance than heretofore. To effect this the inventors connect the line and return wires at both stations by branch conductors in which are introduced resistances (rheostats) or electromagnets, the extent of the resistances being determined by experiment. The same effect is also produced with condensers if such be used in place of the resistances in the branch conductors. The electrical capacity of the condensers must be determined in every case by experiment. Claims: (1) The means for preventing disturbing action in telephonic circuits consisting in the use of branch conductors between the line and return conductor, or generally between the outward and return terminal screws of telephonic circuits, in which branch conductors are introduced either resistances, electromagnets, or condensers; (2) the use, in long telephonic lines, of discharge conductors between line and return wires, in combination with contact closers for automatic intermittent making and breaking of the communication with the discharge conductor.—No. 836. January 16th, 1890. 8*d.*

MINING MACHINERY.—*W. B. Brain & F. Baker, both of St. Kilda, near Melbourne, and A. J. Arnot, Melbourne, Victoria.*—In the annexed illustrations Fig. 1 is a side elevation, and Fig. 2 a horizontal central section on a small scale of a mining

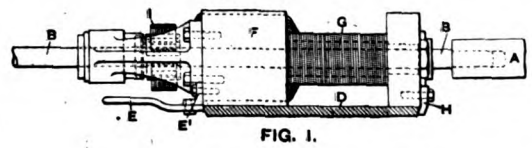


FIG. 1.

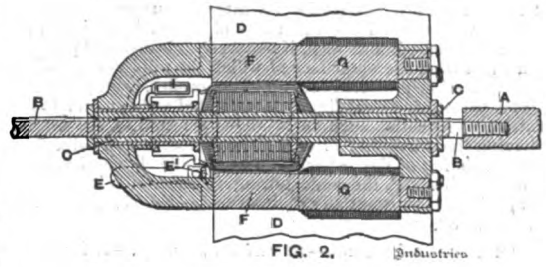


FIG. 2. Industries

machine constructed on the principle of this invention. A is the earth-boring auger fixed to the end of a spindle B sliding in but revolving with the hollow spindle C of an electromotor, as shown. In order that this motor may be moved bodily parallel to the work, it is arranged upon a comparatively long bed-plate D, having bevelled edges in order to admit of the employment of a holding-down clamp E pivoted to the underside of a bracket E^1 secured to the forward ends of the pole-pieces F of the field magnet G. This clamp is adapted to grip the bed-plate against a pair of clamp pieces H at the other end of the field-magnet, the bed-plate being fixed in any suitable manner. The armature and commutator are of the ordinary construction, and are fixed upon the hollow shaft C, the brushes being held in carriers I fixed as shown. Claims: An improved electrical rock drill, coal-digger, or earth cutter consisting essentially in the combination with an earth-boring auger of an electromotor having a hollow spindle such as C, through which the spindle connected to such auger can pass freely longitudinally and at the same time be caused to rotate therewith substantially as and for the purposes herein described and illustrated.—No. 12,997. August 19th, 1890. 6*d.*

ELECTRIC METERS.—*S. Z. de Ferranti, London.*—In meters for recording alternating currents in which an armature or spindle is caused to be rotated by the passage of the current, the inventor magnetically suspends the armature or spindle so as to reduce the friction on its pivots. The suspended magnets used for this purpose are also in some cases used for producing Foucault currents in a metallic disc carried by the spindle to retard the armature's motion. When the spindle is vertical and the armature an iron disc, fixed permanent magnets with their poles in proximity to the upper surface of the disc may be used, or a copper disc may be interposed between the poles of the armature or between the poles and an iron disc on the spindle. Claims: (1) Suspending or partially suspending the armature spindles of electric meters by magnets; (2) an electric meter for recording the passage of alternating currents in which the armature spindle is suspended by an electromagnet or magnets energised by the alternating current; (3) an electric meter in which the armature spindle is suspended by a magnet and in which the suspending magnet serves also to produce Foucault currents in a metallic disc carried by the spindle; (4) the improvements in electric meters substantially as described.—No. 2653. February 18th, 1890 8*d.*

SECONDARY BATTERIES.—*J. K. Pumpelly & F. Butterworth, both of Chicago, Illinois, U.S.A.*—The object of the inventors is to prevent the rapid evaporation and the spilling of the electrolite solution when the batteries are used in a moving vehicle. The positive and negative electrodes, composed of a set of metal plates, preferably perforated, are fixed one above the other in a horizontal position and with a suitable space between them. The space between them is then filled with cellulose packing, and when the cell is thus packed, a sufficient quantity of the electrolytic solution is poured into same, so as to thoroughly saturate the cellulose when the battery is ready for use. Six claims are made, embracing the use of cellulose or woodpulp in secondary batteries to prevent the escape either by evaporation or spilling of the electrolytic solution as described.—No. 16064. October 10th, 1890. 6*d.*

MISCELLANEOUS.

MANUFACTURE OF TUBES.—*C. R. Smith, Providence, Rhode Island, U.S.A.*—The invention relates to the manufacture of seamless tubes. The process consists of drawing up a sheet of metal into the form of a longitudinally split tube or shell in the usual manner. This is then placed upon an arbor, which has adjustable sleeves capable of being fastened in position upon said arbor, the shell being located on the arbor between the sleeves. The tube and arbor are then passed through the flame of blow-pipes, so fusing the metallic shell upon the arbor, so as to flow the edges of the longitudinal opening together. The shell is then drawn through a draw-plate whilst still upon the arbor to give the exterior surface a smooth finish. The sleeves are then removed from the arbor and the tube drawn off. If a metal-plated hollow wire is required one split tube is placed upon the arbor, and is covered with borax or other fluxing material, and a second tube of different metal slid over it, but in such a manner that the longitudinal slot in one tube is opposite a solid part of the other. The two tubes are then fused and drawn as described. Five claims are made, embracing the process as described with modifications.—No. 17249. October 28th, 1890. 8*d.*

NUT LOCKS.—*C. A. Thompson, Irwin, Pennsylvania, U.S.A.*—Formed in the screwed part of the shank of the bolt is a longitudinal slot, and around the nut, which may be of any suitable shape, is a thin metal sleeve, which fits the bolt accurately. Projecting from one end of this sleeve are projections or arms, the ends of which are bent round to embrace the inner face of the nut. The opposite end of the collar projects slightly beyond the outer face of the nut, and a series of spring lips are cut in it which project inwardly towards the bolt shank and engage the longitudinal groove therein, so preventing the nut revolving on the shank in that direction in which it must turn to unscrew itself. Claims: (1) In combination with a bolt having a longitudinal groove therein, a nut and a strap or case encircling the nut, and having a series of spring lips extending therefrom over the face of the nut to engage with the bolt; (2) a bolt having a longitudinal slot, and having a rounded point together with a nut carrying a sleeve as above described; (3) a bolt having a longitudinal slot and a strap or case encircling the nut, and having fingers extending backwards therefrom and passing on to the back of the nut as described.—No. 19422. November 28th, 1890. 6*d.*

ANTI-CORROSIVE BOILER COMPOUND.—*J. L. Wade, London.*—The compound is for the prevention and removal of incrustation in steam generators, and consists of a compound prepared by treating in a boiler or other suitable receiver the following ingredients—viz., caustic potash, esparto grass, and water. These are boiled until the esparto grass is reduced to a pulp, when there is added thereto sumac finely powdered, containing tannic acid. After this addition the mixture is further boiled until the whole is converted into a homogeneous mass. While in this condition the following substances, each in solution, are added:—Potash, chloride of potash, silicate of soda, Irish moss, and lastly, creosote and green mineral oils. The compound is then ready to be added, from time to time, with the water in the steam generator. The quantity of the various ingredients are not stated. Claims: A compound which not only removes and prevents incrustation, but which, by covering the interior of the boiler or tubes with a dark film-like coating, preserves the plates from corrosion, also at the same time neutralising the corrosive properties present in the water.—No. 18451. November 15th, 1890. 4*d.*

NON-CONDUCTOR OF HEAT.—*H. W. Johns, New York, U.S.A.*—The process of manufacturing a non-conducting and sound deadening compound according to this invention is as follows:—Sponge, either picked apart, cut, or shredded, is taken, together with minerals or mineral products, such as agalite, actinalite, chrysolite, hornblende, mineral wool, and the like, or any two or more of them if preferred, in a fibrous condition, and metallic turnings or filings, the oxides of the metals, and chalk, and the whole is then mixed together. The resulting mass after being pressed is ready for use, and may if desired be wetted with any suitable sizing or adhesive substance, such as silicate of soda, rubber solution, starch, glue, and the like, and then pressed into such shapes or forms as desired. Claims: (1) The herein-described composition of matter, consisting essentially of fibrous or comminuted sponge and hornblende, mineral wool, the oxides of the metals, or like bodies, substantially as set forth; (2) a composition consisting of the above-mentioned ingredients, together with an antiseptic or disinfecting material; (3) the combination of fire-proofed sponge, and hornblende, mineral wool, the oxides of the metals, and like bodies; (4) the combination of water-proofed sponge and hornblende, mineral wool, the oxides of the metals, and like bodies.—No. 19202. November 25th, 1890. 4*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.

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THE "DEMON" COLD IRON SAW.

THE engraving given herewith shows a general view of the "Demon" cold saw, designed for cutting iron, mild steel, or other metals of fairly large sections, that is, up square or round, and any rectangular section up to 8in. by to 4in. 4in. The maker, Mr. R. G. Fiège, of 11, Queen Victoria Street, London, E.C., claims for this appliance that it is a cold iron saw, at once powerful, simple, and effective. It is always in readiness for work, and can be worked by inexperienced workmen. The bed-plate has T slots, to receive a parallel vice, which can be fixed at any angle for angular cutting. The articulated lever carries a saw of 10in. or 12in. diameter, on the spindle of which a bronze pinion is fixed, gearing with the worm shown. The latter derives motion from a pair of bevel wheels, which are in turn actuated from the pulley shown in the engraving. The lever and the saw connected with it can be raised and held up by a pawl while the work is being fixed. In small work the weight of the lever itself is found sufficient to feed the saw, but in heavier work it is found necessary to attach a weight on the end of the lever. The machine is fitted with fast and loose pulleys, strap-fork, and bar. We are informed that one of these machines is capable of making 400 cuts through bars of Bessemer steel 4in. diameter, each cutting occupying six minutes on an average, without changing the saw.

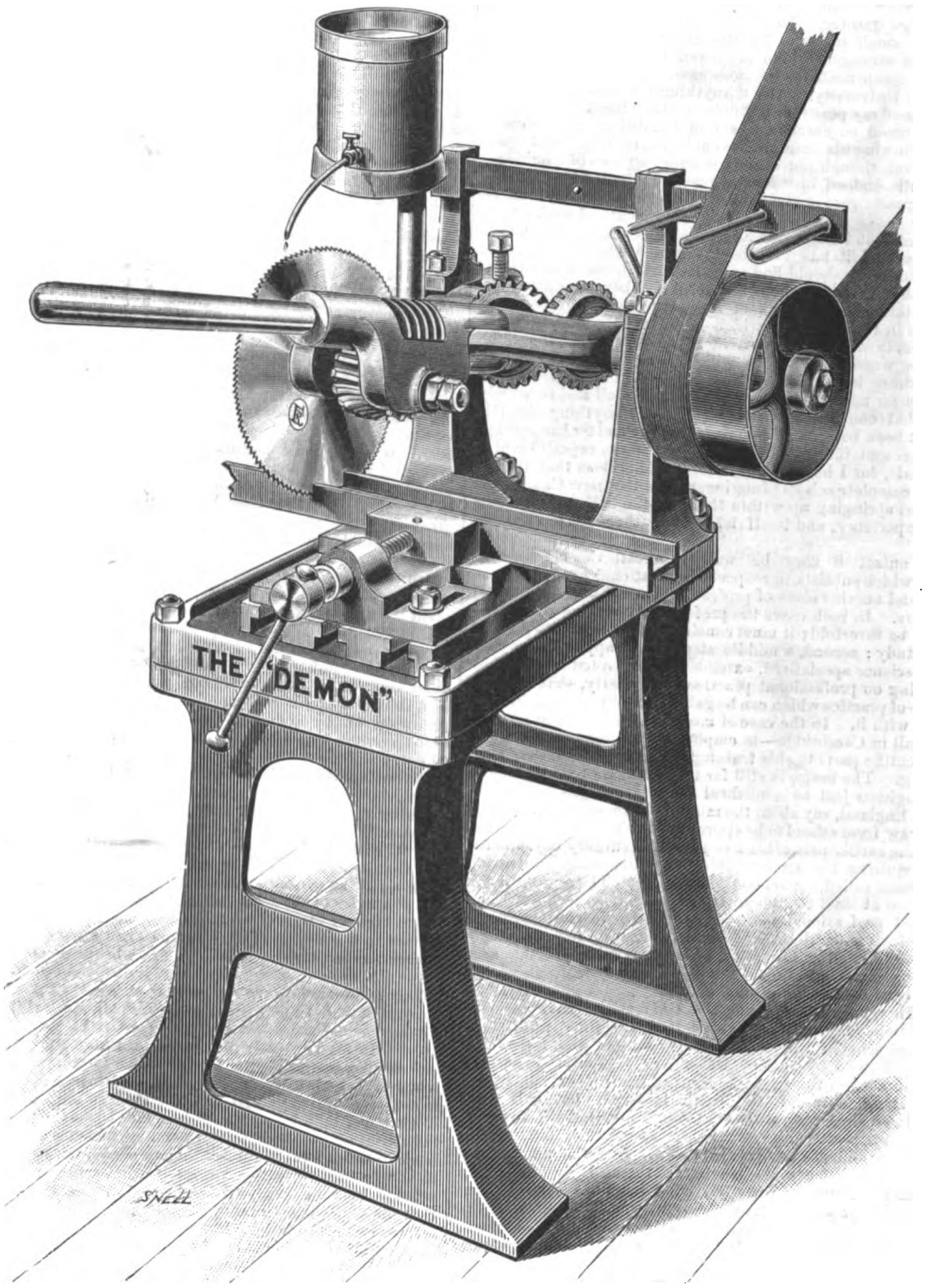
THE "SHARPSHOOTER" CLASS OF TORPEDO GUNBOATS.

BY the recent trials of the first-class torpedo gunboat "Gossamer" at Sheerness, the possibility of a vessel of the "Sharpshooter" type to pass through the prescribed eight hours natural draught trial on the first attempt, without experiencing a breakdown, has at length been fully demonstrated. The repeated failures which have characterised the trials of previous vessels of this kind have caused not only a considerable amount of disappointment to their designers, but have also been a source of much annoyance and anxiety to the constructors of their machinery. The ultimate utility of this class of vessel has frequently been called in question on account of their frailty. In their construction the scantlings have been reduced to the lowest possible limit, and, considering the abnormal horse-power which the machinery was intended to develop in relation to its weight, and the limited space allotted to it, experts have not been slow in regarding a speed of 21 knots and 4,500 i.h.p. as too much to expect from them. Certain it is that the estimated speed and power have not as yet been maintained, nor even approached, in any one of these vessels, and in virtue of the performances of the "Spanker," "Speedwell," and the unfortunate "Sharpshooter," we may feel confident that the highest hopes of their designers will never be realised, at least until some alterations are made either in the hull or machinery of these vessels. The vibration experienced when working with only a moderate allowance of forced draught has already necessitated the addition of a large amount of material to their hulls, in the shape of intercostals and stiffeners in the wake of the engine and boiler spaces, to better enable them to withstand the strains of their powerful machinery. After strengthening the hulls of the "Sheldrake," "Speedwell," "Spanker," and "Skipjack," the officials at Whitehall determined to submit one of them to a series of trials, in order to ascertain what speed and power could be obtained without injury to the boilers. The "Speedwell" was chosen, and, on attempting to maintain 3,500 i.h.p. with an air pressure of 1·5in., the trial had to be abandoned on account of leaky tubes. A subsequent three hours trial was made on the 27th February of last year, when a speed of 17 knots was registered, the engines developing 3,584 i.h.p., with 257 revolutions. Notwithstanding that the contract horse-power for the engines in these vessels was fixed at 4,500, an order was issued previous to the trial of the "Skipjack" in September last, prohibiting the engineers to exceed 3,500 h.p. The realised results, however, with this vessel were—Speed, 19·75 knots, and i.h.p., 3,560. This is about the best performance recorded with any vessel of this type, and is certainly a long way in advance of the average 16·5 knot speed of the "Sharpshooter," which was attained during the regulation eight hours trial in October last, with a mean i.h.p. of 3,010.

Repeated trials with the "Sharpshooter" and "Spanker," built at Devonport, and engined by Messrs. Bellis & Co., of Birmingham, have proved that it is hopeless to expect even 4,000 h.p. without considerable apprehension on the part of the officers in charge of the machinery. Only in October last an alarming incident occurred on board the "Spanker" during a three hours trial under forced draught, when the tubes of the

THE "DEMON" COLD IRON SAW.

CONSTRUCTED BY MR. R. G. FIÈGE, 11, QUEEN VICTORIA STREET, LONDON, E.C.



GENERAL VIEW.

starboard boiler gave out and leaked to such an extent that the boiler was at once well nigh emptied. On this occasion a speed of 19 knots was reached, with the engines developing 3,760 i.h.p., and it was while endeavouring to attain 4,000 i.h.p. that the accident happened, which but for the means adopted, since the "Barracouta" disaster, to prevent the flames and gases from the furnaces issuing into the stokehold, the consequences might have been serious. After every conceivable alteration made by the contractors for the machinery, in regard to the boiler fittings, draught, &c., with the idea of securing the estimated results, had been tried and stamped by failure, the Admiralty sanctioned a reduction in the contract horse-power from 4,500 to 3,500. Notwithstanding this reduction the "Spanker" and "Sharpshooter" were at last taken over from Messrs. Bellis & Co., after having failed to maintain the reduced power on trial for the regulation period.

The estimated horse-power with natural draught for this class is 2,500 during a period of eight hours, and the "Gossamer," built at Sheerness Dockyard, has recently scored a success by exceeding the stipulated power by 117·8, the average recorded during the eight hours being 2,617·8. The "Gossamer" is the first warship the machinery of which has been constructed at Sheerness, and is also the first of her class engined by the Admiralty. From the first turn of her engines in the preliminary basin trials to the completion of her eight hours trial not the slightest hitch or difficulty has been experienced with the machinery of this vessel, a performance which is quite unique in the records of her class. The Admiralty have expressed their satisfaction with the results of the natural draught trial of the "Gossamer," but have issued an order that she is not to be subjected to the ordeal of a forced draught trial. She is to be commissioned forthwith, and will be the first of the seventy-two vessels provided for under the Naval Defence Act to leave the Royal dockyards. According to this Act, twenty-seven first-class torpedo gunboats are to be completed before the 1st April, 1894. Of this number, nine have already been built—viz., the "Sharpshooter," "Speedwell," "Salamander," "Spanker," "Seagull," "Sheldrake," "Skipjack," "Gossamer," and "Gleaner." They are popularly known as torpedo-boat catchers, and their official speed is tabulated as 21 knots, but, so far, not one of them, in all their numerous trials, have yet been able to maintain an average speed exceeding 19·75 knots for the official full period of time. First-class torpedo boats have already realised 6 knots in excess of this speed in trial, and have maintained a 20-knot speed for a lengthened period. Under these conditions, then, it is hardly likely that recent first-class torpedo boats will be taken in the chase by these so-called "torpedo-boat catchers."

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THE UNIVERSITY TRAINING OF ENGINEERS.*

THE feelings of pride, of responsibility, and, above all, of diffidence natural to a young man who finds himself at the goal of professorial ambition—a Cambridge Chair—would surely be sufficiently overwhelming even to one who had all the advantages of a Cambridge training. In my case these feelings are accentuated in no small measure by the consciousness that I come among you a stranger, whom not even the kindness of your welcome can compensate for his ignorance of the traditions and usages of the University. And if anything could make me still more sensible of my position, it would be the reflection that I am called to succeed so eminent a son of Cambridge as Professor Stuart. Following his example, I would wish to regard this chair as being in fact, though not strictly in name, a Chair of Engineering. The title, indeed, of "Mechanism and Applied Mechanics" covers the greater part of the subject of engineering, in so far as that subject lends itself to academic treatment. I understand there has been some discussion as to the proper scope of such a professorship, and it has even been disputed whether a department of engineering should find any place within the University. In view of that, it may perhaps be useful if I beg your attention for a short time while I speak of the education of engineers, of the function in their training which a university may fulfil, of the directions in which development of the department should be sought; in a word, of the aims which I venture to cherish in taking up these high and arduous duties. The education of engineers is no new subject: it has been so well and so widely discussed that one can scarcely hope to say anything about it that has not been better said before. But the matter has perhaps enough of present interest for us to excuse the repetition of a twice-told tale, for I have to plead for nothing less than the inclusion of a complete school of engineering in that new Cambridge which is fast springing up within the old—the heir to its traditions and experience, and itself rich in the enthusiasm of vigorous youth.

At the outset it may be well to recall the close correspondence which subsists in respect of educational needs between engineers and another class of professional men—namely, medical practitioners. In both cases the professional training to be complete must be threefold; it must consist in, first, a basis of general scientific study; second, a middle structure of applied science—that is, of science specialised, extended, and adapted with a view to its bearing on professional practice; and lastly, that kind of knowledge of practice which can be gained only by coming directly in contact with it. In the case of medicine, there is now no need—least of all in Cambridge—to emphasise the importance of the earlier scientific parts of this training. But it is otherwise with engineering. The usage is still far too common of attempting to train an engineer just as a medical practitioner was commonly trained in England, say about the middle of this century, when he was sent raw from school to be apprenticed to a doctor in practice, spending the earlier part of his five years as a surgery boy, and the later in acquiring the art of talking to patients and cultivating what has been called a good bedside manner. The apprentice in medicine had at least the advantage of close association with an experienced professional man, the apprentice in engineering is seldom so fortunate. I am far from undervaluing the advantage, or of questioning the necessity, of contact with practice as a part of professional training. But the tendency in England has certainly been to ignore the fact that this is not all that is required. In regard to medicine the Universities have asserted their function, they have recovered their historical position as professional schools. No one will now contend that a doctor is adequately trained by passing through an apprenticeship which takes no account of the scientific basis of his subject. In regard to engineering, however, the battle is as yet but half won. Experts have declared, with one voice, not, indeed, that the system of apprenticeship should be abandoned, but that it should be modified and supplemented. And the universities and provincial colleges are bestirring themselves, often with very remarkable energy, to supply what has been lacking. But the youth who aspires to the profession, or the parent who has sons to settle in life and wants to make engineers of them, often finds himself at a loss. In too many cases he asks and takes the advice of old engineering friends, once trained as apprentices themselves, and now perhaps not very conversant with the scientific movement of their profession, and the result is that the youth is sent directly from school into the office of a civil engineer or into a great mechanical workshop. His powers of observing and reasoning are little developed: he has no grasp of mechanical principles: his stock of mathematics is scanty at the best, and he is absolutely ignorant of how it may be applied to material affairs. The theory of engineering is a sealed book to him, and in the office or the workshop he finds no one who will break the seal. Even as to matters of practical detail he is left pretty much to pick up what he can: it is the business of nobody to teach him. In time, of course, if he is a man of the right sort he does learn a good deal, and some of the lessons are lessons that could be learnt in no other school. Before his five years or so of apprenticeship have expired he has seen actual work in all its stages. He has learnt something of the commercial conditions under which it is done. He has become heir to the experience of an earlier generation of engineers. He has found that to make himself useful is the first step to success. He has been in touch with men; he has learnt their habits and how they are to be managed. He has become acquainted with matters of organisation and business routine. He has come to know what good work is, and what it costs, and what is the time that should be taken for one and another kind of job. These lessons are invaluable, but I submit they are not the whole of engineering. If the pupil, on quitting his apprenticeship, carries away the faintest idea of how scientific principles bear upon engineering practice, he is exceptionally fortunate. The apprenticeship makes no provision whatever for teaching him that. Lest you suspect me of painting too black a picture, listen to a criticism passed on the system of engineering pupilage by an eminent practical engineer. In the evidence laid before the Royal Commission on Technical Education, whose report was issued in 1884, Dr. Anderson, now director of the Woolwich Ordnance Factories, speaking then as a partner in the Erith Ironworks, said:—

"I have from twelve to twenty pupils who come chiefly from the great public schools. . . . . The minds of most of these young men who come to serve their apprenticeship with us are a complete blank as regards any of the sciences. . . . . Their mathematical knowledge is generally of a useless kind: it is all pure mathematics, and they do not know how to apply it. They might just as well know no mathematics at all. They do not seem able to apply their knowledge to the simplest practical questions. . . . . I have an uneasy feeling that the pupils who leave our establishment know little or nothing except the use of their hands."

That is the verdict of a practical man who has studied the system under his own eye, in his own works. It is perhaps more severe than anything a professor of engineering could well venture to say. Dr. Anderson's evidence is so representative of what I conceive to be the drift of the best modern opinion on this subject, that I will quote a few sentences more. Dr. Anderson is not merely a destructive critic, he is prepared to point out a remedy, and the remedy he advocates is exactly that which I wish to press upon your notice. Asked what was his ideal of the training of the higher class of mechanical engineers—viz., employers and managers—in the future, he replied: "They ought to have a training such as the scientific colleges can give, and then come and carry out a shorter apprenticeship in the works. Instead of remaining five years at the works, as they do now in a great many cases, it would be better for them to spend three years at college, and then come for two years to a practical training. . . . . I am convinced that that would be better." And Dr. Anderson then goes on to speak in appreciative terms of the kind of training in the theory of engineering which is now offered in many British colleges, advocating it as a much-needed preliminary stage in the training of an engineer. It gives him something that the apprenticeship does not give, and at the same time allows the apprenticeship to be abbreviated without loss, by preparing the pupil to reap its advantages in a much shorter time than he would otherwise require. Much other evidence was laid before the Commission to the same effect—notably by Professor Kennedy, who could speak with the double authority of a successful practitioner and an experienced teacher of engineering. These, I take it, are beyond question the lines along which we should proceed: not to supplant the apprenticeship but to supplement and shorten it. These are, in fact, the lines—already marked by much substantial progress—along which the advance has been made by the Scottish Universities and many of the higher English colleges. The chief aim of a University School of Engineering is to give such a training in pure and applied science that when the pupil follows it up by spending two or three years in contact with actual constructive work he is well fitted to begin his professional career.

Before speaking of the work of the English schools in any detail, however, let us glance at what has been done abroad. Nothing could be sharper than the contrast which presents itself between the routine of pupilage in England, as we still often find it, with absolutely no place for theoretical instruction, and the Continental method, in which theoretical training plays so large a part as to leave little or no room for practice. The origin and character of the Continental schools in which the education of the highest class of engineers is accomplished are well described in the Report of the Commissioners, from which I quote a few sentences (Report, p. 507):—"The beginnings of the modern industrial system are due in the main to Great Britain. Before factories founded on the inventions of Watt, of Arkwright, and Crompton had time to take root abroad, and whilst our own commerce and manufactures increased from year to year, the great wars of the early part of this century absorbed the energies and dissipated the capital of Continental Europe. . . . . Thus when, less than half a century ago, Continental countries began to construct railways and to erect modern mills and mechanical workshops, they found themselves face to face with a full-grown industrial organisation in this country, which was almost a sealed book to those who could not obtain access to our factories. To meet this state of things foreign countries established technical schools like the Ecole Centrale of Paris and the Polytechnic Schools of Germany and Switzerland. . . . . With the exception of the Ecole Centrale, all these schools have been created and are maintained almost entirely at the expense of the several States, the fees of the students being so low as to constitute only a very small proportion of the total income. The buildings are palatial, the laboratories and museums are costly and extensive, and the staff of professors is so numerous as to admit of the utmost subdivision of the subjects taught."

To this class belong the Federal Polytechnic School of Zürich, which has so high a reputation as to draw some 70 per cent. of its students from outside of Switzerland, and the Polytechnics of Munich, Vienna, Stuttgart, Dresden, Hanover, Carlsruhe, Aix, Delft, and Moscow, and the technical high school of Berlin. The schools I have named represent a capital expenditure of not less than three millions sterling, and are maintained at an annual charge of over £200,000. They exhibit, as might be expected, somewhat wide differences in regard to their curricula of studies. But they have this general intention in common, that they aim at teaching not merely the scientific principles that underlie the art of engineering, nor merely the relation of those principles to the art—they aim at teaching the art itself. By means of descriptive lectures, and by accustoming the student to design machines and structures, they aim at giving that kind of knowledge of the details of professional practice which we look to the apprenticeship to give. The Moscow school, which, however, is rather exceptional in this respect, affords its students opportunities of mechanical engineering with workshop practice on a comparatively large scale. It includes an engineering establishment, which executes work commercially to the value of £8,000 or £10,000 a year, and in which the foundry alone is big enough to require the employment of 25 workmen. But even with or without such an adjunct as this, the Continental polytechnic school stands in this relation to the training of engineers, that when a pupil has passed through it he is able to earn his bread. He is regarded, at least by himself, as fit for a responsible professional position or for engaging in the design of constructive work. Abroad, pupils go to those schools for just the same reason as, at home, they enter on an apprenticeship. It is the recognised avenue to practice: the diploma of the polytechnic school is the accepted passport to a professional career. Before admission they have usually to pass a somewhat exacting examination in mathematics, mechanics, and physics; in the school itself they carry the study of these subjects to a height which not one in a hundred of English engineers ever reaches. They listen to descriptive lectures from one professor after another, each well versed in the details of some branch of engineering practice. They are given a mass of facts, informing, I think, rather than educative, and finally they are set to make designs which are acknowledged even by unfriendly critics of the system to be an astonishingly clever imitation of real work. There is much that is admirable in the foreign technical schools, and it will be admitted that they have fostered industrial development in France and Germany and Switzerland as perhaps nothing else could have done. But when we examine the constructive work that is carried out in those countries, or when we read the expressed opinions of men who have had experience of the system, we find evidence that the highly finished product of the foreign technical school lacks something that is often present in his rough-hewn English competitor. The Report of the Technical Educational Commission contains emphatic testimony on this point. Even those witnesses who are most alive to the inadequacy of our English apprenticeship as the sole means of training engineers give no encouragement to the idea that we should seek a remedy by copying the foreign polytechnic school. Take for instance the evidence of the late Sir William Siemens, a man rarely qualified to form a sound judgment by his wide knowledge alike of the theory and the practice of engineering, and by his cosmopolitan sympathies. Asked whether he would recommend us to copy the German Polytechnic School, he replied, "Certainly not. . . . . I would rather employ a person who had been brought up in practice and who had supplemented his knowledge by study for himself, than I would take a young man who had been entirely educated at an establishment like one of the polytechnic schools. . . . . I think those schools are apt to teach the student details which he mistakes afterwards for principles."

It would take too long to quote the expressions in which Sir William Siemens amplified and enforced this highly suggestive criticism. Like other authorities, he urges the need of a university training—for the higher class of engineers—to supplement the experience of the workshop, and he agrees that when so supplemented two or three years of workshop practice should suffice. He contends that this training in theory should be given in a university rather than in a special or polytechnic school. He gives hearty approval to the growth of universal teaching in engineering as it has been going on in England, of which I shall presently speak, saying that further development on the same lines is what we need. And as to the character of the teaching that should be offered, the burden of his often repeated advice may be gathered from the sentence I have quoted. It should deal very much with principles and very little with details.

In America we find a number of highly organised and admirably conducted engineering schools, forming in some cases an integral part of universities; in others standing alone. In some respects they follow the Continental pattern, but with a difference. If I were to select one for special reference it would be the Massachusetts Institute of Technology, where the subject of engineering engages the attention of seven professors, with many assistants, and where separate systematic courses of the most thorough kind, each extending over four years, are offered in (1) civil engineering, (2) mechanical engineering, (3) mining engineering, (4) chemical engineering, (5) electrical engineering, (6) sanitary engineering, and (7) architecture. Workshop instruction is given "as an adjunct to the theoretical treatment of professional subjects;" and there is a superbly equipped engineering laboratory for which new rooms, covering 15,000 square feet, were provided less than a year ago. The work of this school is spoken of in the highest terms, and the fact that it has now 900 students bears witness to the estimation in which it is held in the United States. The Massachusetts Institute carries the college training of engineers to a degree of elaboration which we are perhaps disposed to deprecate; but it seems to me to avoid the most serious fault in the Continental schools. Its engineering course, says its President, General Walker, "is designed to thoroughly train the students in the principles upon which the profession is based, and to qualify them to occupy technical positions of trust and responsibility as soon as they shall have gained the necessary familiarity with the practical details of the particular branch of the subject into which circumstances may throw them. The principal point which is kept in mind in the course is that principles and practice must go together, and that the student must be made to clearly see the relation between the abstract principles which he learns and the actual everyday work of the engineer, without, however, devoting much time to minor details of practice which he will learn much better and more quickly after he leaves the school."

I turn now to our own country. The university training of engineers as we understand it—the training which it should be our effort to give here—may be said to have had its foundation laid when Rankine was appointed to the Professorship of Civil Engineering and Mechanics in the University of Glasgow. His introductory address—a noble vindication of the harmony of theory and practice in mechanics—was delivered just thirty-five years ago. It will be found printed as an introduction to his text-book of Applied Mechanics, the first of that great series of treatises in which he formulated the theory of engineering with so much of comprehensiveness, of precision, and of philosophic grasp that they hold their place to this day as the most indispensable volumes in the library of the educated engineer. Edinburgh followed twelve years later with the institution of its University Chair of Engineering, of which Fleeming Jenkin was the first occupant. It was my privilege to receive my first lessons in applied mechanics from that most inspiring and sagacious teacher, who succeeded in bringing his subject into close touch with the co-related sciences in the universal curriculum and in securing academic recognition of the course by means of the degree of Bachelor of Science in the Department of Engineering. The work so well begun in Glasgow and in Edinburgh goes on, but for the moment the development of these engineering schools has been outstripped—in respect of material equipment—by that of some of the younger colleges, which have had the advantage of a greater command of resources. If we wish to see the modern British ideal of a university school of engineering most fully realised we must rather turn to Manchester, where the genius of Osborne Reynolds, aided as it has been by the wise liberality of the Whitworth Trustees in spending

* Abstract of an introductory lecture delivered at Cambridge on the 29th ult. by Professor J. A. Ewing, F.R.S.

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£10,000 upon an engineering laboratory, has achieved results of which Owens College is justly proud. The Victoria University is indeed peculiarly rich in Engineering Schools, for besides Owens it includes the Yorkshire College in Leeds and University College in Liverpool, each admirably furnished for the teaching of engineering. At Leeds the engineers of the district have given unequivocal evidence of their faith in the professional value of a college training by subscribing £10,000 to provide buildings and plant for the department of engineering, and at Liverpool the Walker Engineering Laboratories, recently completed at a cost of some £23,000, form the most lavish provision of which any English college can boast. Time would fail me to speak of the many other institutions in this country at which similar teaching is given, with the aid of more or less perfect laboratory appliances —of the colleges at Birmingham, Bristol, Sheffield, Nottingham, and Cardiff; of the comparatively venerable school of engineering at King's College, London; of such special colleges as that at Cooper's Hill; of the laboratory I have just left at University College, Dundee—in the furnishing of which, again, the local engineers gave substantial help; of the great work the City Guilds have done in London by founding the Central Institution in the West, with Professor Unwin's splendid laboratory, and the Finsbury College in the East, where the suggestive ideas of a most original teacher—Professor Perry—have taken practical shape. Amongst the London schools there is still one that calls for very special mention: I mean University College, for it was there that Professor Kennedy created the first of those laboratories which now fill so large a place in the university training of engineers.

(To be continued.)

APPARATUS FOR DRYING CLAY AND MINERAL EARTHS.

In all branches of manufacture economy is now essential, and an important factor is fuel economy. In order to effect this latter result in connection with the drying of clays, fuller's earth, umber, ochre, barytes, &c., Mr. James Bell, Lower Blowing House, St. Austell, Cornwall, has brought out a new apparatus, which is illustrated below in Figs. 1 and 2. The principle upon which it is constructed is based on the fact that a current of hot air is a good drying agent. A fierce heat applied locally to a slow conducting substance quickly burns it, but if the heat is applied to air in motion, and means provided for its escape, burning is prevented.

One of the great difficulties in existing modes of drying such substances as have been enumerated above is that they get burnt. In Mr. Bell's system a drying floor D is constructed of porous concrete, laid upon T irons so as to allow of 2 cubic feet of air per minute passing

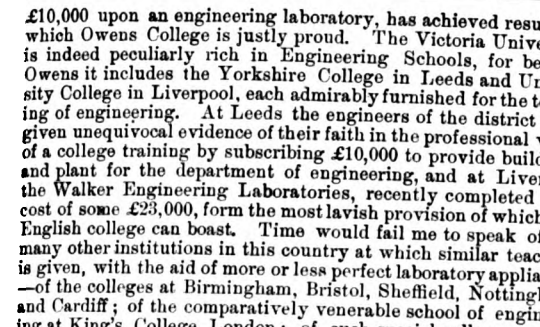


Fig. 1.—Sectional Elevation.

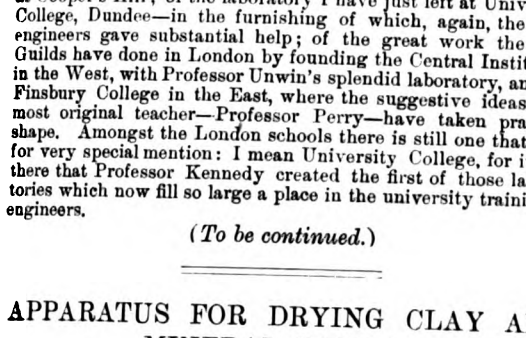


Fig. 2.—Sectional Plan.

through a superficial foot of the floor when the pressure in the air chamber A is ½lb. per square inch. The heat is maintained and increased by means of a wrought-iron flue F, having a fire-place at the end P. This flue extends the whole length of the "dryer." Air is forced into the air chamber through the tube T by means of an air compressor, and, finding no means of escape except through the porous floor, it has to pass through this floor, and the substance to be dried, which is placed upon it. The air in its passage to the chamber is heated by any convenient means—say by exhaust steam—and is further heated by the furnace mentioned. The steam from the material being dried escapes by the pipe E. A dryer has been erected by Mr. Bell, at St. Austell, of this design, and he finds that a heat of 150° to 200° F. forced equally through the material dries it in less than half the time required by a heat of 800° or 900° allowed to take its own time to permeate first the drying floor and then the material to be dried. The dried material can be kept dry in an adjacent chamber. As shown in our illustrations, a chimney can be employed to create a draught, but in the case of the dryer which has been erected Mr. Bell has an air exhauster instead, a water-wheel driving this and the air compressor.

THE "UNIVERSAL" SHEET METAL CUTTING MACHINE.

In the acco mpanying illustrations is shown a machine recently designed for rapidly cutting tinned iron and other metals without the use of special tools, dies, or patterns, which is being manufactured by Messrs. Greenlee Brothers & Co., Chicago, U.S.A. This machine is said to be the outcome of long study and experiment by a practical metal worker. It is claimed for it that it is simple in construction, economical, and capable of doing more and better work in one hour than a man in the ordinary way can do in ten. The makers state that the work turned out by this machine requires no additional trimming. Referring to our illustrations, for which we are indebted to our American contemporary *The Iron Age*, Fig. 1 shows the machine set for cutting the sides of coned and other shaped vessels, and Fig. 2 shows the machine complete, with elbow cutting attachment. The machine has a heavy iron framework, on the top of which slide two head blocks, each carrying two circular cutters. These blocks may be readily moved and locked at any point, and their position is indicated by pointers on the graduated scale shown. The cutters have concave surfaces, and require no grinding or sharpening; they are also adjustable lengthwise on their spindles. The pattern table is supported and slides on a frame which travels on steel guides parallel with the framework. It also swings on a pivot, and can be readily set and locked in any desired position. The elbow cutting attachment includes extension table with support and a large head block with one pair of cutters. Guides or forms (see Fig. 2) for cutting elbows from 2in. diameter upwards can also be furnished.

THE "UNIVERSAL" SHEET METAL CUTTING MACHINE.

Constructed by Messrs. Greenlee Brothers & Co., Chicago, U.S.A.

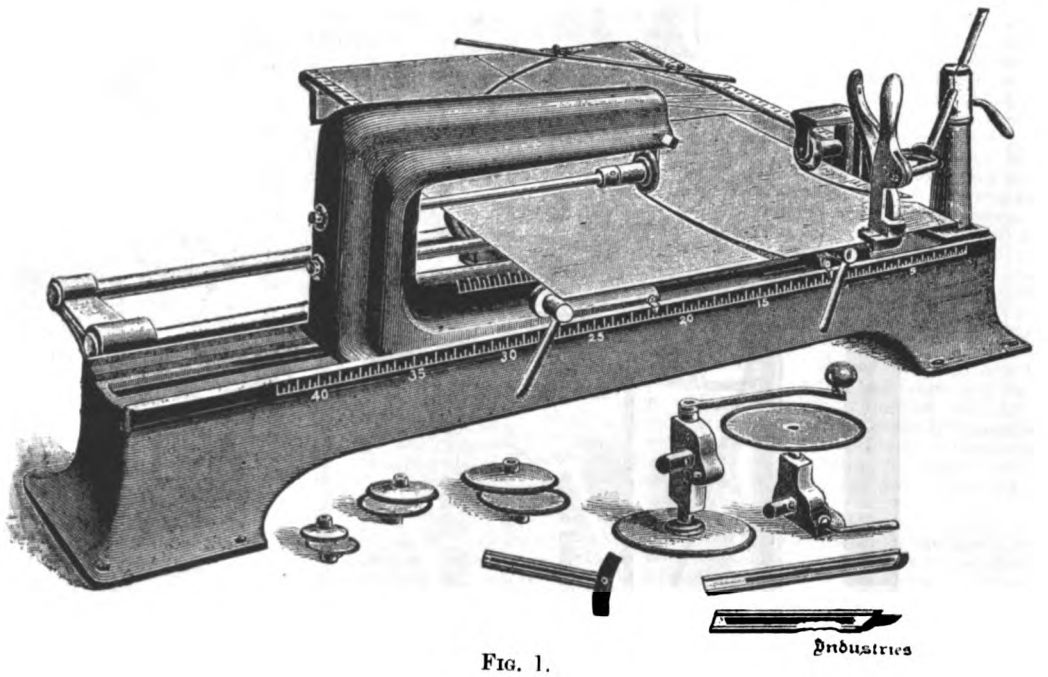


Fig. 1.

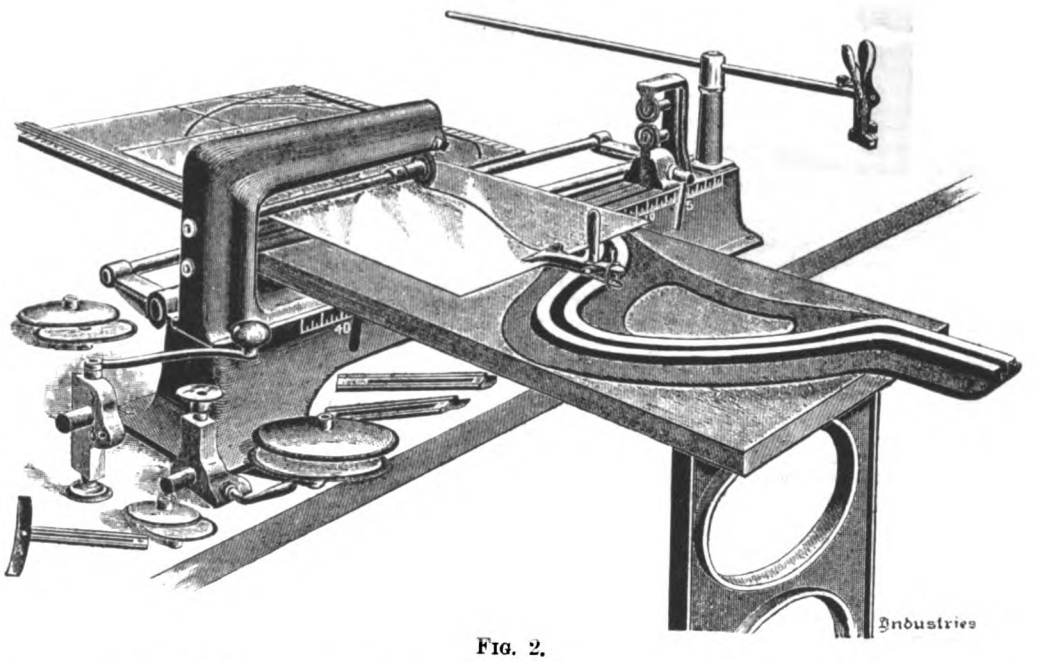


Fig. 2.

THE HULL INSTITUTION OF ENGINEERS AND NAVAL ARCHITECTS.

The members of this Institution held their fourth general meeting of the sixth session on the 10th inst., the President, Mr. C. F. Amos, being in the chair, when

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OVERHEAD STEAM TRAVELLING CRANE.

CONSTRUCTED BY MR. THOMAS SMITH, STEAM CRANE WORKS, RODLEY, NEAR LEEDS.

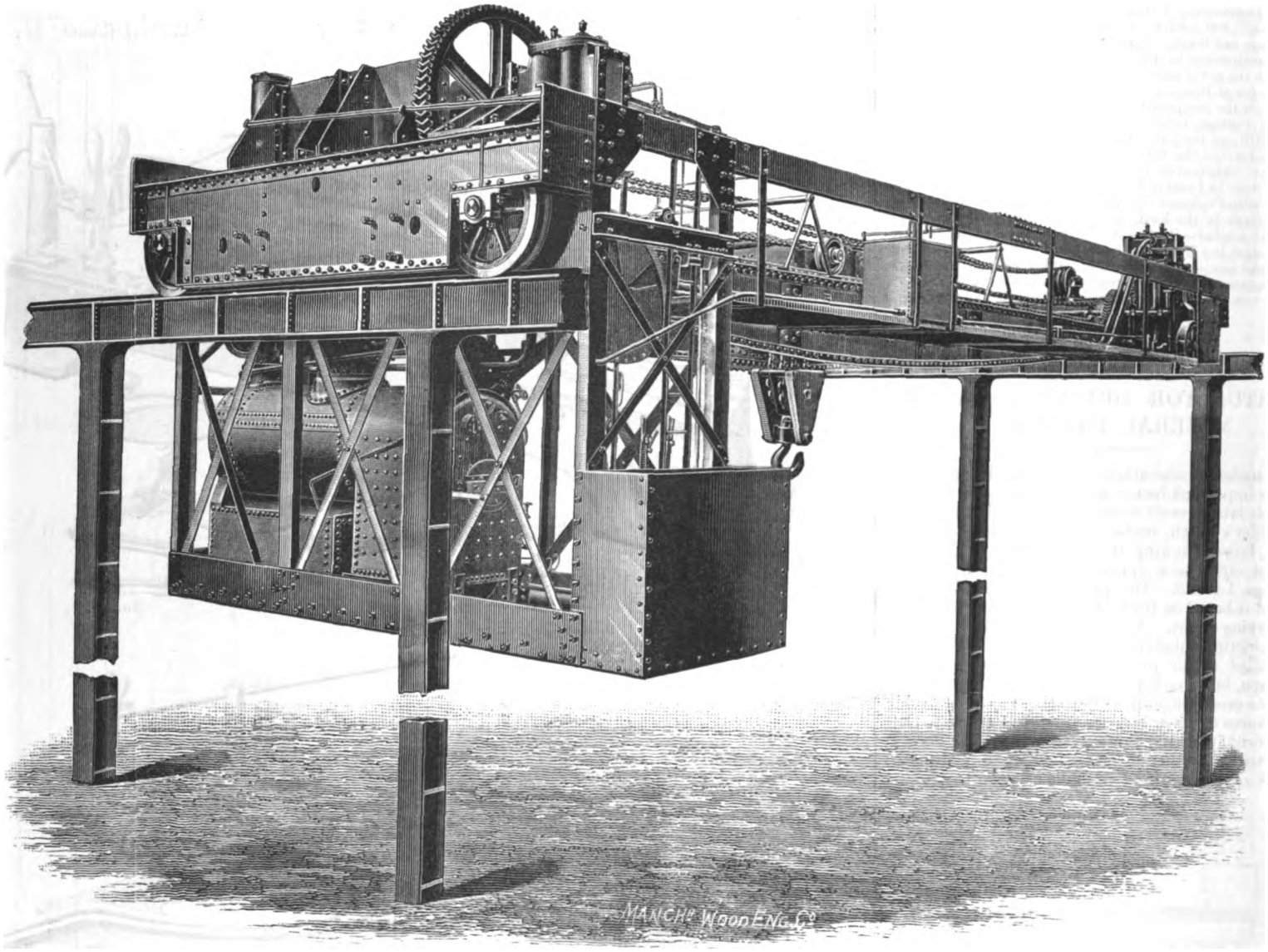


FIG. 1.—GENERAL VIEW.

an interesting paper was read by Mr. R. Pawley, on "A Few Examples of Underpinning," of which the following is a short abstract:—

"Underpinning" was defined as the process of constructing a new foundation to an existing building or structure, and is resorted to in cases where the original foundations of the structure have been inadequate to support the superincumbent weight, in consequence of faulty design in the first instance, or to a subsequent increase in the height and weight of the building; but the necessity for underpinning arises more frequently from the ground in the vicinity of a building being disturbed by the construction of railways, subways, sewers, or similar works at a lower level than the foundations of the adjacent structures. The usual method of underpinning is by excavating in short lengths under the old foundations, and when the required depth is reached, filling the trenches with concrete or brickwork to the level of the old work. The author described the method adopted when the operations had to be conducted in a sub-soil of a wet and silty nature, and also enumerated the various difficulties which had to be overcome in constructing railways in towns where the value of property is considerable, and where the companies would be liable to heavy compensation claims in the event of important buildings being injuriously affected. The following examples of underpinning, which had come within the personal knowledge of the author, were described, the special features of the undertakings being clearly illustrated by diagrams:—(1) The construction of the Hindley and Pendleton Railway under the "Maypole" Hotel, Pendleton, near Manchester. (2) The enlargement of the "Sough" Tunnel, near Blackburn, by lowering the rail level and underpinning the side walls. (3) The construction of the East London Railway under the sugar warehouses at the London Docks. (4) The construction of the East London Railway under the viaduct of the London and Blackwall Railway. A discussion followed the reading of the paper.

At the next meeting a paper on "Air Vessels" will be contributed by Mr. J. Brackenbury.

OVERHEAD STEAM TRAVELLING CRANE.

We show in Fig. 1 above a general view, and in Figs. 2 and 3 on the next page, a side elevation and plan of an overhead steam travelling crane, which has been constructed by Mr. Thomas Smith, of Rodley, near Leeds, for use in a steel works, to lift, lower, and travel with loads up to 15 tons. The crane is designed for hoisting and lowering while travelling transversely or longitudinally, and all the movements are readily controlled from the cage, which is placed at one end of and underneath the transverse beams, and from which the load can be readily seen. All the gear wheels are of steel and have double helical teeth; the shafts are also of steel, and the principal bearings are adjustable and bushed with hard gunmetal. This crane has a separate pair of engines for each motion, which are supplied with steam by the multitubular boiler placed in the cage as shown. The hoisting motions consist of double-purchase gearing, with grooved drum, treble-best iron chain with block and hook, driven by one pair of 8in. by 12in. engines. The transverse travelling motion consists of gearing, chain, and carriage on four tram wheels, with grooved chain pulleys, driven by the second pair of 6in. by 10in. engines, and the longitudinal travelling motion driven by the other pair of 8in. by 12in. engines. The transverse beams are wrought-iron riveted box girders, firmly secured to the end carriages, which are mounted on four double-flanged steel-tyred wheels, set to suit a 38ft. span.

EXHIBITION AT PALERMO.

THERE is to be held at Palermo from 1st November next until the 31st May, 1892, a National Exhibition, in connection with which will be an international section for engines, machines, and tools adapted for small industries. By "engines adapted for small industries" is meant engines that do not exceed 5 h.p. effective, which fulfil the conditions of perfect safety when introduced into small workshops or the rooms of dwelling-houses, and which do not require special and costly erection. "Small machines" denotes machines worked by hand or by engines which would be suitable for industries carried on in small shops or in rooms. The engines will include gas and oil engines, hot air and compressed air engines, hydraulic engines and electromotors. Steam engines will be excluded unless they offer special advantages—namely, great safety, economical working, and simplicity. Those machines and tools only will be admitted which strictly belong to small industries in so far as they assist manual labour, and present the following advantages—viz., lightness, adaptability to various uses, simplicity, possibility of being fixed in any part of a dwelling-house or small workshop, and at such low cost as to bring them within the reach of small artisans. Arrangements are being made for special rates of freight on goods sent for exhibition, and no duty will be charged for articles re-exported. The National Exhibition consists of the following sections:—1, mining and metallurgical products and raw materials; 2, machinery and engineering; 3, chemicals and dyes; 4, food stuffs; 5, pottery and glass; 6, paper, lithography, &c.; 7, textiles; 8, furniture, &c.; 9, liberal arts; 10, naval exhibits; 11, technical education, provident and co-operative societies; and 12, fine arts. Full particulars can be obtained from the Italian Chamber of Commerce, St. Mary Axe, London, E.C.

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OVERHEAD STEAM TRAVELLING CRANE.

CONSTRUCTED BY MR. THOMAS SMITH, STEAM CRANE WORKS, RODLEY, NEAR LEEDS.

(*For description see opposite page.*)

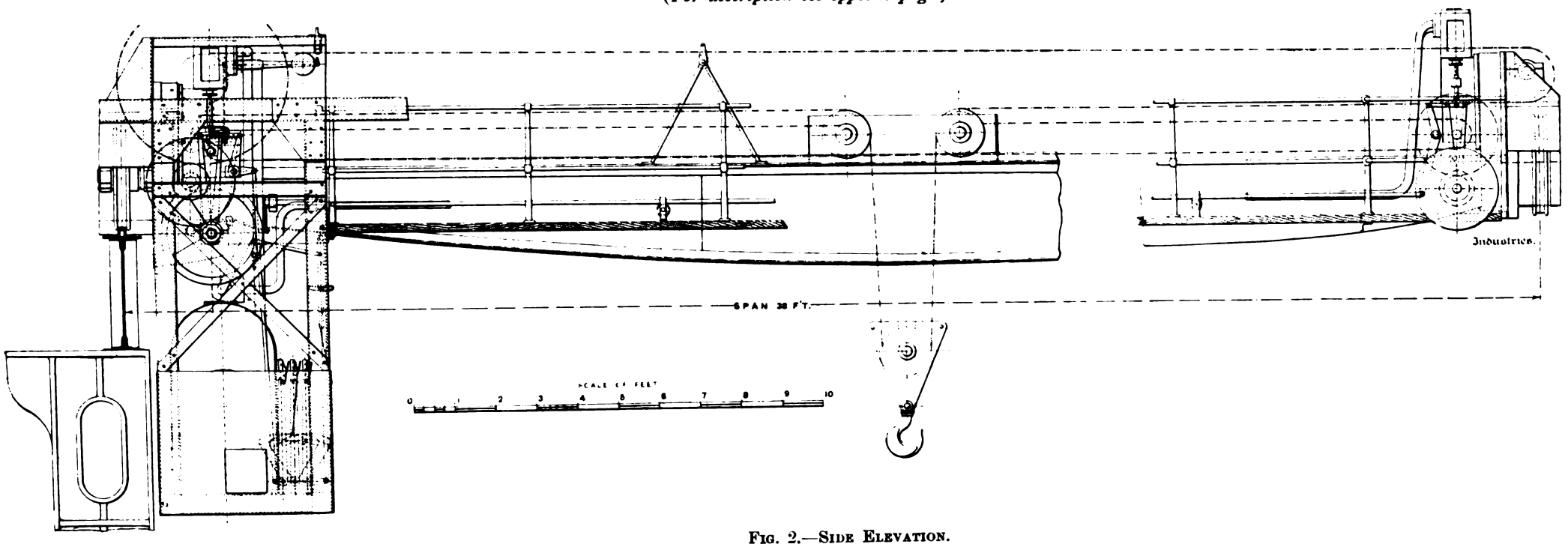


FIG. 2.—SIDE ELEVATION.

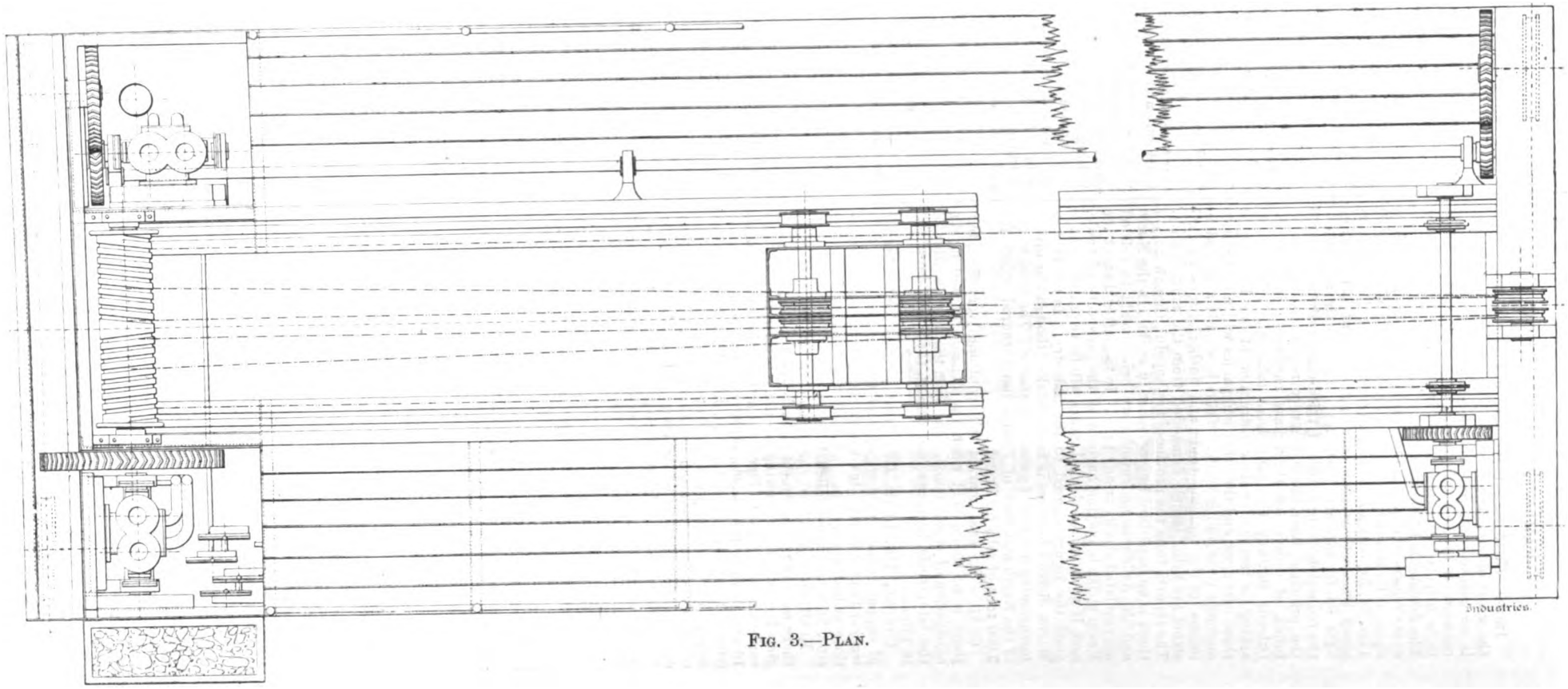


FIG. 3.—PLAN.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 17th February, 1891.

Iron.—There are evident signs in the iron market that the worst of the slack season is over, though as yet there is no marked improvement in prices. This may be accounted for by the accumulation of stocks, which will have to be disposed of before a rise in prices can take place. The demand is much more active this week, and there is every reason to expect a fair rise in quotations at an early date. The prices fixed by the Paris Syndicate remain at 128s. 6d. for bars and 136s. 6d. for joists per ton, but very many transactions have been negotiated at 124s. 6d. and 132s. 6d. for bars and joists respectively. On account of the reduction in the tariffs of third-class railway fares on the principal lines, there is every reason to look for an influx of orders for third-class carriages; in fact, the Orleans Railway Company have taken the initiative in asking for tenders for the construction of one hundred of these carriages, and the other companies will also have to augment their rolling stock. There is already a revival in orders for the building trade, and authorisations to construct are being largely demanded from the municipality. The reports from the provinces are hopeful, though as yet there is no important improvement in trade. In the North and the Ardennes endeavours are being made to sell off accumulated stocks at any price. In the latter district the Revin strike is playing havoc with the prospects of trade, and, if not soon terminated, years will be required to make good the injury caused to the industry. In the Haute-Marne district business is fairly brisk, although the orders forthcoming are not of great importance. The steel works of the North and East of France have secured orders for 3,000 tons of rails for Brazil.

Coal.—The coal market still continues very firm, but there is no doubt that when the demand, caused by the exhaustion of stocks consequent upon the long duration of the late frosts, becomes less urgent, there will be a fall in prices.

Copper, Tin, Lead, and Zinc.—Prices for all brands of copper remain unchanged, and the market is slightly weaker than it was. Tins are firmer at the same quotations as last week. The lead market is weak, as is also the zinc, Silesian having fallen 4s. a ton.

Electric Lighting.—At the close of the past year there were in public streets in Paris 297 arc lamps and 115 glow lamps. The following are the official returns of the various installations:—Place du Carrousel, Edison dynamos, 16 arcs of 75 to 100 carcels, price per carcel hour in francs 0·00592 to 0·0044; Parc Monceau, Jablochkoff lamps, 12 arc lamps of 40 carcels, price 0·01184; Parc des Buttes-Chaumont, Brush and Henrion dynamos, 50 arc lamps of 80 carcels, price 0·00375, 30 glow lamps of 1 carcel, price 0·025; Palais Royal, Edison dynamos, 85 glow lamps of 1·6 carcel, price 0·0166; Boulevards, Thomson-Houston and Gramme dynamos, 47 arc lamps of 75 to 100 carcels, price 0·006 to 0·0045—Edison dynamos, 45 arc lamps of 75 to 100 carcels, price 0·0066 to 0·005—Desroziers dynamos, 39 lamps of 75 to 100 carcels, price 0·006 to 0·0045; St. Lazaire Station, Société Alsacienne dynamos, 6 arc lamps of 150 carcels, price 0·00466; Jemmapes and Valmy Quays, Desroziers dynamos, 66 arc lamps of 75 to 100 carcels, price 0·00533 to 0·004; and Avenue de Clichy, Société Alsacienne dynamos, 16 arc lamps of 75 to 100 carcels, price 0·00533 to 0·004fr.

BERLIN, 16th February, 1891.

The Berlin Sea Canal.—This canal, about which much has been said recently, appears to be making progress. It is stated that at present not only is a company in course of formation to construct a canal from Berlin to Hamburg, but that at the same time several capitalists have promised to provide the necessary funds for the preliminary works of the Berlin-Stettin Canal. In the interests of Berlin, *Kuhlow's* states that it is to be hoped that both enterprises will make speedy progress.

Coal Mining in Prussia in 1890.—According to preliminary investigations the coal raised in Prussia has increased from 61·43 million tons in 1889 to 64·48 million tons in 1890. Divided among the five districts of the Upper Mine Office, the output is as follows:—Breslau, 20·09 million tons (19·00 millions); Dortmund, 35·37 million tons (33·85 millions); Bonn, 8·18 million tons (7·08 millions); Klausthal, 0·63 million tons (0·57 millions). In Halle the output of coal is inconsiderable, but on that district falls almost the entire raising of lignite in Prussia, whereas the entire produce of lignite amounted to 15·51 million tons (14·23 millions). In the coal mines there were, on the annual average, 233,143 people employed (212,056); in the lignite mines, 26,309 (24,503). The figures in parentheses refer to the year 1889.

Electrical Exhibition at Frankfort.—The town commissioners have decided to contribute 1,500 marks to the expenses of the proposed International Electrical Congress. The Chamber of Commerce has also voted 1,500 marks for the same purpose. The Electrical Association is also taking important measures for the furtherance of the scheme.

Electrical Street Railways in Berlin.—The magistracy of Berlin has recently passed an important resolution which affects the erection of electrical railways in the streets of Berlin. No concessions are to be granted for street railways which either are supported on columns (elevated railways) or when on the level of the street require supports to be erected in the roads or footpaths.

VIENNA, 16th February, 1891.

The Iron Market.—During the past few weeks the Austrian and German iron works have competed against each other in reducing prices. The renewal of the agreement which was concluded between the Austrian Iron Syndicate and the German Union of Rolling Mills in Berlin, so as to exclude competition in what are termed the natural trade districts, has led to difficulties. The Austrian Syndicate last year, soon after its renewal for three years had been effected, invited the German Union to prolong the existing agreement for the same period of time. The German Union replied that it was prepared to renew the agreement "for a further period." This offer was refused by the Austrian Syndicate, who desired a fixed period of time to be agreed upon. A struggle was then begun on both sides, in order to lay stress on their demands. The Westphalian iron works sent bar iron into Austria at prices considerably lower than those quoted in that market. On the other hand, the Austrian Syndicate replied by underbidding the prices quoted in the German trade districts, and offered bar iron to Saxony and Bavaria at 10 marks (exclusive of customs duties), or about 3 marks below the German prices. A settlement on this basis appears unlikely to be arrived at either in Germany or in Austria. The German Union of Rolling Mills sent a delegate to Vienna to treat for a peaceful solution of the difficulty. The Austrian Syndicate wishes for the renewal of the agreement without any alteration, so that Austria should not sell goods to Germany, nor Germany to Austria, and that the supplies from the Silesian and Hungarian works, and Wittkowitz to the Balkans, should be regulated according to the old conditions. The desired result has not yet been arrived at, but a truce prevails for the present. A reduction in the prices of all those articles which are subject to foreign competition is evidently expected. Bar iron alone, for which there is a large demand in consequence of the activity of the building trade, shows no signs of a reduction; but a considerable lowering of prices in plates of every sort has become necessary.—The manufactory of arms in Steyr has concluded an agreement with the Government of Saxony for the delivery of 65,000 arms.—The Gotthard Railway has ordered a locomotive here, which will be one of the largest yet built. It is 14 metres long, can carry 12 tons of water and coals, and, when fully loaded, weighs 84 tons. Its power is about 800 h.p.

The Sugar Market.—Strong prices prevail in the sugar market. Trade has been exceptionally brisk during the recent market days, and large quantities of raw sugar for North America were taken off the market. This occasion has been utilised by speculators for the formation of new companies, and recently a syndicate has been formed to erect a large sugar manufactory in Aussig (Bohemia). The title of the company is "The English-Austrian Sugar Refining Company, Limited," and consists mainly of English firms. Its representative in Austria is Mr. Carl Steffen, who has obtained both wealth and fame by his discoveries in this branch of industry.

City Railway in Vienna.—A project, which has been worked out by the Ministry of Commerce, for the construction of a railway in the city, is now being considered in the office of the General Superintendent of Railways. This railway already partly exists in the Government railways connecting the stations of Vienna. This project may, therefore, ultimately be authorised.

BRUSSELS, February 17th, 1891.

Metals.—The price of iron shows a tendency to become stronger, and some considerable projects seem on the point of being carried out. Rolling mills and manufactories are receiving some orders, as well as some offers, from abroad. Several mills have plenty of work, and the price is quoted at from 125fr. to 130fr. In general, prices are not remunerative, but manufacturers are well employed, and hope that a change in the price of coal will better enable them to meet the situation. There are plenty of orders for rolling stock and iron bridge frames. Steel works have a good supply of orders for rails and sleepers. The pig iron market remains unaltered. Prices do not vary, and the amounts which still remain to be delivered on previous contracts are sufficient to take all the production for several months. Red short iron of Charleroi is quoted at 47fr. to 48fr. Messrs. Cockrell have sufficient orders on their books for several weeks. Messrs. Angleur are actively engaged in the manufacture of sleepers for Porto Rico, and of rails for the Belgian Government. Messrs. Ougrée have had some important orders from abroad. The Industrial Society of Louvain have received an order for a supply of bridges for the Congo. The prices of iron are as follow:—Sheets, No. 1, 135fr.; No. 2, 155fr.; No. 3, 175fr.; No. 4, 275fr.; joists, 135fr.; angles, 137fr. Cast iron—Luxembourg, 57·50fr.; Charleroi, No. 3, 85fr.; scrap iron, 52fr.; red short iron, 48fr. Steel rails, large sections, 122·50fr.; small sections, 145fr.

The Coal Market.—The market is weak, even for household sorts, in consequence of the advancement of the winter season and of the depressed state of the iron and glass manufactures. The prices of industrial sorts are uncertain, as buyers hold back and wait for a fall in prices. The prices for close burning sorts is 14fr. to 16fr.; small sorts, 9fr. Coke remains at 16fr. to 18fr., small sorts at 10fr. to 10·5fr., and briquettes at from 16fr. to 18fr. The buying of *demi-grasses* for sugar work has commenced, and the price appears to be 17fr. for delivery in France, or a reduction of 1fr. on last year's price. Coal for manufacturing purposes, in which the trade usually becomes brisker during March, is quoted at 27fr., which is the same price as last year.

DÜSSELDORF, 17th February, 1891.

Iron and Steel Market.—The pig iron market is rather quiet, and all those who had hoped for an improvement of prices through the favourable state of the money market have been disappointed. The quotations of best forge pig are rather lower, in spite of the fact that the Siegerland Company has booked several heavy orders of spiegel containing 20 per cent. of manganese. Steel works continue in full operation; the Georgsmarienhütte has obtained an order for steel rails at 131 marks from the Hanover State Railway Direction. Makers of bar iron, wire, and plates are eagerly looking for new orders.

The Coal Market.—Notwithstanding the present warm weather the scarcity of waggons continues to be widely experienced, and there is a deficiency almost every day of from 2,000 to 3,000 cars in the Ruhr district. Prices are rising.

Traffic on the Prussian State Railways.—The following interesting figures have been taken from the official report on the traffic of all the railway lines under the management of the Prussian State:—

	1888–89.	1889–90.	Increase in 1889–90.
"Passenger-kilometres" in millions	5,951	6,706	755 or 12·7%
Receipts from passenger traffic in millions of marks	195	213	18 or 9·2%
Passenger cars in service	13,776	14,383	607 or 4·4%
"Tons-kilometres" of goods of all kinds in millions	13,194	14,203	1,009 or 7·7%
Goods waggons	177,541	186,832	9,291 or 5·2%
Locomotive engines	8,711	8,961	250 or 2·9%

From these figures it is evident that during the past year the traffic has increased at a much quicker rate than the rolling stock. The difficulty caused by the scarcity of waggons has been predicted for a long time past by manufacturers. It has inflicted great damage on the German industries, and there exists amongst traders generally a strong feeling against the bureaucratic system of Mr. Maybach, the Prussian Minister of Public Works.

AMSTERDAM, 16th February, 1891.

The Blitong Tin Company.—The Government has been rather severely attacked in the First Chamber for attempting to enforce upon the company some manifestly unfair terms in its concession, which would have given to the State an unduly large share in an always risky mining speculation, and would have left very little profit to the actual workers. It is urged that the Government should initiate another and more equitable agreement. Before doing this, the Government has determined to hold another inquiry into the matter, for which purpose a high Government official will proceed to Blitong in order to make a local investigation.

The Sewage of Amsterdam.—Very important experiments have been conducted in Amsterdam with that portion of the sewage which is treated in accordance with the so-called Liernur system, which consists of deodorising and utilising the fæces for industrial and agricultural purposes. At the Central Pumping Station, in the course of an experimental year, 10,000 cubic metres of sewage matter were treated by the contractor, Mr. Lambert Ketjen, manufacturer of sulphuric acid. The treatment resulted in a gross profit of over 3,000 guilders. An amount of 8 per cent. was written off, and 5 per cent. dividend reserved on the capital employed—viz., £1,000. There remained an available balance of 1,463 guilders, to be divided in equal moieties between the Town Corporation and the contractor. The experiments having been so eminently successful, both from a financial and a technical point of view, the town authorities of Amsterdam have now proposed to make an agreement for ten years with the said Mr. Ketjen, which agreement he shall be at liberty to transfer to a company as soon as it shall have been approved by the Town Council. The gross profit is to be equally divided between the town of Amsterdam and the concessionaires. The concession is to last ten years, after which term all the apparatus will be taken over by the Town Corporation at one-half the original cost price, the concessionaires in the mean time being required to maintain everything in a state of efficient repair. The carrying into effect of this agreement will necessitate upon the part of the town of Amsterdam an expenditure of 27,000 guilders.

Railways.—The Holland Railway Company has submitted to the consideration of the Dutch Government a new system of passenger fares, which will permanently fix them at a much lower level than they are at present. The originally Hungarian "zone" system has not suggested the new

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method, although it is no doubt akin to it. The directors of the Holland Railway Company propose to divide their mileage into sections. Up to 50 kilometres the fares would remain practically what they now are, but beyond 50 kilometres fares would be lowered considerably, especially for return tickets. The "zone" system does not admit of this reduction, but in the case of the Holland Railway Company it will form the basis of the new development, as 85 per cent. of all travellers in Holland are holders of return tickets.

STOCKHOLM, 14th February, 1891.

The Sawmills and Timber Export Society.—This Society held its annual meeting on the Stockholm Exchange on the 10th inst. In the report it was stated that the prices of timber, in consequence of a surplus of sawn timber having been held over from the previous year, and favourable floating-down conditions, had fallen to a very low figure. When it became manifest that over-production was the real cause of the decline in prices, the Society determined to forward to all the sawmills and exporters of timber in the country a request to reduce the cuttings for this winter. The result of this application was that all owners of sawmills undertook to reduce their production to some 30 per cent. of that of last winter. From calculations it appears that the available quantity of sawn timber will be less by 39,130 standards at open water this year than what it was last year. Among the matters discussed was the question of mode of payment on sales to England, and a general desire was expressed that the time of six months should be reduced.

New Steamer.—A new steamer, "A. Wijkonder," built at the Lindholmen Engineering Company's shipyard, had its trial trip on the 5th inst. The dimensions are:—Length, 217ft.; breadth, 29½ft.; carrying capacity, 1,700 tons. The engines indicate 650 horse-power. The trial trip was in every respect satisfactory.

The Herring Fishing.—The herring fishing on the west coast has not been so good of late. The exports from November last year to February this year amounted to 10,396,000 kilogrammes, against 13,069,000 kilogrammes during the same period last winter. The State railways had forwarded 7,600,000 kilogrammes, against 10,000,000 kilogrammes during the same period of last winter.

Electric Transmission of Power.—Transmission of power by electricity is being adopted at the Skutskör Saw mills. The engine which is working the large pumps will be abolished, and the requisite power is to be transmitted by electricity from one of the large engines. The power in question is 8 h.p., and the distance about 2,000ft.

CHRISTIANIA, 14th February, 1891.

The Wood Pulp Industry.—The past year was by no means a favourable one for this important industry, which has, in fact, developed so quickly that the consumption has hardly been able to keep pace with the supply. Prices have during 1890 reached a lower point than was thought possible a year or two ago. Both buyers and sellers, especially the latter, have been well stocked. Buyers have been holding back, and the manufacturers have had to sell in several cases at unremunerative prices. Wet 50 per cent. mechanical wood pulp has been sold at £1 12s. 6d. per ton, delivered in English ports. Efforts were, therefore, made to bring about a better state of affairs by a reduction in the output. This was also agreed upon in August last, when it was decided to stop the works from Saturday noon to Monday noon by a large number of wood pulp manufacturers in Norway and Sweden, but a good many Norwegian makers were prevented by pending contracts from joining this arrangement. It is, however, to be hoped that this movement will include all Scandinavian wood pulp manufacturers, whereby it will gain in strength and effect. An improvement in the demand, attended by somewhat better prices, began in November, enabling the makers to clear the bulk of their surplus stock. America is virtually a closed market for foreign wood pulp, owing to the new tariff, but this is not a matter of great importance. The complications in connection with the French and Spanish commercial treaties are far more serious, as the former country, especially, is a large buyer of Norwegian wood pulp. The exports of wet mechanical wood pulp were about 205,000 tons in 1890, 190,000 tons in 1889, 175,000 tons in 1888, 155,000 tons in 1887, 115,000 tons in 1886, 100,000 tons in 1885. These figures show an uninterrupted and fairly regular increase. There are at present in Norway altogether fifty-four manufactories where mechanical wood pulp is being made.

COPENHAGEN, 14th February, 1891.

The Copenhagen Waterworks.—The works in connection with this pumping station have progressed rather slowly, owing to the strike last year and the severe frost of the present winter. The installation of machinery is, however, expected to take place about the beginning of March, and the station will probably be ready for work by the 1st of May. This new pumping station will increase the daily water supply from 210,000 barrels to about 350,000 barrels, and at the same time provide a reserve for the old waterworks. It is thought that the fact of drawing part of the daily supply from the new pumping station will not perceptibly increase the cost per 1,000 barrels, as the new station will be more economical than the old one.

Breweries.—The Tuborg Brewery, which is a limited company, made last year a profit on its brewing of 244,322kr., against 276,494kr. the previous year. At the annual meeting this decrease was explained as due to the cold and wet summer of last year, and the inferior quality of the malt. In addition to profits on beer, the company had derived various other profits from its harbour, its workmen's dwellings, and its petroleum stores. The net profits amounted to 99,824kr., of which 96,000kr. were absorbed by the payment of a 6 per cent. dividend to the shareholders. The question of the effect of the proposed beer tax was touched upon. The tax is an extraordinary one, and affects only one class of beer. If it should be imposed, the breweries will probably have to produce another kind of beer which is exempt from taxation.

Danish Industries.—Though the industries of Denmark are not so important in extent as those of some other countries, only about 14 per cent. of the population being engaged in industrial pursuits, the extreme care shown in the manufacture has led to many successful results. The Royal Porcelain Manufactory is one of the most flourishing of these industries. It was originally started by a private individual in 1775, and was shortly after taken over by the State, for whose account it was carried on up to 1867, when it again passed into private hands. In 1882 it was purchased by the Aluminia Company of Copenhagen, whose earthenware factory adjoins, and which has been successfully carried on under the management of Mr. W. Edwards, an Englishman, who brought into the business his experience gained in the Potteries. Since its foundation the Royal manufactory has confined itself to the production of hard porcelain (*porcelain dure*), the principal components of which are kaolin quartz and feldspar.

MADRID, 16th February, 1891.

Export of Iron Ores.—The export of ores from Bilbao up to the present time is about 30 per cent. below the export of last year. This deficiency is owing to the severe weather, which has caused difficulty in the workings. The total export during the present year is not likely to amount to that for the past year.

Bridge over the Nervion.—This interesting bridge over the River Nervion, from Portugalete to Las Arenas, will be high enough to allow the largest vessels to pass under it. The material for the bridge is daily expected at Bilbao, and the bridge will be erected as soon as possible so that it may be opened before the second cruiser is launched in September next. The contract for the metal work has been carried out by a French works, under the management of M. Arnodin. The shore supports of the bridge are 65 metres high, its length is 160 metres, and height from the level of the highest tides to the girders is 45 metres. Two ways of crossing from one shore to the other will be provided — a movable platform, to which there will be access on a level with the shore, and a footpath over the bridge, which will be reached by lifts like those employed in the Eiffel Tower. The total cost of the bridge will be about £12,000, and it is expected that a fair interest will be paid on the capital. In case of success another bridge will be built higher up the river.

The New Railway Station at Madrid.—The new railway station, which is being constructed by the Madrid, Zaragoza, y Alicante Company is making rapid progress, and will be a very fine building. The company has nearly 3,000 kilometres of lines. The length of the station will be 152 metres, and the span over the platform will be 50 metres. There are ten platforms at a distance from each other of 17 to 18 metres. The height from the rails to the centre of the arches is 25 metres, and the station covers 7,500 square metres of ground. The steel portions of the structure have been constructed by the Belgian Company "Société Anonyme de Construction et des Ateliers de Willebroeck." Mr. Leon Beau is the representative of the company in Spain.

Improvements at Barcelona.—Tenders for the extensive improvements which are to be carried out at Barcelona, and which may be compared to those made at Paris under the Empire, are to be received on May 27th. Several thousand buildings are to be pulled down, and many new streets are to be erected in their place. There is much risk in the conditions of the contract, as a slight alteration in the value of the property to be bought and sold would result in financial loss. The only tender, which is likely to be sent in, is that of the author of the scheme, as he has the right of undertaking the contract at the lowest of the tenders.

NEW YORK, 7th February, 1891.

Lead.—The annual meeting of the stockholders of the Lead Trust was held here on the 4th inst. Representatives of about $50,000,000 of the stock out of a total of nearly $90,000,000 were present. A dividend of 50c. a share was declared, and it was announced that that amount would be paid quarterly hereafter. The net earnings of the year after all expenses are deducted amount to $2,028,552. The company or trust controls a large share of the sheet lead business, and also of the white lead business, but they have strong competition. About one-eighth of all the linseed oil business and one-eighth of all the smelting and refining business done in the United States is under their control. The valuation of the properties of the trust on January 31st was $24,217,638, of which their investment in plant amounted to $17,992,989, and their net working capital to $5,765,414. The total sales made by the trust during the year amounted to $19,898,835.

Copyright Decision.—The decision of the judge of the United States Circuit Court in New York probably settles the long litigation over the right to reprint the "Encyclopædia Britannica" in this country. He refused to prohibit the sale of the American pirated edition, on the ground that the British publishers had no rights in the United States except as to certain articles in the "Encyclopædia" which were written and copyrighted here. As the American publishers had substituted other articles for those, there was nothing to prevent their selling their edition.

Carnegie's Steel Works.—A connecting bridge is to be built by Carnegie Bros. & Co., and Carnegie, Phipps, & Co., from the Homestead Steel Works to a point on the north side of the Monongahela River near the Carrie furnaces, at Keating Station, Pa. The object is to establish direct communication between the two plants. It is said that the direct process of manufacture now in vogue at the Edgar Thomson works will be introduced at Homestead. The iron will be taken in a molten state over the bridge from Braddock in vessels.

Pumping Machinery.—The Snow Steam Pump Company, of Buffalo, New York, is about to ship to the Montreal Mine, Hurley, Wisconsin, one of its improved mine pumps, having a capacity of 100,000 gallons per day, the water to be raised 1,500ft. Among other recent orders was a 200,000 gallon elevator pump for the new Rockefellar & O'Day building in Buffalo.

The Berlin Iron Bridge Company.—The business of the Berlin Iron Bridge Company, of East Berlin, Conn., has increased so rapidly in the last few years that at the annual meeting recently held the shareholders decided to increase the capital from $125,000 to $300,000. The entire increase has been subscribed for by the present shareholders. The additional capital will be used to improve the plant at East Berlin, and the company will immediately put up a new building 80ft. wide by 600ft. long, and expects to have it in working order by July next. The addition is expected to increase the output of the works 25 per cent., with the shop running 10 hours per day. The works have been running night and day for a large portion of the last three years. The company has shipped during the past year 8,000 tons of iron work, consisting of iron bridges, iron buildings, and iron roofs.

PHILADELPHIA, 6th February, 1891.

A Philadelphia Pipe Line.—The largest oil pipe line leading into Philadelphia will be completed during the present week. It extends from Morgantown, the centre of the Doll's Run and Mount Morris oil field, to the works of the Atlantic Refining Company in this city, and will have a capacity of 15,000 barrels of oil per day. These oil fields in South-Western Pennsylvania and Northern West Virginia have proved very productive, and the oil is of excellent quality. The Standard Oil Company has but little interest in the territory as an operator, but all the oil passes through its pumping station at Moyertown, where the tanks of that company have a capacity of half a million barrels. The average daily output of these fields is 5,000 gallons per day.

Pumping Engines.—The tenders for pumps, with a capacity of 20,000,000 gallons, for use at the Spring Garden station of the city water works were opened this week. The Holly Manufacturing Company bid $81,000, agreeing to complete the work by February 1st, 1892; the Southwark Foundry and Machine Company, $72,500, to complete in nine months from date of order; the Worthington Pump Company, for $127,000; and the I. P. Morris Company, $83,400. The tenders for boilers were $19,900 by the I. P. Morris Company, $23,165 by the Henry Worden Company, and $18,865 by the Southwark Foundry, to the latter of whom the contract was awarded.

Locomotives. — The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered three freight engines to the Central New England and Western Railway Company, and they are building two eight-wheel and two ten-wheel engines for the Los Angeles Terminal Company. The Rhode Island Locomotive Works, of Providence, R.I., have delivered four ten-wheel engines to the Union Pacific. The Schenectady Locomotive Works, of Schenectady, N.Y., has an order for freight engines for the New York Central and Hudson River. The Rogers Locomotive Works, of Paterson, N.J., are building three decapod engines for the Chicago, Burlington, and Quincy. The Cincinnati, Hamilton, and Dayton has put on two powerful Mogul freight engines, weighing about 65 tons. The Rogers Locomotive and Machine Works, of Paterson, N.J., have delivered four eight-wheel passenger engines to the Louisville, New Albany, and Chicago. The Brooks Locomotive Works, of Dunkirk, N.Y., have an order for ten ten-wheel engines for the New York Chicago, and St. Louis; they will have cylinders 19in by 24in., and driving wheels 50in. diameter, and will be fitted with the Westinghouse air brake and American steam brake. The Grant Locomotive Company is said, according to the *Engineering News*, to be at work on the construction of its plant at Cicero, Ill.

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THE WORLD'S MONEY.

Mr. Leech, the Director of the United States Mint, has prepared for the House Committee on Coinage a series of interesting tables, showing the gold and silver estimated and officially reported to be in circulation as money throughout the world, and the specie holdings of the leading European banks. The most comprehensive table, which is given in the *Iron Age*, is the following:—

Approximate Amount of Gold and Silver Money in the World.

Country.	Gold.	Silver.
United States	$702,018,869	$482,071,346
United Kingdom	550,000,000	100,000,000
France	900,000,000	700,000,000
Germany	500,000,000	145,000,000
Belgium	65,000,000	55,000,000
Italy	140,000,000	60,000,000
Switzerland	15,000,000	15,000,000
Greece	2,000,000	4,000,000
Spain	100,000,000	125,000,000
Portugal	40,000,000	10,000,000
Austria-Hungary	40,000,000	90,000,000
Netherlands	25,000,000	65,000,000
Scandinavian Union	32,000,000	10,000,000
Russia	190,000,000	60,000,000
Turkey	50,000,000	45,000,000
Australia	100,000,000	7,000,000
Egypt	100,000,000	15,000,000
Mexico	5,000,000	50,000,000
Central American	—	500,000
South America	45,000,000	25,000,000
Japan	90,000,000	50,000,000
India	—	900,000,000
China	—	700,000,000
The Straits	—	100,000,000
Canada	16,000,000	5,000,000
Cuba, Hayti, &c.	20,000,000	2,000,000
Totals	$3,727,018,869	$3,820,571,346

The silver money is classified by Mr. Leech, in the following table, into that which is full legal tender and that which is tender for but limited amounts:—

Country.	Full Legal Tender.	Limited Tender.
United Kingdom	—	$100,000,000
France	$ 650,000,000	50,000,000
Germany	102,000,000	43,000,000
Belgium	48,400,000	6,600,000
Italy	25,800,000	34,200,000
Switzerland	11,400,000	3,600,000
Greece	1,800,000	2,200,000
Spain	90,000,000	35,000,000
Portugal	—	10,000,000
Austria-Hungary	90,000,000	—
Netherlands	61,800,000	3,200,000
Scandinavian Union	—	10,000,000
Russia	22,000,000	38,000,000
Turkey	—	45,000,000
Australia	—	7,000,000
Egypt	—	15,000,000
Mexico	50,000,000	—
Central America	500,000	—
South America	25,000,000	—
Japan	50,000,000	—
India	900,000,000	—
China	700,000,000	—
The Straits	100,000,000	—
Canada	—	5,000,000
Cuba, Hayti, &c.	1,200,000	800,000
Totals	$2,929,900,000	$408,600,000

The total stock of full legal tender silver coin in Europe is given at $1,101,400,000.

THE INSTITUTE OF MARINE ENGINEERS.

A meeting of this Institute was held on the 10th inst., when Mr. W. W. Wilson read a paper on "Improvements in Engine Room Practice." The meeting was presided over by Mr. J. McFarlane Gray. The first detail of the engine discussed was the piston, the different styles of which were referred to, and the adoption of the Ramsbottom rings was considered to be a very great improvement. The valves, eccentrics, shafting, thrust blocks, boiler mountings, and safety valves were mentioned, and the difference between the old and new systems pointed out. The Chairman commented upon the excellent paper which had been given, and the discussion was maintained by several members.

The series of questions recently propounded by the Admiralty Engineer to the engineers of the mercantile marine, regarding the practice in connection with the working of boilers and the feed-water arrangements, were given for discussion. It was stated, in reply to the first question, that boilers had been run for about five months with the same water, or without emptying them. The other questions were also dealt with, and it was explained that in the most recent types of marine machinery provision was made for supplying the loss of fresh water by means of evaporators, by tanks built in the engine-room or stokehold, and by purchasing fresh water at ports of call, or supplementing it by means of the donkey boiler. It was explained that the supply of steam to baths and sculleries, and leakages, were the chief sources of loss of fresh water in steam vessels, and that these amounted generally to more than three tons per day.

The next meeting will be held on the 24th inst., when Mr. Green is expected to read a paper on the "Application of Zinc for the Preservation of Boilers."

TRANSFORMER DISTRIBUTION.*

The distribution of electrical power by means of alternating-current transformers can hardly be considered to have reached its final state, and though it may be somewhat difficult to say what system will be in general use ten years hence, there is little doubt that present practice will be largely superseded.

The method now in vogue is simple: it consists of running several independent dynamos, each with its own engine; each dynamo supplies a few high-pressure mains, which branch off, and supply transformers placed in the houses, or wherever light is required. This system, admirable for country towns or straggling villages, is hardly likely to be permanent elsewhere. It has many disadvantages. Except that all the dynamos and engines are in one building, it is nothing more than a collection of little independent installations. Each engine and dynamo supplies its own circuits, which are independent of all the others. In cases of a breakdown of an engine or dynamo, and in many cases of the leads, there is a stoppage till new arrangements can be made at the station. In addition to this, great lengths of high-pressure conductor are required, and this leaves openings for breaking down of insulation. The introduction of high pressures in private houses is dangerous if not well managed, and is in any case expensive, demanding compliance with all sorts of regulations, rendered necessary for the security of the public. The greatest drawback to the present system, however, lies in the waste of power in the transformers themselves. For a long time transformers were supposed to have an efficiency of about 98 per cent. More will be said on this subject presently.

It must be borne in mind that in spite of the drawbacks of the present system of putting transformers in houses, it may be, and probably has been, advisable for electric light companies to begin on that system, even in such places as London; but I do not think such an arrangement will pay in the long run, and a time will arrive when the mains will have to be changed and a low-pressure supply system substituted. When an electric light company begins, it has to take on houses here and there, where it can get them; but if its district is populous and wealthy, it should soon be enabled to work on some low-tension or sub-station system; and then the question is whether it is not better to lay the low-pressure mains at first, instead of beginning on one system and changing to another. Probably none of the existing companies mean to change from one system to another. Their engineers have no doubt gone into the merits of the particular cases, and have come to their conclusions with great deliberation, and I do not think it well to offer any criticisms lightly.

Parallel Running According to Orthodox Hypothesis.

To begin at the beginning of my somewhat extensive subject, the first question is that of running machines in parallel. There are few matters of greater importance to engineers, and few on which opinions differ so widely. One says that machines will not run in parallel unless they have large self-induction; another that it is necessary to have iron in the armatures; another that they will only run together if they have no self-induction, or as little as possible. Others say that there is no difficulty in running them in parallel. No engineer who employs direct currents denies the advantages of running machines in parallel; if independent running is advisable in alternate systems, it is equally advantageous in the case of direct currents, and direct-current stations should have separate circuits for each little district, each district being run by one dynamo. I do not think, therefore, independent running is advisable.

In 1884 Dr. Hopkinson showed that alternate-current dynamos could be run in parallel, or could be run as dynamo and motor, and even that a machine giving a high pressure could be run as a motor off a circuit of lower pressure. In his paper he assumes that machines have "self-induction." He points out that the self-induction varies, but that it would be impossible to work out the calculations if the "self-induction" were taken as variable. For some reason or other, Dr. Hopkinson's calculations have received little application. That is to say, engineers have not taken actual cases and worked them out. Calculations have been made in which the various quantities have appeared in the form of letters, and diagrams have been drawn in which they are represented by lines whose lengths have been chosen at random. The geometrical treatment of many problems of this kind shows most of the actions very clearly to students, but is not always of value in practical work, as in most cases some lines are so long and others so short that it would be difficult to avoid large errors. The result of this is that few of us, if any, have had any definite idea of how much "self-induction" a machine should have to make it work well in parallel with others. The general impression is that it is somewhat difficult to design a machine whose "self-induction" is large enough, and that most failures to run in parallel are due to deficiencies in this respect. I am using the term "self-induction" under protest, as I prefer to look at the question from another point of view. But, whatever goes on in a dynamo, if the no load electromotive force is treated as constant, a value for a constant coefficient of self-induction can be assumed which would produce results somewhat similar to those found in practice. To overcome the difficulties arising from deficient self-induction in the armature circuit, Dr. Hopkinson has proposed to insert it artificially, in the form of choking coils, or to use induction couplers to compel synchronism. Without knowing that it had been done before, I described a similar arrangement to the Institution a few years ago.

In the spring of 1890 Mr. Mordey read a most important paper, in which he described some experiments on alternate machines. He argued from them that self-induction was deleterious, and that machines would run together best if they had none. In the discussion, Dr. Hopkinson pointed out that the experiments were quite in accordance with his theory, and that there was nothing that could not be foretold by it.

To begin with, it is necessary to get a clear idea of what is required for parallel running. It is not exactly the same as the case of alternating motors, neither is it the same as two machines of equal pressure coupled in parallel by themselves. If all the machines are coupled to two main conductors, we may consider them one at a time, and take each dynamo as coupled to a system whose pressure and variations of pressure are independent of it. Suppose the effective pressure to be 2,000 volts, for example: we have to consider a pair of mains with 2,000 volts, and we have to couple on a dynamo to add so many amperes to it. Such a machine must not be excited to give 2,000 volts on no load, being then thrown into circuit with full steam turned on immediately afterwards. It should be excited to give somewhere about half load with 2,000 volts at the terminals, and should then be thrown in. Steam can then be turned on, and the excitation raised to its normal value. The machine should be so designed that any excessive power that the engine may give shall not only not throw the machine out of step, but shall not increase the armature current to such an extent as to damage the insulation by excessive heating.

The power absorbed by a dynamo working on a parallel system is

$$P = \frac{B^2 r}{2 i^2} - \frac{A B r}{2 i^2} \cos 2\pi n \tau + \frac{A B L}{2 i^2} \sin 2\pi n \tau,$$

where A is the maximum station electromotive force—that is to say, the station pressure is $A \sin 2\pi n t$ — B is the maximum "impressed" electromotive force in the armature, r is the armature resistance, i the impedance of the machine, and τ the angle of lead. This equation is taken from Dr. Hopkinson's paper. When the dynamo is doing its proper share—that is to say, under normal conditions—

$$B = I c,$$

where I is the impedance of the whole circuit when the machine is isolated, and working at full load on an external resistance, and c is the maximum value of the current. To find how much the driving power may increase for a small increase of current, we may differentiate with respect to c, and then find the value of L which makes the result a maximum.

$$c = \sqrt{\frac{A^2 + B^2 - 2 A B \cos 2\pi n \tau}{i^2}},$$

$$\text{Cos } 2\pi n \tau = \frac{A^2 + B^2 - i^2 c^2}{2 A B}.$$

So,

$$\frac{d P}{d c} = \frac{A B r}{2 i^2} \cdot \frac{2 c}{A B} + \frac{A B 2\pi n L}{2 i^2} \cdot \frac{d \sin 2\pi n \tau}{d 2\pi n \tau} \cdot \frac{d 2\pi n \tau}{d \cos 2\pi n \tau} \cdot \frac{d \cos 2\pi n \tau}{d c};$$

and in the case of a dynamo working on resistance, or on a station load when supplied with just its right share of power,

$$\cos 2\pi n \tau = \frac{A + r c}{B},$$

$$\text{and cosec } 2\pi n \tau = \frac{B}{L c}.$$

So,

$$\frac{d P}{d c} = \tfrac{1}{2} A + c r,$$

c being the maximum, not the effective current. It will be observed that L has disappeared altogether.

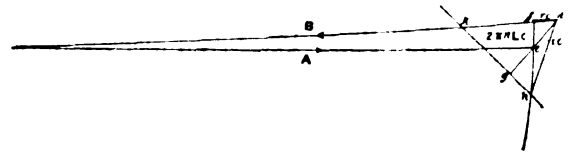


Fig. 1.

This shows that for a very small increase of power the increase of current will be the same, whatever the self-induction of the machine may be. It would not matter if the machine had none. A machine with no self-induction would (Mr. Mordey notwithstanding) short-circuit the mains if the engine supplied too little power; in fact, at full load it would be giving its minimum possible output, and any attempt to diminish this would be disastrous.

Discussing the question of a very small increase is not exhaustive; an engine may supply a large proportion more than its share of power to one machine. For instance, suppose it supplies twice the normal power. Many engines could not give such an excessive power, but in others which have expansion gear controlled by a speed-governor, it is easy to get double power if the station is running at a slightly slower speed than that for which the governor is set. These matters are always made much clearer by taking practical examples and working them out. The great difficulty is to obtain accurate data. I should prefer to discuss such machines as those described in Mr. Mordey's paper read here a short time ago. Without wishing to say anything in disparagement of his excellent paper, I must point out that an account of experiments should contain full particulars of the machines on which the experiments were made. Such omissions are exceedingly common in electrical papers. Mr. Mordey has not given us the details of the field magnets, air space, armature coils, or exciting coils; he has not even given us the currents in the different experiments. I have found similar omissions whenever I have tried to gain information from any of the numerous experiments which have been made on alternate machines in America. Mr.

* Abstract of a paper read by Mr. J. Swinburne before the Institution of Electrical Engineers on the 19th inst.

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Mordey does, however, say that about half the drop in his machines is due to resistance, and half to self-induction. The machines give an output of 2,000 volts and 20 amperes, and when fully excited give 2,200 volts at no load. This would correspond to a self-induction of 0·05 henry.

Suppose, first, that the self-induction were such that $2\pi n L = r$: on increasing the power supply, the effective current increases evenly, and when the power supplied to the machine is doubled, the effective current is only about 44 amperes. It is necessary, however, that the machine should stand decrease of load, as well as increase, without injury. Keeping the same self-induction, let us decrease the load to zero with the full excitation on. The current gradually diminishes to just below 15 amperes, and then increases to just over 20 again. These figures are extremely troublesome to work out from Dr. Hopkinson's equations, as the angle is so small that an error in about the sixth place of decimals will vitiate the results.

Many people prefer diagrams such as those used in mathematical books when dealing with harmonic variations. Mr. Blakesley has applied these diagrams to the discussion of alternate dynamos and motors, and Messrs. Kapp, Fleming, and others have applied them too. The chief drawback is that it is not always easy to draw such figures to scale. They are generally drawn with the values taken at random, to give ideas of the principles involved. So far as I know, no scale diagram of this sort has ever been published. In the case of the 40,000-watt machine such diagrams can be applied; but with 100,000 machines, which will probably be the standard size, the diagrams are almost illegible.

Fig. 1 is a diagram to scale. The lines are all rotating positively. The diagram is made as follows:—The pressure in the mains A is drawn first. Instead of the maximum, it is simpler to draw the effective pressure—in this case 2,000 volts. From the end e, $2\pi n L c$ is drawn at right angles to it to f; and then $r c$ from f, parallel to A, B, is drawn to join the ends of A and $r c$, as shown. The lines are all pressures; but the instantaneous current is in step with the pressure $r c$ and with the pressure A, so that the power is proportional to $B r c \cos f d m$. I use the expression "in step" to mean co-phasally synchronised. Thus two machines may be running at the same speed without being in step; just as soldiers may take the same number of paces per minute without being in step.

To find the current at double load, produce $i c$ to g, so that $d g = 2 i c$. Through g draw a straight line cutting B at k, at an angle, $g k d$, equal to the angle $d e f$. The line $g k$ is the locus of the end of the line representing the pressure spent over the resistance and self-induction of the armature with currents giving double load. It is unnecessary to go into the proof of this. With m as centre and A as radius, describe arc cutting $k g$ at h; join $d h$. Then the current at double load is to 20 amperes as $d h$ is to $d e$. In this case the double-load current is not much more than 40 amperes.

(To be continued.)

SHIPBUILDING NOTES.

On the 10th inst. H.M.S. "Latona," a second-class cruiser, built and engined by the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, underwent her forced draught trial at Portsmouth, when the result was most satisfactory. She is the first of her numerous class now building which has been delivered to the Admiralty. The horse-power contracted for under forced draught was 9,000, but this was exceeded by 438 h.p. Both her natural and forced draught trials reflect much credit on her constructors, and the Admiralty are to be congratulated upon having such an efficient vessel as the "Latona" has proved to be.

On the 10th inst. the steel steamer "Agnes" was launched by Messrs. R. Craggs & Sons from the Castle Moat Shipyard, Stockton. She is of the following dimensions:—Length, 173ft.; breadth, 26ft.; depth, moulded, 12ft. 11in.; and will be fitted by Messrs. Westgarth, English, & Co., Middlesbrough, with triple-expansion engines, having cylinders 13in., 21in., and 34in., with 24in. stroke. She will be fitted with all the latest appliances for rapid loading and discharge of cargoes.

On the 14th inst. there was launched from the yard of Messrs. W. Doxford & Sons, Limited, Pallion, Sunderland, the s.s. "Clan Macneil," the first of the new Clan Liners, being built to the order of Messrs. Cayzer, Irvine, & Co., managers Clan Line Steamers, Limited, Glasgow. Her principal dimensions are:—Length between perpendiculars, 312ft.; breadth, extreme, 39ft.; depth of hold, 23ft. 6in.; and she will carry about 3,500 tons. He engines are triple-expansion, the cylinders being 23in., 37in., and 62in., with 42in. stroke. The boilers are built for a working pressure of 180lb., and are fitted with Messrs. Howden's force draught system.

Notices of Meetings.

THIS WEEK.

Society of Arts.—Friday, February 20th, at 4.30 p.m. Lecture on "The Science of Colour," by Captain Abney, F.R.S.

North East Coast Institution of Engineers and Shipbuilders.—Friday, February 20th, at 7.40 p.m. Discussion on Mr. A. Blechynden's paper on "The Influence of the Relative Dimensions and Proportions of the Screw Propeller on the Vessel's Performance." Papers to be read: "The Strength of Short Flat-ended Cylindrical Boilers," by Mr. J. T. Nicholson; "Results of Experiments on the Strength of Boilers," by Mr. J. C. Spence.

Junior Engineering Society.—Friday, February 20th, at 8 p.m. Papers to be read: "Carriage Way Pavements in Large Towns and Cities," by Mr. J. B. Ball; "The Design and Construction of Sewage Precipitation Works," by Mr. A. Wollheim.

Royal Institution.—Saturday, February 21st, at 3 p.m. Lecture II., on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

NEXT WEEK.

Society of Arts.—Monday, February 23rd, at 8 p.m. Cantor Lecture II., on "The Electric Transmission of Power," by Mr. Gisbert Kapp, M.Inst.C.E. Thursday, February 26th, at 4.30 p.m. Lecture on "The Economic Development of Siam," by Mr. R. Gordon, M.Inst.C.E.

Cleveland Institution of Engineers. — Monday, February 23rd, at 7.30 p.m. Paper to be read: "Notes on American Blast-Furnace Practice, and a Comparison with the Work Done in the Cleveland District," by Mr. W. Hawdon.

Institution of Civil Engineers.—Tuesday, February 24th, at 8 p.m. Adjourned discussion on the paper by Messrs. Atkinson on "On Electric Mining Machinery." Paper to be read (time permitting): "On the Subterranean Water in the Chalk Formation of the Upper Thames, and its Relation to the Supply of London," by Mr. J. T. Harrison, M.Inst.C.E.

Sanitary Institute.—Tuesday, February 24th, at 8 p.m. Paper to be read: "Scavenging: Disposal of Refuse and Sewage," by Mr. Charles Jones.

Society of Architects.—Tuesday, February 24th, at 7.30 p.m. Ordinary meeting.

PRICES CURRENT, 18th February, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 17 6	.....	7 7 6	London.
" Angles	7 0 0	.....	7 10 0	"
Crown Sheets	7 5 0	.....	7 15 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			8 0 0	"
" Ship and Girder			7 0 0	"

PIG IRON.

Middlesbro' Warrants, No. 3.	42/-	Cash.
Scotch Warrants, m/n	46/10½	"
Hematite Warrants, m/n	50/6	"

Stocks in Stores. Scotch	554,033—Dec. for week	5,884	Tons.
Middlesbro'	124,280—Dec. "	225	"
Hematite	211,737—Dec. "	431	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	...	.....	...	f.o.b.	Glasgow.
Gartsherrie	...	.....	...	"	"
Carnbrae ex Store	50/6	.....	50/3	"	"
Eglinton "	50/-	.....	49/9	"	"
G.M.B. "	47/6	.....	47/3	"	"

METALS.

Spelter: Ordinary	£24	12	6	to	24	17	6
Copper: British Cakes and Ingots	57	10	0	"	58	0	0
" Chili Bars, G.O.B.'s	53	0	0	"	53	7	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	53	0	0	"	53	7	6
" Manufactured (strong)	65	0	0	"	66	0	0
Lead: Common Pig	13	10	0	"	13	15	0
" English Sheet	14	5	0	"	14	10	0
Tin: Straits	90	0	0	"	90	10	0
" Australian	90	2	6	"	90	15	0
" English Ingots	94	0	0			.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: There is practically no change to report in the position of copper, which continues quiet with limited business. Since our last report the market for Chili bars has been weaker, but is now recovering, quotations to-day being £53 to £53 7s. 6d. cash, or about 5s. higher on the week. Manufactured continues steady, at £65 to £66 "strong."

Tin has shown a weaker tendency throughout the week, but to-day's market is firmer.

Lead: Quiet, with values unchanged.

Spelter: The market has kept very steady during the last week, and there has been a slight advance, which seems to be fully maintained. In Silesia the demand for spelter by rollers of sheet zinc has been large, and, therefore, the Continental producers are very firm.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

	£ s. d.		£ s. d.
Acid: Carbolic Crystals ...lb.	0 0 5¼	to	0 0 6¼
" " Liquid ...gal.	0 1 0	—	.....
" Citric ...lb.	0 1 8½	—	.....
" Oxalic ... "	0 0 3½	—	.....
" Sulphuric ...ton	1 15 0	—	.....
" Tartaric ...lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.) ...ton	5 12 6	—	.....
Ammonia: Carbonate ...lb.	0 0 3½	—	.....
" Muriate (Grey) ...ton	25 0 0	—	.....
" " (White) ... "	26 10 0	—	.....
" Sulphate ... "	10 17 6	—	.....
" Liquor ...lb.	0 0 3	—	.....
Antimony ...ton	75 0 0	—	.....
Bleaching Powder ... "	6 12 6	—	.....
Bisulphide of Carbon ... "	13 0 0	—	.....
Borax ... "	28 10 0	—	.....
Benzole (90 %) ...gal.	0 4 9	—	.....
" (50/90 %) ... "	0 3 7	—	.....
Copper Sulphate ...ton	16 10 0	—	.....
Copperas ... "	2 0 0	—	.....
Kieserit ... "	.....	—	.....
Lead: Nitrate ... "	.....	—	.....
" White Sugar ... "	25 10 0	—	.....
" Brown " ... "	.....	—	.....
Potash: Bichromate ...lb.	.....	—	.....
" Caustic ...ton	22 0 0	—	.....
" Carbonate ... "	20 10 0	—	.....
" Chlorate ...lb.	0 0 5½	—	.....
" Prussiate (Yellow) ... "	0 0 10	—	.....
" Sulphate (Basis 90 %) ...ton	4 0 0	—	.....
Precipitate: Red ...lb.	0 3 6	—	.....
" White ... "	0 3 6	—	.....
Salts: Epsom {Bags ...ton / Casks ... "	3 0 0	--	.....
	3 15 0	—	.....
" Glauber ... "	1 10 0	—	.....
Sulphur: Sublimed Flowers ... "	9 10 0	—	.....
" Recovered ... "	7 5 0	—	.....
Soda: Ash ...deg.	0 0 1⅝	—	.....
" Caustic (White 70%) ...ton	11 2 6	—	.....
" " {" 60%) ... " / Cream 60%) ... "	9 17 6	—	.....
	9 10 0	—	.....
" Crystals ... "	8 8 0	—	.....
" Bicarbonate ... "	7 10 0	—	.....
" Hyposulphite ... "	6 10 0	—	.....
Solvent Naphtha ...gal.	0 1 8	—	.....
Tartar, Cream of ...cwt.	5 7 6	—	.....
Zinc Sulphate ...ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: For bleaching powder there is less inquiry, but other "Union" articles are in good demand. Sulphate of ammonia is quiet, but prices steady. Benzoles in moderate demand. Carbolic acids still very depressed. Sulphate of copper has had a sharp fall, but is again firmer, though the foreign inquiry is very small. Green copperas is more plentiful. Foreign white sugar of lead has advanced strongly, but other qualities have not changed. Recovered sulphur unobtainable on spot, and makers heavily engaged forward.

OILS.

	£ s. d.
Cocoanut: Cochin ...per ton	35 15 0
" Ceylon ... "	29 0 0
Cottonseed ... "	19 0 0
Cod ... "	23 0 0
Lard ... "	33 10 0
Linseed ... "	21 15 0
Olive, Spanish ... "	43 0 0
Palm, Lagos ... "	26 0 0
Rapeseed: English ... "	28 10 0
Seal: Pale ... "	25 0 0
" Brown ... "	.....
Sperm ... "	48 0 0
Whale ... "	21 0 0
Turpentine ...per cwt.	1 8 9
Coal ...per gal.	.....
Petroleum (Refined) ... "	0 0 5¾
Spirit ... "	0 0 8

Erratum.—In the illustrated description we gave on page 163 of our last week's issue, on "The Recovery of Hydrochloric Acid from Waste Products," we referred to Mr. Thomas Turner, "of Sheffield." Mr. Turner's address should have been given as "Mason College, Birmingham."

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HOME INDUSTRIES.

LONDON, 19th February, 1891.

The Money Market.—Partly through the continuance of gold withdrawals for abroad, and partly through the action of the Bank of England in taking funds from outside, so as to bring open market rates in line with the official minimum, and thus help to check further withdrawals, money rates have hardened very appreciably during the week. The demand for accommodation now rather exceeds the supply of money, and the maintenance of the firmer rates ruling seems certain for some time to come. Inactivity is still the complaint of the Stock Exchange, the greater dearness of money and the collapse of the price of silver reducing the already diminutive volume of business. The weakness of silver securities has been the only well-marked feature of the week, with the exception perhaps of the depression which has affected the stocks of the Scottish railways. Otherwise there is little to take notice of, markets being in general weak and unsettled. There is a little activity in mining shares, but it is unequal and partial.

British Economic Association.—This Association, which was founded at a meeting held at University College, London, on November 20th, 1890, the Chancellor of the Exchequer being in the chair now numbers about 500 members. The president is Mr. Goschen, M.P.; the vice-presidents are Mr. A. J. Balfour, M.P., Mr. H. C. E. Childers, M.P., Mr. L. H. Courtney, M.P., and Mr. John Morley, M.P.; and the editor and secretary is Professor F. Y. Edgeworth. The object of the Association is the advancement of economic knowledge by the issue of a journal and other printed publications. The *Economic Journal* is to represent all shades of economic opinion, and will be published by Messrs. Macmillan & Co. The first number, to which several well-known writers on economic subjects have promised to contribute, will appear at the end of March next. The first of the additional publications will be a translation of Roscher's History of English Political Economy in the Sixteenth and Seventeenth Centuries. The Association may perhaps extend the scope of its action by supplying a common meeting place for English economists, and by promoting economic investigations.

The Factory Acts Amendment Bill.—On the 12th inst. Mr. Matthews received, at the Home Office, an influential deputation of manufacturers from Lancashire, Yorkshire, and other parts of England, as well as representatives from Scotland and Ireland. Mr. Maclean, M.P., who introduced the deputation, criticised the Bill of Sir Henry James, and said that its provisions had been drawn up with reference to the cotton industry, and were absurd when applied to other textile industries. He complained that the Bill contained certain clauses which both employers and employed had agreed to strike out. Mr. Matthews, in reply, said that he was glad to hear the views of the deputation, as he was himself preparing a Factory Bill. On the 13th inst. Mr. Matthews received a deputation of operatives engaged in the textile industries of Lancashire and Yorkshire. Sir Henry James introduced the deputation, and said that he regretted that no understanding had been arrived at between employers and employed as to the proposed legislation. The operatives agreed with their employers that the latter should not be obliged to disclose facts which would give foreign manufacturers a knowledge of their business, and thus increase competition. Mr. Matthews, in reply, said that many of the technical points could best be settled by operatives and employers, whose interests were, in many respects, identical.—On the 13th inst., also, Mr. Stuart Wortley received a deputation, which asked that the provisions of the Factory Act might be relaxed in favour of the fruit-growing and preserving industries.

Petroleum Fuel.—At a meeting of the Shipmasters' Society on the 13th inst., a paper was read on "Liquid Fuel in Ocean Steamers," by Captain W. V. Carmichael. The lecturer stated that, partly owing to the cheapness of coal, and partly to the reluctance of owners to adopt it, the use of oil fuel had not hitherto been much taken up by steamship owners. An economy of space was effected, since the oil could be carried in the cellular bottom of the ship. Moreover, the fires could be entirely controlled by the engineer on watch. As the consumption of oil, compared with coal, was, weight for weight, one-half—ten tons of coal, in other words, being only equal to five of oil—the storage of fuel could be made much more compact and easier of access; there was increased speed in fuelling the ship; and port charges were avoided, as more fuel could be carried in proportion than formerly. Petroleum was to be found in all parts of the world, and competition would probably bring the fuel within easy reach of the commercial world. With regard to the important question of fuelling our men-of-war at sea during a blockade, he thought that the large tank steamers of the present day could always fuel the fleet, even in heavy weather.

City and South London Railway Company.—The directors of this company state that since the 18th December, when the railway was opened to the public, a service of trains, running at intervals of about five minutes, has been maintained, and although there have been a small number of occasional delays from the failure of engines and other causes, there is every reason to be satisfied with the use of electricity as a motive power. The average number of passengers carried has been about 15,000 per day, but as the weather improves, and the line is better known, this number will no doubt steadily increase. It has been found in working such a rapid service that the siding accommodation provided is insufficient, and arrangements are now in progress for the construction of additional sidings at the Stockwell terminus, which will add greatly to the facilities for working the line. A fourth engine and dynamo will be added to the generating plant at Stockwell Depôt, and these have accordingly been ordered, and it is intended also to add two additional trains and four additional locomotives to the rolling stock. As soon as these additions are complete, it will allow of a considerable accession to the number of trains run, and the opening of the line on Sundays, if thought desirable. With the view of developing the traffic on the line, a Bill has been deposited in Parliament to authorise the construction of a branch line from King William Street to the Bank, and thence, under Moorgate Street, Finsbury Pavement, and the City Road, to the "Angel," at Islington.

The Projected Central London Railway.—A Bill is now before Parliament for the construction of subway railways from Caxton Road, Uxbridge, to Cornhill, at a spot near the Royal Exchange.

MANCHESTER, 19th February, 1891.

The Manchester Association of Engineers.—The annual dinner of this Association was held on the 14th inst. The report which was then read showed that the number of members was 335, and that the balance of profit on the year's working amounted to £190. A successful year in every respect had been passed through, the general attendance at the meetings having increased. The President, Mr. John West, referred to the transfer of the Technical School to the Whitworth Institute, and said that this was a step in the right direction, as it would economise the energies of teachers. Professor Goodman, of the Yorkshire College, insisted on the necessity of workshop practice in the training of engineers, and he urged that it should be of greater duration than the mere collegiate education.

A Prosperous Company.—The half-yearly report of Messrs. Brunner, Mond, & Co. has been published, which shows that during the half year a profit of £154,517 has been made. Of this £132,486 goes in payment of 7 per cent. on the preference, and 40 per cent. on the ordinary shares, £28,829 being added to the reserve, which is thus raised to £200,000. £2,500 is written off the patents account, and £10,539 is carried forward. The assets are valued at £1,509,273, and the liabilities at £1,037,000.

Waterproof Paper.—In our issue of the 26th December last, we gave a short description of a special kind of paper, called "waterproof paper," which we ventured to predict would be of great value for many purposes. The makers of this paper, Messrs. Leech & Horrobin, of Albert Works, Kay Street, Openshaw, are also the makers of liquid waterproof compositions for coating articles such as leather, strapping, machinery, polished steel, brass, and copper, which, it is claimed, will resist damp, heat, cold, and acids. The compositions are colourless, and do not rub or peel off, and are only removable by the application of paraffin or turpentine. We understand that these compositions have undergone very severe tests, and have given general satisfaction.

The Linen and Jute Trades.—The demand this week has been moderate; the shipping trade has been very dull. No change for the better has in fact been noticeable in that quarter for some time, and under the influence of news received by private firms this week from the West Coast of South America the prospects of trade with Chili have become more discouraging. Messages by cable that are worth relying on can only be sent by way of the land wires in Argentina. Nothing coming direct from the offices within the Chilian Republic is allowed to pass without being scrutinised by Government officials. With reference to the demands of firms in the United States, the McKinley Act, although it has not so much affected business in the aggregate, has destroyed trade in certain branches. In the low end there are goods, such as those below 35s. and 40s., on which the duties overlap, the American public being able to buy a better article at about the same price on the basis of the new rates. Jute goods are slightly weaker. The demand for linen threads is brisk, and, though competition is keen, prices are steady.

Portable Bath.—An ingenious arrangement is being put on the market, which is designed to enable a stream of water to be thrown in any direction by means of a pump worked by the feet of the person using the arrangement. A small platform is provided, on which two pedals are fitted in such a way that the heels of the user can rest upon them, and by the pressure set up and a slight muscular action a small pump is operated. This enables the water to be drawn from a vessel detached from the main device and ejected by means of a nozzle. This device is adapted for several purposes, one of which is for a portable bath. In this application the platform is placed in the middle of a tray by which the water can be received after use, and the outlet pipe terminates in a combined brush and rose. The chief feature in this arrangement is that it leaves both hands free, the mere swaying of the body being sufficient to give the necessary power for pumping. The contrivance is also being applied to such purposes as window cleaning, garden sprinkling, and carriage washing. It is the invention of Mr. Donald Noble, of Manchester.

The Calico Printing Syndicate.—With reference to the Calico Printing Syndicate, it may be stated that, although great progress has been made since August last, nothing definite can yet be stated concerning the scheme. Each house, even where formal notice of a desire to join the syndicate has been given, must be dealt with on its own basis, and settlements made by separate agreement. The copper rollers, which form an important item in the assets of the calico printers, will, we understand, be valued at the price of new copper rollers, plus an allowance for outlay on engraving.

GLASGOW, 19th February, 1891.

The Iron Trade.—It is announced that the ironmasters intend to put one-third of the furnaces in blast. The furnaces that are being worked are for the most part supplied with "blackleg" labour. The furnacemen still remain on strike, supported by the Cleveland trade unions, and are holding out for some concession as regards Sunday labour. The opinion is universal that the smallness of the demand at present existing for pig iron has not been equalled in recent years. The prospect of production, even on a limited scale, depresses the market.

Shipbuilding.—Contracts to build two hopper barges for service in South America have been received by Messrs. Murdoch & Murray, Port Glasgow. The vessels will be similar to those supplied by the same firm to the Clyde Trust, and will have a capacity of 500 tons. The engines will be compound surface-condensing, and will be constructed by Messrs. David Rowan & Sons, Glasgow.

The Calico Printing Syndicate.—The English promoters of the Calico Printers' Syndicate have been endeavouring to secure the adhesion of the Scottish firms in the trade. It is quite obvious that unless the extensive firms in the West of Scotland are included in the syndicate there is little chance of its successful formation. The leading firms in this district are the Thornliebank Printing Company, Messrs. Inglis & Wakefield, Messrs. James Black & Co., Messrs. Wm. Stirling & Sons, Messrs. John Orr, Ewing, & Co., Messrs. Archibald Orr, Ewing, & Co., Messrs. John Glen, Guthrie, & MacArly. It seems that some of the firms are indisposed to join the proposed syndicate. In some cases the firms named have already a practical monopoly of the particular class of goods manufactured by them, and in other cases there are special conditions which render it inadvisable for them to ally themselves with the English firms. It is thus doubtful whether the syndicate will receive any considerable support in Scotland. Should the syndicate be formed, however, on an extensive scale, the result of the consolidation of a whole group of industries might be very serious. The group would include the alizarine makers, who have practically been consolidated for many years, the Chemical Union, and now the Calico Printers' Union.

The Glasgow Tramway Company.—This company, whose lease expires in a few years, and whose existence as a company is threatened by the Glasgow Corporation Bill now before Parliament, has petitioned the House of Lords against the measure. The Corporation, who already own the tramway lines, propose to carry on the traffic without the intervention of lessees. The company say that they do not object to the use of mechanical power; but that electricity as a means of haulage is in its infancy, and that the use of cable traction is impracticable in Glasgow owing to the fact that the Central Railway is being constructed so near the street level that there is no room for a cable channel. This is a reason against the use of cables in certain routes, but it is hardly fair to say that the use of electricity for tramways is in its infancy, when in the United States 2,000 miles of track are operated by electricity, and in this country there are twelve separate lines of electric tram or railway.

Minerals.—The arrears of loading, which had accumulated during the strike, are now almost worked off, and the shipments of coal for the past week show an increase of 18,000 tons.—A portion of Messrs. Merry & Cunninghame's properties is being detached from the main concern, and is to be worked by a limited liability company. It will be remembered that a few years ago the whole business of the firm was sold to a company, and was afterwards repurchased by the partners. The property now concerned includes the Carnbrae ironworks and mineral fields, the North Motherwell collieries, Bardykes, Auchenraith, and a number of pits in Renfrewshire.

Jardine's Housing Gear for Rolling Mills.—Messrs. Colville & Sons, of Dalzell Steel and Iron Works, Motherwell, who, some eighteen months ago, had their No. 1 plate mill fitted with Jardine's housing gear, by means of which the four screws regulating the rollers can be actuated by one man, instead of four as heretofore, have, we are informed, found the gear so successful that they have recently had their No. 2 plate mill similarly fitted. As a result, it is stated that the output of this mill last week was the largest it had ever accomplished.

Scottish Railways.—The Yoker and Clydebank Railway Bill, having passed the first reading and the examiners, will shortly be read a second time in the House of Commons.—In the operations in the West End Park, in connection with the new underground railway, the contractors have discovered a seam of coal. The seam, however, is too thin for profitable working.

The Recent Strike.—The postponed meeting between the directors of the North British Railway Company and representatives of the men was held yesterday. The proceedings were conducted in private at the offices of the company in Edinburgh.

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(From our own Correspondents.)

LIVERPOOL, 18th February, 1891.

The Liverpool Engineering Society.—At a meeting of this Society held yesterday, the President, Mr. F. Hudleston, being in the chair, a paper was read by Mr. H. G. F. Barham, on "Foundations." The author first showed the necessity of making trial borings upon the site of any proposed stratum, and the methods and appliances generally adopted for making such borings. He then referred to the different strata, which necessitated special foundations for each particular condition, and gave instances of the various forms of foundations on rock, firm and soft ground, describing the plans adopted for preparing rock surfaces, the construction of sumps, and the timbering of the trenches. Foundations of concrete blocks, concrete in *situ* and in bags, piles and cofferdams, pneumatic and other processes of mining were fully described.

The Isle of Man Steam Packet Company.—The directors of this company have contracted with the Fairfield Shipbuilding company for the construction of a new twin-screw steamer with triple-expansion engines, which is to be ready for the next season. The returns for last year show an increase of £16,987 over those of the previous year, the increased expenditure being £9,166, the increase in the number of passengers from Liverpool and Fleetwood being 14,420. The directors at the last meeting decided to recommend the payment of a dividend of 5 per cent., leaving a balance of £2,503 to be carried forward.

The Navigation of the Ribble.—At a meeting of the Navigation Commissioners on the 13th inst., the scheme of the Southport Corporation was explained by Mr. Vernon Harcourt. In order to provide a fixed waterway from Preston to the sea, he suggested that one of the existing training walls from Preston to Lytham should be continued towards the sea, and that a south-western channel should be made to a certain point on the foreshore of Southport. This scheme was opposed by the Preston Corporation and by others, who were in favour of a channel being made on the northern side of the estuary.

SHEFFIELD, 18th February, 1891.

Coal and Iron Trades.—Business in general continues good, although a number of contracts in hand for South America have been stopped until a settled form of government is established in that part of the world. There is little change in quotations for manufactured iron or steel, but pig iron is much easier, and as it cannot, under present conditions of labour and fuel, be sold at a profit, many of the large makers are stocking their produce. Carriage and waggon tyres are quoted at £10 to £12, locomotive tyres at £12 to £14, and springs at about £10. The P. & O. Company's new steamships, now being built by Messrs. Caird & Co., of Greenock, are to be fitted with steel shafting, the cranks being supplied by Messrs. Vickers, and the straight shafting by Messrs. John Brown & Co., who will also supply their Purves flue for the boilers. These flues have been an entire success. An order for locomotives, given out by the Manchester, Sheffield, and Lincolnshire Railway Company, will probably go to Scotland, although a large portion of the material will be produced in this district. Three of the important steel companies have presented a most satisfactory account to the shareholders. Messrs. Brown, Bayley, & Co. and Messrs. Henry Bessemer & Co. each pay 25 per cent., while Messrs. Vickers, who are spending enormous sums on their ordnance plant, give a most satisfactory account of the year's work.

Fuel.—Fuel of all classes is in active demand, and prices are fully maintained. Manufacturing fuel is increasing in price, and users are complaining of its being inadequately screened and cleaned from dirt.

Electric Lighting.—The Sheffield Electric Light and Power Company are building new premises in order to augment their engines and dynamos. A portion of the premises will be utilised for a new switch room, which the increasing business of the Telephone Company has rendered necessary.—The Westinghouse Company have declined to proceed with the installation of the electric light at Barnsley. The company were to have put down the plant and worked it for three months before receiving payment. It is probable that some satisfactory arrangement will be made with the Corporation which will enable the contractors to proceed with the installation.

NORTH STAFFORDSHIRE, 18th February, 1891.

The Iron Trade.—Owing to increased competition prices are suffering. The mills and forges in this district are not working more than about four days per week. Of the thirty-nine furnaces built, there are now nineteen in blast, as compared with twenty-three twelve months ago. Owing to the high price of raw materials it is impossible to make pig iron at a profit at current rates.

The Pottery Trade.—No settlement has at present been arrived at with regard to the question of wages, and the Arbitration Board is still in abeyance. Manufacturers complain that prices are low and unremunerative, and state that payment of higher wages would hamper them in competition with foreign countries.

BARROW-IN-FURNESS, 18th February, 1891.

Hematite.—There is a very serious outlook in the hematite pig iron trade this week. Trade has largely fallen off, and holders of stocks are underselling makers by 3s. a ton, who are thus shut out of the market. The production has been lessened, with a view to reducing stocks. They stood a year ago at 380,000 tons, and, although they have been reduced to 213,000 tons, they still depress the price of metal below its cost when trade is bad. Makers are asking 53s. per ton net f.o.b. for Bessemer mixed numbers, while warrants are changing hands at 50s. There are forty-two furnaces in blast out of seventy-six, compared with fifty at the beginning of the year.

Steel.—Difficulties with workmen will probably lead to the closing of some of the large works in the northern part of the district, where makers have a deficiency of orders, especially in the Bessemer department. If the difficulty cannot be overcome, 1,400 men will be thrown out of work in a week. Heavy rails are still quoted at £4 15s. per ton, light sections at £6, and colliery at £7.—The Moss Bay Hematite Iron and Steel Company, Limited, have recommenced in the steel rail mill department, after a stoppage of ten weeks. The company are engaged upon a German steel rail contract of about 6,000 tons. Both ends of the rails are being planed. Their four blast furnaces are shut down. Messrs. C. Cammell & Co. are working short time. On the 14th inst. the workmen at the West Cumberland Hematite Iron and Steel Company, Limited, received notice to cease work in a fortnight. This is thought to be preparatory to some rearrangements in wages and working hours. The Maryport Hematite Iron and Steel Company, Limited, have erected one of "the Luhrig Company's" coal washers, and are working a blast furnace, using only their own coke, instead of mixing it with East Coast cokes as hitherto.

Shipping.—The shipping returns still show depression. The total shipments of iron this week from West Coast ports amounted to 16,095 tons, compared with 21,939 tons in the corresponding week of last year, a decrease of 5,844 tons. The total shipments now amount to 99,732 tons, compared with 117,975 tons in the corresponding period of last year, a decrease of 18,243 tons.

"Propping" Plant for Mines.—The faulty and insufficient propping and timbering of working shafts and roofs in underground works such as mines, tunnels, &c., and the consequent collapsing of the roofs and sides of such shafts is largely responsible for a number of deaths greatly in excess of those from explosions. Government inspectors have from time to time called attention to the want of care exercised and the methods employed in the staying of these underground shafts. With a view to remedying the existing defective appliances, Mr. W. Wilson Barnes, of Harrington, Cumberland, utilises instead of timber, as heretofore almost exclusively used, iron and steel rail "ends," defective rails, &c., which have been discarded for railway purposes. It will be readily understood that such material will be safer than timber, and will adapt itself to a number of requirements, such as propping and supporting roofs, walls, &c. The inventor claims that in the majority of uses the cost will be less than the cost of timber, with much greater durability.

MIDDLESBROUGH, 18th February, 1891.

Pig Iron.—The market is firmer, and a more hopeful tone prevails. There was a large and animated attendance on 'Change yesterday, and inquiries were more numerous. The minimum price quoted by merchants for No. 3 G.M.B. was 42s., but many held out for 42s. 3d. Warrants were quoted by buyers at 41s. 10½d. cash prompt, 42s. a month; sellers, 1½d. more. In hematite, East Coast brands are 54s. per ton f.o.b. for mixed numbers; maker's iron, West Coast, buyers, 50s. 7d. cash, 50s. 9d. a month; sellers, 1d. more. The stock in Connal's store on the 16th inst. stood at 123,811 tons, being 503 tons more than on the 31st January.

Shipments of Pig Iron.—These have improved very much this month, chiefly owing to the increased shipments to Scotland. Up to the 16th inst. the shipments of pig iron amounted to 41,036 tons, against 17,458 tons to the 16th of last month, and 25,074 tons to the 16th February last year. The shipments to Scotland were 22,475 tons, against 8,130 tons for the corresponding period of last year. Shipments for abroad have also increased.

Manufactured Iron and Steel.—These are much the same as last week, with perhaps more inquiry. Iron ship plates are £5 15s.; angles, £5 12s. 6d.; bars, £5 15s.; steel ship plates, £6; angles, £6 5s.; rails (heavy), £4 17s. 6d. per ton f.o.t. at works, less the usual discount.

Natural Gas.—A discovery has been made on the land of the Tees Salt Company. Whilst boring for salt an outburst of natural gas occurred at a depth of 780ft., which, becoming ignited, shot up into a flame of some 40ft. in height. It is conjectured that there is more underneath, but the quantity is at present unknown. It will add to the desire of many who are working the salt bed to bore underneath it.

SUNDERLAND, 18th February, 1891.

The Shipping and Coal Trade.—There is no improvement to report in the freight market, and the number of steamships laid up does not decrease. The local coal trade continues to be partially paralysed by the continuance of the strike. Last week the coal shipments only reached 57,374 tons, a decrease of 5,984 tons as compared with the previous week; 37,364 tons went coastwise and 20,010 tons to foreign ports. The remaining exports were 705 tons of coke and 900 tons of pitch.

Shipbuilding.—Steady progress is being made with the work in hand, but new contracts are scarce. The Marquis of Londonderry is having two new screw colliers constructed, which will be of steel and fitted with triple-expansion engines. One of the orders has been obtained by Sir William Gray & Co., Limited, West Hartlepool, and the other by a firm on the River Wear. Some heavy repairing work is being done. Mason's patent skylights and sidelights continue in demand. Messrs. Short Bros., Pallion, are fitting six of the skylights and a number of sidelights to a steamer for West Hartlepool owners.

The Shipping Federation.—Notwithstanding all rumours to the contrary, the Shipping Federation continues to do good work. During the first nine weeks of its active operations here it shipped 295 men enrolled on its books, who have formed crews for a large number of steamships, along with 113 men not members of the Federation.

A Historical Vessel.—The steamship "Bergen," now being fitted with triple-expansion engines, and new steel boilers, of 160lb. working pressure, may fairly be styled a historical vessel. When built, twenty-three years ago, the engines fitted were of the "trunk" type, and the boilers of 30lb. working pressure; some years ago compound engines replaced the original ones, and boilers of 70lb. working pressure were supplied. Perhaps the new engines will, in their turn, be "converted" or replaced by quadruple-expansion engines.

The River Wear Commissioners and the Coal Trade.—The annual returns of the River Wear Commissioners would have been most satisfactory if there had not been a diminution in the coal shipments, due to the lessened output of local collieries, the result of higher wages, and to the stoppage of collieries by disputes. 3,740,330 tons were shipped in the year ending December 31st, 1890, a decrease of 382,179 tons as compared with the previous year. The Monkwearmouth Colliery strike accounts for 131,000 tons, and although there was no cessation of work the output of Rhyope Colliery shows a falling off of 60,000 tons. In similar instances the decrease is at least as great, and at all the local collieries there have been decreased outputs. The total income for the year amounts to £128,240 19s. 10d., or £6,193 14s. 10d. less than in the year 1889. The principal shipments, in addition to coal, were 7,822 tons of bottles and glass, 20,758 tons of iron, 33,641 tons of patent fuel, 7,202 tons of cement, and 15,592 tons of lime.

The Paper Trade.—There is much activity in all the local paper manufactories, more especially at the Ford and Hendon Paper Works. Messrs. Chapman's patent apparatus for recovering soda ash from the black liquor, supplied by the makers, Messrs. Fawcett, Preston, & Co., Limited, Liverpool, continues to give as good results as when first fitted. It evaporates 37 tons of water per ton of coal, or 10¼ cwt. per ton of ash recovered.

Electric Lighting.—At a meeting of the County Council, on the 16th inst., it was decided to make application to the Board of Trade, under the Electric Lighting Acts of 1882 and 1888, for supplying electric light.

NEWCASTLE, 18th February, 1891.

The Coal Trade.—The demand for steam coals continues satisfactory, and prices are well maintained. For bunker coals, however, there is very little inquiry, and as the consumption of gas and household coals has, during the past fortnight, largely decreased, the prices of these qualities tend to recede. Nearly all the Northumberland pits, however, are working full time, and as the colliery proprietors have many important forward contracts, steady work is likely to be maintained. The shipments of coal and coke at Tyne Dock during the week ending the 14th inst. amounted to 111,798 tons, being an increase as compared with the shipments for the corresponding week last year of 8,669 tons.

Shipbuilding.—Inquiries for new tonnage are still very scarce, although builders are offering lower quotations. While so many steamers, however, are laid up through want of employment speculative building is likely to diminish, and it is to be feared that a serious dearth of employment will soon be felt at the yards. In a few cases a marked slackness is already apparent, and in view of the fact that the supply of tonnage is greatly in excess of present needs, it seems probable that, excepting at those establishments where Government contracts are in progress, the slackness will in a short time become general.

Engineering.—The question raised some time ago by local members of the Amalgamated Engineers' Society, regarding the placing of further restrictions on the working of overtime, is not yet settled. The engineers' committee are now reconsidering the question, and a modified proposal will shortly be submitted to the employers. In the marine engineering establishments business is still very active, and locomotive factories also have a fair supply of work. Messrs. John Abbott & Co.'s brass finishing and boilermaking departments are very busy, and in the iron foundry connected with their establishments several good contracts are in progress.

Glass Works.—In the flint glass trade business is still inactive, and in some establishments wages disputes are still further limiting the area of production. At the Tyne Plate Glass Works, which for a long period were practically inoperative, business was resumed on a limited scale some months since, and it is expected that in a short time the establishment will again be in full work.

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THE MANCHESTER SHIP CANAL.

(*For description see page* 184.)

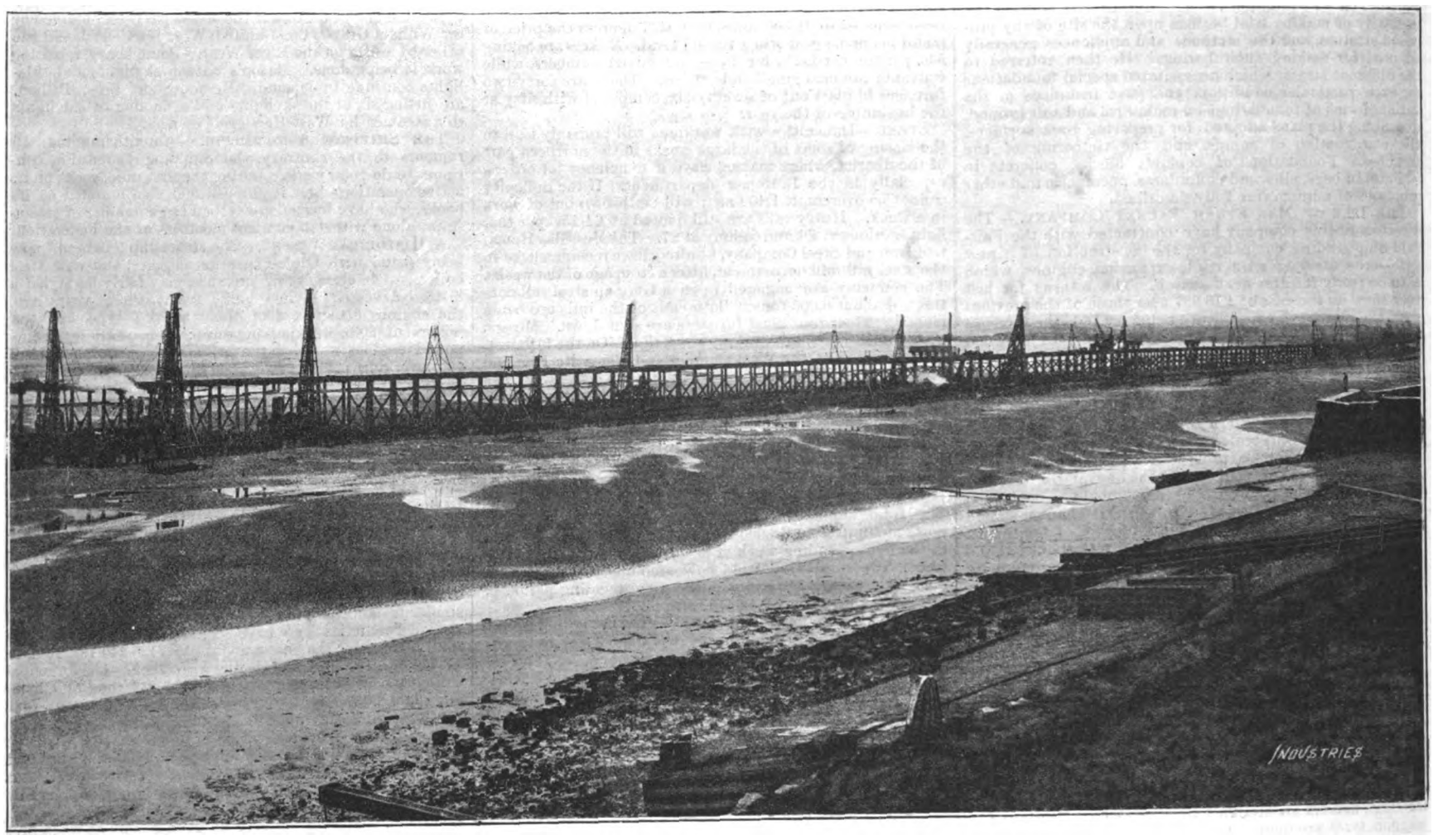


FIG. 1.—GANTRY FOR ESTUARY EMBANKMENT—ELLESMERE PORT BAY.

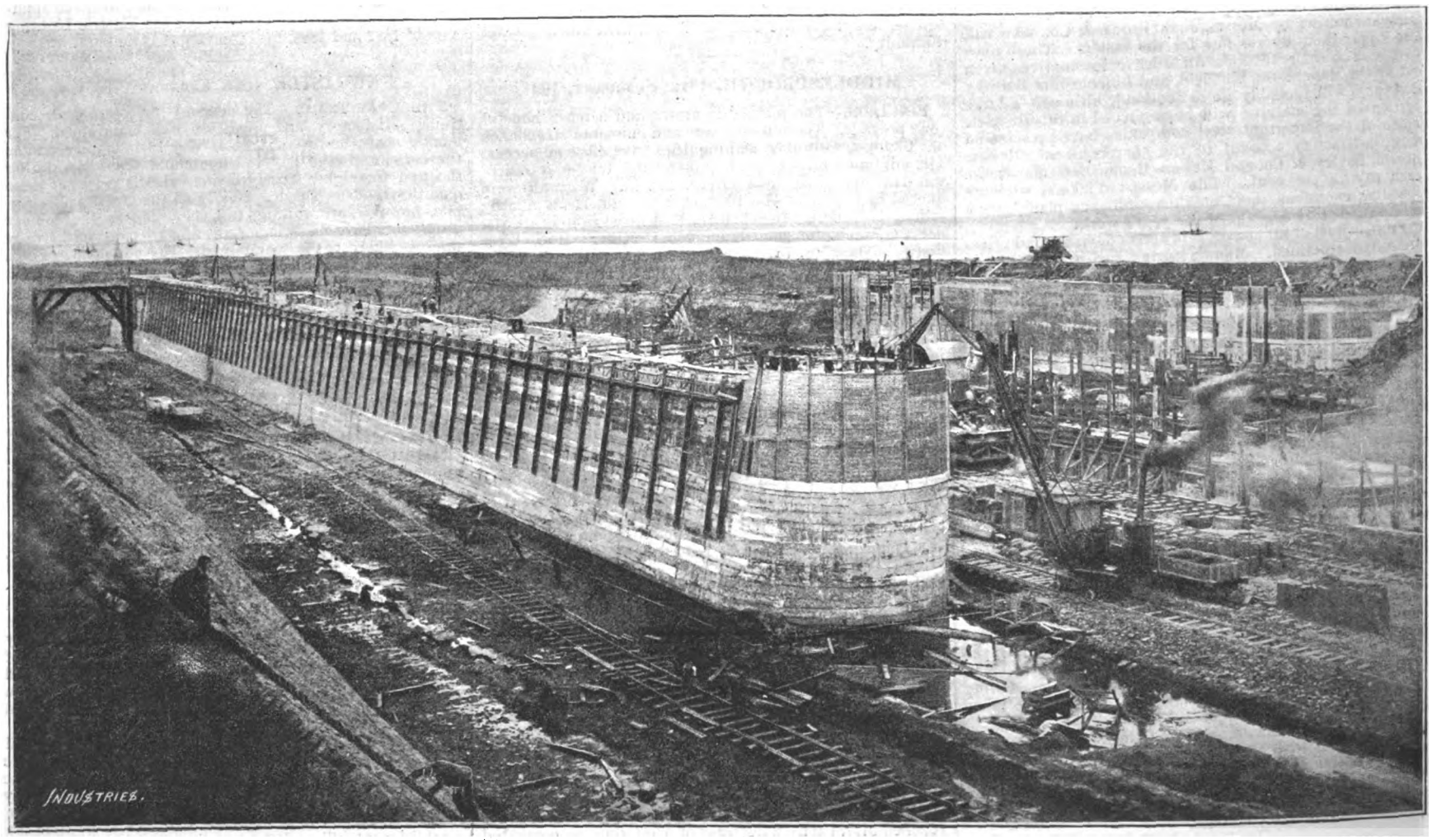


FIG. 2.—EASTHAM LOCKS—SLUICEWAY IN FOREGROUND.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 368, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 20TH FEBRUARY, 1891.

THE TRAINING OF TECHNICAL TEACHERS.

AT a recent meeting of the Institution of Engineers and Shipbuilders in Scotland, the manager of one of the largest engineering establishments on the Clyde expressed the opinion that the persons most in need of technical education were workshop foremen. The difficulty which he had to meet was where and how to get the instructors. His opinion would not lead us to infer that the foremen are exceptionally unfitted for the due performance of their work, but rather that technical education was not so much needed for the great bulk of the workmen as for those in charge of them. We have very often pointed out that it was much more important to the majority of working men that they should have a good, or, at least, a fair general education, which would enable them to perform their duties as citizens, rather than the mere elements of a few technical subjects, which are of little use from an educational point of view, and which they have few opportunities of applying. In fact, we have little faith in what is usually called technical education by itself in any department of life. Moreover, we have been told by engineers and manufacturers that they do not care for the present system of technical education, which, although it enables the students to pass examinations with facility, seems to deprive them of all originality. Their experience had shown that a healthy, well-educated youth from a country school, almost entirely ignorant of technical training, very soon develops into a more useful man than the town-bred apprentice, whose brain has been narrowed by an unnatural system, which is supposed to be specially fitted to the industrial wants of the present times.

The difficulty stated in the opinion we have quoted, as to where and how to get proper instructors, is one which has never been faced by those in charge of technical education. Too often the men who act as teachers and professors in technical institutions have simply drifted into their work without any special preparation as teachers, and with a very limited experience of practical work. The results have, therefore, been of a most unsatisfactory nature from an educational point of view. Unfortunately, the greatest failures have too often the appearance of success. A man who has passed with difficulty a qualifying examination may, in many cases, by a careful study of the idiosyncrasies of examiners and a judicious investment in old examination papers, be able to make a greater show as regards passes, grants, and even scholarships and exhibitions, than one who tries really to educate his pupils. The teacher whose training has been chiefly in the workshop or manufactory, and who has picked up his theory in an unsystematic way, is too often limited by his own narrow experience, and fails to give a systematic view of the subjects under consideration. On the other hand, the man who is only a university graduate often lectures to students on subjects which they cannot understand, or he enlarges on some theories of his own, which are useful neither from an educational nor a practical point of view. All this proves that discussions about technical education are largely in vain unless they lead to arrangements which give a good supply of well-trained teachers. We must always remember that there are two very distinct classes of minds. One of these shows a leaning towards the practical aspects of affairs, and the other towards the theoretical. We cannot expect successful engineers, who are engrossed in business, to pay much attention to education, or to become teachers, unless they have retired from active work. Our educational institutions might, however, keep themselves more in touch with the advances of the practical applications of science if they occasionally invited well-known men to lecture to their students. This is done to a considerable extent in America, and with the very best results. A few years ago the Institution of Civil Engineers had two such courses of lectures, and the high quality of these showed that there were to be found in this country men who were able to combine eminence in practical work with the ability to make a clear exposition of its principles. The main body of the teaching, however, must be done by men who have adopted teaching as a profession. These teachers should have had a certain amount of practical experience each in his own special department, and they ought to have opportunities of keeping themselves acquainted with the most recent advances by visiting from time to time the best workshops and manufactories in their neighbourhood. There ought, moreover, to be associated with them in the management of their classes a committee of the best men in their district, who would keep them in touch with the requirements of the students. This arrangement is found to be of the greatest advantage to all parties.

Some more systematic method of selecting and training teachers is greatly needed. We ought, if possible, to exclude all those who have no faculty for imparting their knowledge. This should be done at an early stage of the future teacher's career, but we are afraid that it must in the meantime be left to the results of what will be often a very bitter experience. We would impress upon all who have the making of appointments the importance of inquiring, not only into the abilities of the candidates as displayed in their college and other examinations, but also as to their possession of the somewhat rare gift of teaching. We should imagine that the best way of training teachers would be to keep them at a good school till they were 16 or 17 years of age, and thus enable them to study the elements of the subjects which were likely to chiefly engage their attention in the future. They should not be called upon to specialise at this age, since a good general education is likely to be of more use to them than a narrow technical one. On leaving school they ought to proceed to a workshop or manufactory for at least three years, attending evening classes in the meantime. The experience gained in that time will generally be sufficient to warrant a decision on the point as to whether they are more fitted for the workshop or the lecture room. There ought to be a certain number of bursaries and scholarships for assisting the best students among the working classes, but nothing should be done which would tempt large numbers into a career for which they are unfitted. It must be admitted that the tendency of improved education is not so much to enable men to do their present duty in a more efficient manner, as to excite hopes in them of attaining a higher sphere of work.

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Two or three years' attendance at the day classes of a technical college or a university should fit the student for the position of assistant to a professor, and his future then depends chiefly on his own abilities and perseverance. The training given by our colleges and universities has improved very much during recent years. The old lecturing style has given place to a great extent to work in laboratories and drawing offices, but there is still room for improvement. The lecture room, the drawing office, and the laboratory should be looked upon as forming an essential unity in each department, and the most important work should be done in the two latter. The principles which are expounded in the lecture room should be illustrated in the drawing office, and afterwards investigated in the laboratory, and frequent visits should be made to the engineering works in the neighbourhood. Such a training would turn out men who were well qualified to instruct their students in the theory of their work, and who would at the same time be able to guide them in many points regarding practice. Technical education is not, however, intended to supplant practical training in the workshop or manufactory, but only to supplement it, and students who have studied under such men as we have indicated would generally be found to be apt at their work.

The question as to whether there ought to be central institutions for the training of teachers in technical subjects has been often discussed. We have no hesitation in saying that it would be for the interests of education if the local colleges and universities were developed in this direction, in each case, of course, with a due regard to economy and the requirements of the district. The existence of one or two central institutions for teachers of technical subjects might lead to a stereotyped method of teaching, and thus cause a great deterioration in the quality of the education and of the men. Variety is as much needed in education as in anything else, and it is only by having institutions of different types that we can expect to have such conditions as will encourage originality. We do not wish it to be inferred that for special departments of investigation for which there is only a very limited demand it is not often an advantage to concentrate all efforts on a few places. We simply wish to avoid any system of centralisation which would lead to a dead level of uniformity.

A JAPANESE VIEW OF NEW JAPAN.

We have several times directed the attention of our readers to the question of treaty revision with Japan, in so far as it is connected with the development of trade and industry, and have not hesitated in expressing the opinion that the present state of affairs is a grave injustice to Japan and an injury to the foreign trade of this country. We have also pointed out that, on account of the unreasonable delay which has taken place, the problems connected with the matter have been very much complicated, for the Foreign Powers have no longer simply to deal with the members of a practically autocratic Government, but with a representative Government, which is criticised by a widely extended public press. It is not often that people in this part of the world have an opportunity of obtaining the opinions of an educated Japanese—at least, in a direct manner—on questions referring to the relations of Japan and foreign countries, and when such an opportunity does occur it ought to be taken advantage of by all who are studying the questions involved.

Such an opportunity is given in the current number of the *Nineteenth Century*, in which a Japanese view of New Japan is given by Mr. Daigoro Goh, some of whose opinions we may note, in so far as they relate to treaty revision and the development of trade and industry. Mr. Goh writes with a certain dash of Eastern style, and evidently under a keen sense of feeling, which may tend to give his readers the impression that he is not a correct exponent of average Japanese opinion. He is smarting under what he considers the injustice done to his country at a meeting of foreign residents held in Yokohama for the purpose of considering the question of treaty revision, which he says so aroused him as to cause a determination to take up his pen on behalf of his country. Mr. Goh gives a short sketch of the changes which have taken place in Japan since the existing treaties were signed in 1858, when Japan was an obscure country, almost unknown to the rest of the world, and her government an obsolete feudal system. Man or horse supplied the place of the mail train, telegraph, and telephone; and the back of beast or the shoulder of man was her only means of land transport. Her people went about the streets armed with swords, and no signs of Western civilisation could be detected in her social or political life. This state of things has so entirely ceased that we may regard them as ancient history. The name of Yedo has disappeared, while that of the Tycoon, at that time the absolute ruler of Japan, by whom the treaties were ratified, has been almost entirely lost in oblivion. Even the coins mentioned in the treaties are no longer in circulation, and the whole style of expression is so strange to the present generation that there is great difficulty in understanding it. In brief, Mr. Goh says, the present treaties were signed when Japan was in a state of ignorance and inexperience with regard to international intercourse, and hence they are quite unsuited to the requirements of the present times.

The chief points agreed upon in these treaties were that the Japanese Government were to open seven ports as markets for foreign trade, to grant concessions for foreign settlements in which foreigners might reside and trade, and round which they might make excursions within a distance of about twenty-four miles. All foreigners were to be subject to their own consular jurisdiction, and to be quite independent of Japanese courts and laws. Lastly, the custom duties were fixed at 5 per cent. *ad valorem*. By these provisions both the judicial and the tariff autonomy is fettered to a great extent, and the national rights of the country infringed, and these prove very sore points to the younger generation of Japanese. The treaty contains a clause by which both parties had a right to demand a revision of the document at the end of fourteen years—that is, in 1872. Ever since that date the question has been under discussion, and if ever its history comes to be written it will form one of the most curious chapters in the history of diplomacy, and an illustration of laborious trifling on the part of the representatives of the Foreign Powers which is without a parallel. Thirty-two years have passed, and great changes have in the interval taken place in Japan. Her feudal system has passed through a bureaucracy to a constitutional Government, and this by a natural process of evolution, and without those struggles which have usually accompanied such changes in Europe. Her army and navy have been entirely remodelled, her laws and judicial system reconstructed, and education in every department has been largely developed according to Western ideas. These changes have had a most remarkable effect on the industrial and commercial development of the country. The postal and telegraph systems are as good in Japan as in Great Britain, railways are being rapidly extended, the mercantile marine has assumed large proportions, harbours and docks have been constructed, and the lighthouse system is very complete. Her foreign trade has doubled within the last ten years, and quadrupled during the last twenty years, whilst the growth of commercial and industrial enterprise has been something wonderful.

The Japanese are a proud and sensitive people, and the restrictions of the treaties have been very galling to them. The extensive improvements and reforms, and the various public works which have been inaugurated within the last few years, have naturally entailed the expenditure of vast sums of money, to obtain which heavy taxes had to be levied upon the land and other estates, as the treaties prevented an increase in the tariff dues. But the most galling of all was the question of extra-territorial jurisdiction, which the Japanese assert has been much more than a sentimental grievance, for they think that the aliens take an unfair advantage of the protection extended to them by the consular courts to annoy and defy the Japanese people. The subject has caused great excitement in Japan, and has sadly embarrassed the Government. Within the past three years the Cabinet has resigned twice, and two Ministers of Foreign Affairs have been obliged to retire from office, and it was found necessary in order to restrain political agitators to pass a "Peace Preservation Act." These facts are mentioned for the purpose of showing how much the subject has become involved with questions of party and personal politics. The complication has been increased by the recent action of the foreign residents in Yokohama, and it is this which has raised the excitement of Mr. Goh, and compelled him to speak out on the subject. A meeting was held a few months ago, at which two resolutions were unanimously passed, the first protesting against the idea of giving up the right of extra-territorial jurisdiction, and the second against the alteration of the conditions of their tenure of land without their consent. Nothing was said about the tariff, because we suppose no valid arguments could be brought forward to support the present arrangements, but the promoters of the meeting must have known that the Japanese Government would not consent to the consideration of the one without at the same time dealing with the other, so that the resolutions carry more than appears in them to those who are not acquainted with all the facts of the case. They were telegraphed to London, and from thence were sent to all the chief Chambers of Commerce in this country and in Europe and America, and will no doubt come up for discussion in due time. In the meantime, the Chambers of Commerce are collecting information with regard to the question. We understand that a request has been made to the British Foreign Office for accurate information as to the state of the treaty negotiations, which information the authorities have declined to make public for the present. Perhaps they are wise in this for the sake of their own reputation. The proposals which have been made at various times by the Japanese Government have always seemed to us to be very reasonable, and such as might be agreed to without difficulty, especially if there were a period of years fixed during which tentative arrangements would be made and changes gradually carried out. The longer the question is postponed the more difficult will be the solution, for in the present state of public opinion in Japan no Government dare propose any measure which is not fairly satisfactory from a Japanese point of view. It may be taken for granted that the Japanese demands will increase as time goes on. The question of the rights of the holders of land in the foreign concessions is one which admits of easy adjustment, and it is difficult to understand why it was raised. The British Government does not ask the consent either of landlords or tenants when legislating on the land question, although it endeavours to meet the just claims of all parties. The supreme consideration being the welfare of the country.

We cannot enter into either the political or judicial questions involved, but before concluding we will consider shortly how their settlement affects the trade and industry of this country and Japan. Twenty years ago the foreign trade amounted to $33,692,000, ten years later it had increased to $61,128,000, and in another ten years—namely, in 1889—it had exceeded $136,164,000, of which more than one-fourth represents trade with Britain. All this has been done within very restricted limits, for although there are nominally seven treaty ports, practically there are only four in use. There are none of the facilities for extending trade by the introduction of foreign capital or the encouragement of enterprise on the part of foreigners in every department of industry and commerce. And the revision of treaties is the simple and only means whereby the obstacles may be removed. Mr. Goh has compiled tables which show that the proportion of Japanese trade formerly monopolised by England is steadily declining, while that of Germany is rapidly increasing, a fact which he attributes chiefly to the feeling prevailing among Japanese people. We trust that the British Government will at once give attention to this question, not only in the interests of our own trade and commerce, but also in that of justice to the Japanese nation.

TECHNICAL EDUCATION.

The grant of £743,000 under the Local Taxation Act, 1890, for the purpose of increasing the sum available for carrying out the provisions of the Technical Instruction Act, 1889, has already had important consequences. The considerable advance that has been made since the grant became payable is narrated in detail in the "Reports of Committees of County Councils, and Other Schemes and Proposals for the Utilisation of the New Fund, &c.," just issued by the National Association for the Promotion of Technical and Secondary Education. A year ago, only four local authorities had taken advantage of the Technical Instruction Act of 1889; now forty-two local authorities and several counties and county boroughs have adopted the Act, while many of the County Councils in Wales have appointed their joint committees on intermediate education to be committees under the Technical Instruction Act. Attention is called in the Reports to the presumption of permanence afforded by the circumstances under which the annual grant was made available, and by the subsequent statement of the Chancellor of the Exchequer in reply to a question asked by the Marquis of Hartington. Among the reports and schemes drawn up by representatives of institutions for technical education, with the object of increasing the means at their disposal by securing grants from the City and County Councils, are reports from a conference at Liverpool, from a committee at Newcastle, from University College, Bangor, with a scheme for providing a system of agricultural education for North Wales, and from the Joint Education Committee of Carnarvonshire. The Reports conclude with a statement upon the position of secondary education in Scotland, by Professor Laurie, of Edinburgh University

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RAILWAY SERVANTS' HOURS OF DUTY.

At a meeting of the Balloon Society, held on the 13th inst., a paper on the above subject, by Mr. Chas. Jardine, C.E., was read. The author of the paper stated that, having been engaged for over thirty years in railway pursuits in nearly all parts of the world, involving the question of railway labour, he was induced to prepare the paper read. After referring at some length to the motion introduced into the House of Commons by Mr. Channing, and the amendment to the same by the President of the Board of Trade, which was carried by the small majority of 17, he said the plea of the President of the Board of Trade for supporting the companies was that he did not find any desire on the part of the men to forego the pleasure of extra payment for overtime. A return had just been issued in pursuance of section 4 of the Regulation of Railways Act, 1889, showing the number of certain classes of weekly paid servants in the United Kingdom who, during the months of September, 1889, and March, 1890, had worked more than twelve hours at a time, or who, having been on duty for twelve hours, were allowed to resume work with less than eight hours' rest. It was shown that some companies had passed stringent rules as a protection against long hours, and the servants had actually broken them, showing a desire on their part to have no restriction on their working hours and to earn more money by overtime. He considered the code of regulations on the London and North-Western Railway was only a sample of some of the rules in force on some of the principal railways, and overtime was excluded from the time tables for servants of all grades. In conclusion, the author gave it as his opinion that it was absolutely impossible to avoid long hours on certain occasions, and in many cases it was not to the interest of the men that they should be abolished. He hoped that the Select Committee to be appointed to inquire into the question of restricting by law the hours of railway servants would inquire into the management of railways in foreign countries.

Letters to the Editor.

THE PRESENT POSITION OF THE ALKALI TRADE.

To the Editor of "Industries."

Sir,—I have watched with considerable interest the development of the negotiations for the formation of the Chemical Union, not only as a curious study in the evolution of industry, but also from the point of view of its effect on the public. I must confess frankly that all this system of trusts, syndicates, unions, and amalgamations of railways and other concerns seem to point to a state of affairs in which all the industrial interests of the country will be under the control of a comparatively small number of men, and the question for the public to consider is, How are their interests to be represented? Some one has said that large industrial unions, plus a policeman to prevent them from enriching themselves too much at the expense of the public, is Socialism, and there can be no doubt there is some force in the definition. There cannot, also, be the slightest doubt but that such industrial unions lead to economy, by the avoidance of competition, the reduction of the cost of transit and expenses of management, and generally by increased efficiency in the manufactories. But who is to be the judge of the prices of the finished material—who is to keep them at such moderate limits as will yield a fair return? For the question arises, "Return" on what? It is a comparatively simple matter to make the returns appear small by watering the stock to a sufficient amount, and, no doubt, the original shareholders of the alkali works would be content with a very moderate return on their original capital, for, as you point out, and support by evidence which cannot be doubted, the struggle between the old and the newer process of alkali manufacture is no longer doubtful.

Practically, the whole of the registered capital of the Chemical Union is absorbed in the mere purchase of works and patent rights, and it proposes to start operations heavily in debt, so that it has not the means for performing what you have shown to be necessary for its success, from a financial point of view—that is, completely revolutionising its means of production—in fact, by transforming its old plant and remodelling its manufactures on the lines of modern progress. The Union may appear to have some success at the beginning of its operations, but it does not require the gift of prophecy to see that its ultimate break-up and defeat as a dividend-making concern is pretty certain. If the public find themselves left with the alkali baby to hold they will have themselves to blame, for they have received sufficient warning from all independent authorities who have investigated the matter.

Yours, &c.,
Alkali.

Glasgow, 14th February, 1891.

REVISION OF THE ORDNANCE SURVEY.

To the Editor of "Industries."

Sir,—In your issue of the 30th ult. you have a short article on the Revision of the Ordnance Survey, in which you refer to my paper read at the Leeds meeting of the British Association. I shall be glad if you can give me space for a few remarks on your article, and in explanation of the objects of my paper.

In the first place, I cannot agree with you that the arrangements for the supply to the public of the maps "are now fairly good." The present system is the worst that has been adopted since the institution of the survey; although, in my explanation of the various reasons why the productions of the survey are so little utilised, I did not give it the first place, yet it is one of great importance. Engineers and other professional men who "know the ropes" may not experience much difficulty in getting what they want, but to the generality of citizens the Ordnance Survey is a mystery.

There is a vague idea that somewhere or other there exists a quasi military department engaged in the production of maps, but of the extent, variety, and value of this great national work the general public knows little or nothing. For this state of affairs the Government and the Department must share the blame, for no real attempt to popularise the work has ever been made by either. If the public is ignorant of the work of the national survey, the Government is equally dead to modern ideas and necessities. Although the map-using portion of the community is increasing with the rapid advances making in those branches of knowledge for which good maps are essential, the progress of cartographical science in England has certainly not kept pace with these requirements. For certain special purposes and for particular classes, who use maps in their professional avocations, the Government has done excellent work, but popular services it has never attempted to render, and all efforts to arouse the authorities to a sense of their deficiencies in this respect have hitherto been unavailing. The neglect of the popular side of the business has caused the survey to be looked upon as a work intended chiefly, if not solely, for the limited class referred to. As I said at Leeds: "The various productions might be much more largely utilised if the arrangements for the sale and distribution were put on a reasonable basis, and measures taken to let the inhabitants of various localities know something of the state of the publications in their own districts."

The question of the state of the survey has not dropped, as you surmise. The British Association appointed a Committee to carry out the resolution adopted at the Leeds meeting. I attended a meeting of this Committee on Wednesday last, and I trust the Council of the Association will be able to make representations to Government which may lead to some, at least, of the defects being remedied. A thorough revision is the most pressing necessity, and for this work a permanent department must be created.

I confess that I fear little improvement will be made until public opinion is better instructed. Nothing is more difficult to move than a Department which has got into a groove. It is from public interest alone that the impulse can come to move Parliament and the Government to make the necessary provision without which the existing deficiencies in the work of the survey cannot be remedied. The Press, and especially the technical Press, can render valuable assistance if it will take the matter up in the spirit in which you have done.

Yours, &c.,
Henry T. Crook.

9, Albert Square, Manchester,
12th February, 1891.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—I think the modification of Mr. Thwaite's original plans, as suggested by your correspondent, Mr. James Armer, will be necessary before the scheme has a chance of commending itself to financiers. The idea of making gas at the pit mouth and then piping it to London is no new thing, but the expense of suitable mains, the leakage and condensation, and the enormous difference in the value of the residuals at the pit, where they are not wanted, and in London, where they are, would go far to neutralise the advantage of cheap coal. Also what compensation would have to be made to existing vested interests? The nominal capital of the Chartered Gas Company alone is about ten millions sterling.

When the public have got rid of a lot of foolish and antiquated ideas about the danger to health of burning gas as fuel, the change from gas light to electric light, and from raw coal fires to gaseous fuel fires will be brought about quite rapidly enough. Then we shall get rid of fog and smoke. If Mr. Thwaite will continue his crusade against the filthy coal fire, and devote his energies to proving that a gas fire is as cheap and infinitely more convenient and cleanly, the battle will be won. I fear he will have to abandon the pipe-line and hot-air-from-the-basement parts of his scheme.

Yours, &c.,
F. G. D.

London, 13th February, 1891.

To the Editor of "Industries."

Sir,—One feature that would follow the carrying out of Mr. Thwaite's project would be the removal of that swindling fraternity—the mushroom coal merchant, described in a favourite non-technical weekly contemporary. It appears that although the London County Council have framed bye-laws to prevent the poor people from being swindled, they are comparatively useless, and a great part of the London poorer population pay from 30s. to 40s. a ton for rubbish composed of coal and dirt. It would be as well if the London County Council dropped, for the present, their water supply scheme, and instead undertook the supply of gas for heating. Nearly all the northern towns obtain a splendid profit from the gas departments which they own, so much so that a great part of the sanitary improvements are carried out with the surplus profit, which for London would be enormous, as Mr. Thwaite's calculations show.

Yours, &c.,
D. H. N.

Manchester, 17th February, 1891.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

To the Editor of "Industries."

Sir,—It appears to me that perhaps the most conclusive manner in which the above question can be answered is by the very simple method of asking what the meanings of the two words—Engineer and Thermodynamics—are. The best definition, so far as I know, of an engineer, is "one who controls the forces of nature so that they may administer to the wants of man." Of all these forces the most potent is heat, and thermodynamics is the science which teaches us the laws governing the transference of heat into work.

Now let us put our question thus: Is the study of the laws governing the transference of heat into work of use to a man whose chief business in life is to effect this transference in the most efficient manner possible? Put in this way, "Student" will probably see that there can be but one answer to the question, and that the affirmative.

So much for the question in its largest aspect, but probably "Student" would prefer a little more detailed answer; also there are some points worth noticing with regard to one source of this discussion—viz., the review in the *Engineer* of Professor Cotterill's book, on which something of interest to all students may be said. The great aim of an engineer is to make a set of engines which shall be as efficient as possible, bearing in mind first cost, amount of coal consumed, cost of repairs, &c., the great aim being, as a rule, to get as much work done as possible for as little money as possible. In order to be able to do this, he must be able to calculate with accuracy the efficiency of his engine, and also to determine what gain of efficiency he is likely to make by any proposed alteration, and hence to determine whether such alteration would pay, for in a general way it is no good gaining, say, 5 per cent. in coal at a cost of 100 per cent. in first cost, although of course there may be cases in which this would be justifiable.

Now, taking for definiteness, a marine steam engine, the best set of engines and boilers is that which drive the ship farthest at a given speed per ton of coal; but if I wish to get a better result, I must first find out where improvement is possible, for I may have a good set of engines with poor boilers, or *vice versâ*. At once, then, we see that we must have a separation between the efficiency of the boiler and that of the engine, or otherwise we might be condemning one for the faults of the other. But a little consideration will show that we must go farther still in our separation, because the engine itself has two separate efficiencies—viz., a thermal efficiency and a mechanical efficiency, the former being the ratio which the work done in the cylinder bears to the heat expended on the steam, and the latter the ratio of the work done in propelling the ship to that done by the steam in the cylinder. The boiler efficiency depends on the size and arrangement of the boiler and its furnaces, flues, &c., and the last mentioned on the mechanical details of the engines and the proportions of the screw, and neither requires thermodynamical knowledge; but there is left now for determination steam pressure; type of engine, simple, compound, or triple; actual size of engine, proportions of cylinders, and speed of piston, these being the things which determine the thermal efficiency, and which are plainly of the utmost importance, and it is for the study of these questions that a knowledge of thermodynamics is now an absolute necessity. Without this knowledge, although one engine can be recognised, as a whole, as superior to another, yet the source of its superiority cannot be determined, nor the amount of gain apportioned, should there be more than one source, and thus only by a long and costly process of trial and error can we tell the proper direction in which progress can be made.

Of course we shall hear to this the usual objection, as stated in the *Engineer*, that the engineers who have brought us to our present state of efficiency were ignorant of the theory of the steam engine; and this is no doubt to a great extent true; but what writers of this type fail to grasp is that these engineers were making the theory, and that the engineers of the present day have to commence where their predecessors left off. The steam engine of twenty or thirty years ago was, in general, such a wasteful machine that almost any alteration was bound to improve it, and an immense margin for gain existed, so that little matters of one or two per cent. were not worth considering.

But now, except perhaps in gas engines, the ones and twos per cent. are nearly all the engineer can look to gain by his different improvements, and to make these small gains he wants a much more intimate acquaintance with his subject than was necessary when the large ones could be obtained. I do not know if the *Engineer* maintains that a knowledge of thermodynamics is not required in the study of gas engines, but I pity the student who may make the attempt to do without it.

This consideration as to the smallness of the margin left for improvements brings us to one of the most important uses of theory of the steam engine as pointed out by Mr. Bodmer—viz, that there is no 90 per cent. margin for improvement. Without thermodynamics it is doubtful whether anyone can really grasp this fact; many engineers agree to accept it, but there is always a hankering after "saving the latent heat," and new inventions regularly crop up directed to this end, meeting sometimes with a reception that shows that many eminent engineers still doubt the second law of thermodynamics: the latest of these is probably fresh in the memory of most of your readers—viz., Yarrow's "Zephyr" launches. I remember the claims for saving the latent heat advanced at the time, and for all I know still believed in, but although no doubt a handy kind of boat altogether, I have not yet heard that they have obtained any increase of economy over steam, and they have certainly not yet overthrown the second law. I do not remember for certain, but have little doubt that the *Engineer* uttered one of its usual triumphant songs on the downfall of theory at the time.

Mr. Bodmer speaks of the saving of fruitless labour, and a most instructive example, which "Student," if young, may not have heard of, is the case of the Marchant engine. Mr. Marchant invented an engine with a peculiar arrangement of pumps, by which the latent heat was pumped back into the boiler, and thus a saving of 90 per cent. effected, and this statement was allowed to appear on the walls of the Inventions Exhibition. Mr. Marchant produced tests to prove his statements, so far as I am competent to judge, with perfect honesty and belief in their genuineness; a company was formed to manufacture the engine, but, directly it was subjected to independent testing, the whole fabric collapsed, as everyone with a knowledge of thermodynamics knew must be the case, and the inventor, after a short struggle, was obliged to confess himself beaten, and has lapsed into obscurity, with, I believe a life's work wasted, for the want of what a few weeks' study would have supplied.

I am afraid I am trespassing too much on your space, but I should like, in conclusion, to say just a few words, to advise "Student" to look with very great suspicion on any statement as to the teaching of thermodynamics, or any other subject, which may appear in the *Engineer*. That journal, as was well pointed out

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by Professor Barr, in his introductory lecture to the Yorkshire College in 1888, is the apostle of ignorance, in not only thermodynamics, but every kind of theory, and, judging by its utterances, it lives well up to its principles; thus, when it states that the progress since 1877 has been in direct opposition to the teaching in Professor Cotterill's book, "Student" should, before attaching any value to this statement, first find out if the writer of it knew what the teaching in "Cotterill's Steam Engine" was, and perhaps the following fact may help to give him an idea of what the result of such an inquiry would be. Professor Cotterill's book was published in 1878, and in, I think, 1887, or thereabouts, a not unimportant member of the staff of the *Engineer* actually read a paper before the British Association, on "Some Hitherto Unnoticed Facts in the Theory of Steam," which was nothing more than a few arithmetical calculations which appear at the commencement of Chapter VII. of that book. If it had taken the *Engineer* nine years' study before they reached Chapter VII., it appears not unlikely that they will be a few more years before obtaining a grasp of the teaching of the whole book.

Yours, &c.,
JOHN H. SLADE,
Chief Engineer, R.N.

Portsmouth, 16th February, 1891.

THE TAXATION OF MACHINERY.

TO THE EDITOR OF "INDUSTRIES."

SIR,—May I ask a portion of your valuable space to call the attention of your readers to the Bill for the Exemption of Machinery from Rating which is down for the second reading on Wednesday next, the 25th inst. It is of the utmost importance that a decisive majority should be obtained in the division, and your readers, who are interested in the question, will greatly assist if they will at once write to their respective Parliamentary representatives, urging them to attend and vote in favour of the Bill.

It is very remarkable to find the members for such constituencies as Newcastle and Sunderland opposing the measure.

Yours, &c.,
G. HUMPHREYS DAVIES, Secretary,
National Society for the Exemption of Machinery from Rating.

22, Buckingham Street, Adelphi, London,
18th February, 1891.

THE PHYSICAL SOCIETY.

AT the annual general meeting of this Society, held on the 13th inst., Professor A. W. Reinold, F.R.S., being in the chair, the reports of the Council and Treasurer were read and approved. From the former it appears that there has been a satisfactory increase in the number of members, and in the average attendance at the meetings. The Treasurer's statement shows that the financial condition of the Society is very satisfactory.

The general meeting was afterwards resolved into an ordinary meeting, and a paper on "The Change in the Absorption Spectrum of Cobalt Glass Produced by Heat," by Sir John Conroy, Bart., M.A., was read by Mr. Blakesley. The absorption spectrum of cobalt glass, when cold, consists of three dark bands in the red, yellow, and green, with a considerable amount of absorption between the first two. When a piece is heated to nearly red heat, the absorption between the first two dark bands diminishes, and the band in the red moves towards the least refrangible end of the spectrum, whilst those in the yellow and green retain their position, but become less distinct. During the heating of the glass the intensity of its colour diminishes, and as the glass cools its original colour and absorption spectrum returns. In conclusion, the author states that his observations, and those of Feussner on solutions, show that the absorption spectra of some substances vary with temperature. In solutions, this may be due to formation of different hydrates or to partial dissociation, but in a solid like cobalt glass an actual change in its chemical constitution at a temperature considerably below its fusing point does not seem probable.

In the discussion, Dr. Gladstone said it was generally known that heat affects the colouring power of substances, and that, in solutions, absorption is greater the higher the temperature. Different solvents sometimes produce effects analogous to heat, for cobalt salt dissolved in water and in alcohol give pink and blue solutions respectively, and rise of temperature makes the aqueous solution more blue. He concurred with the author as to the causes of the phenomena in liquids, and that the same explanation would not apply to glass.

Professor S. P. Thompson thought Sir John Conroy's results agreed with the experiments which Mr. Ackroyd showed before the Society some years ago, when he demonstrated that the colours reflected by opaque bodies —such as porcelain, &c.—when heated, tend towards red.

Professor Minchin showed some experiments in illustration of his paper on "Photo-Electricity," read at the previous meeting. In one of these a seleno-aluminium battery, illuminated by the light of a taper, deflected an electrometer needle, thereby actuating a relay and ringing a bell. He afterwards exhibited one of his "impulsion cells" in action, and showed the change from the insensitive to the sensitive state produced by a Hertz oscillator at a distance.

In the discussion, Mr. Tunzelmann said Kalischer and Von Uljanin had worked at the same subject, the former being the first to make experiments on a photo e.m.f. in selenium. His cells were made by winding brass wires on glass tubes and coating them with selenium, which was subsequently annealed. These cells lost their power after some time, and would not respond to feeble lights. By using two wires of different metals, he obtained better results. Fritts, in 1883, used brass and gold plates coated with selenium, and Uljanin employed platinum plates deposited so thin as to be transparent. The latter experimenter found that the e.m.f. was proportional to the square root of the intensity of the light. He also observed that the orange-yellow of the prismatic spectrum produced the greatest effect, whereas the yellow-green and the green rays of the diffraction spectrum gave the maximum e.m.f. Comparing these results with Langley's observations on the energy of the spectrum, it would appear that the e.m.f. bears no relation to the maximum energy falling on the surfaces. Speaking of the cause of the phenomena, he said the electrolytic idea of Von Uljanin seemed inapplicable to Professor Minchin's results, and he inquired whether a mixture of selenium and aluminium would undergo a gradual change by exposure to light.

Dr. Gladstone said such a change, if it occurred, would be very slow, for nearly all difficult chemical reactions take time to complete. The fading of colours was adduced as an instance of slow chemical change produced by light.

Dr. Waller thought the subject might throw light on the changes occurring in the retina, and asked if it was possible to separate thermo-electric and photo-chemical effects.

Dr. Burton said he had suggested that the action of light on the retina was a photo-chemical one some time ago, but hitherto it had been difficult to obtain substances sensitive to any but the blue and violet rays, whereas the eye was most sensitive to green and yellow light. In the photo-electric batteries, however, the e.m.f. may generate a current, and therefore energy, and the important question seemed to be — Where does this energy come from? Is a chemical change precipitated by the action of light, or does a direct conversion of light into electric energy occur?

Professor Minchin, in his reply, said he thought his cells really transformed the incident energy. They were usually kept on open circuit, and there appeared to be no deterioration with time, the only change being a sluggishness in developing their maximum e.m.f.

THE MANCHESTER SHIP CANAL.

I.

SINCE the publication of our former articles (see *Industries*, Vol. IX., page 171), describing the works of this great undertaking, considerable progress has been made with the work throughout the entire length of 34½ miles. The two serious floods which occurred last year, although they stopped a large portion of the works at the time, were not so disastrous as might have been expected; a portion of the flooded work was completed, and the water has been allowed to remain in, and the remainder was very speedily got rid of by effective pumping machinery and other devices. At the last general meeting of the shareholders, held at Manchester, on the 3rd inst., the chairman announced that the company intended to complete the construction of the work themselves, and, as a large amount of money would be locked up in the enormous plant in use—which could not be realised until the completion of the work—it was decided to apply to the Manchester Corporation for financial assistance, and to Parliament for further borrowing powers.

By the courtesy of Mr. Leader Williams we are enabled to give a series of illustrations of the progress of the work since we last described it, the present series showing the state of the work in June, 1890. The works, of course, are now much further advanced; but these views will form a connecting link between those already published and those which we propose publishing at a later date when the work is further advanced.

Fig. 1, on page 180, shows the gantry which was constructed at Ellesmere Port to enable the permanent works to be constructed for confining the canal at this point. This work is one of the most interesting in the whole length, and had to be carried out under great difficulties, for it was necessary to construct a swing bridge and other temporary works, so that the traffic between the docks and the Mersey was not interfered with. The permanent work is now approaching completion.

Fig. 2 shows the work at the Eastham Locks. This is the point where the canal commences, and where it leaves the estuary of the Mersey by means of three locks of different sizes to accommodate the various sizes of ships. The largest lock is 600ft. long between the upper and lower gates, and 80ft. wide; the extra width beyond the 65ft. locks in the remainder of the canal being given to facilitate entrance during stormy weather. The middle lock is 350ft. between the gates, and 50ft. wide below the copings; the outer lock—next the river —being 150ft. long by 30ft. wide. Each of the docks is provided with storm gates in addition to the ordinary ones. There are, in addition, two Stoney sluices, each 20ft. wide. The sluices for emptying and filling the docks are all on the Stoney principle, the culverts being of large capacity to ensure a good scour of the heel posts and of the entrance. The illustration shows the sluiceway in the foreground.

SOME APPLICATIONS OF PHOTOGRAPHY.

ON the 6th inst. an interesting lecture on this subject was delivered at the Royal Institution by Lord Rayleigh, F.R.S. The lecturer, after referring to Mr. Muybridge's photographs of animals in motion taken by means of a movable shutter, said that rapidly occurring phenomena might also be photographed by the exposure of the lens to a flash of magnesium light or to the electrical spark. Neither of these flashes of light was absolutely instantaneous. Their degree of instantaneity might be estimated by means of a wheel with black and white divisions revolving at a great speed. If the flash were of sufficiently short duration, the wheel would appear to be stationary. A series of teeth cut in the edge of the wheel allowed the rapidity of their motion to be calculated by means of a syren. With a flash of magnesium light the wheel appeared of a grey colour, and the flash was shown to last from $\frac{1}{10}$th to $\frac{1}{50}$th of a second. A spark from a Leyden jar, however, made the wheel appear stationary. It had been shown that the duration of the principal part of such a spark was less than $\frac{1}{1500000}$th of a second. Some idea might be formed of such a duration by considering that it was nearly the same fraction of a second as one second is of a year, as a year contains roughly 25,000,000 seconds. Multiple discharges from a Leyden jar might, however, last for $\frac{6}{1000}$ths of a second. In using the spark of a Leyden jar for instantaneous photography, it was better to connect the plates of the machine with the inside coatings of the jars, and photograph the object by a spark taken between the outside parts of the jars. There was thus no high potential, and less chance of losing the effect of the discharge. By means of instantaneous photography, it was seen that a jet of oxygen on passing through water was at once split up into bubbles on its first issuing from the tube. A jet of water, when made to issue into the air from a nozzle of drawn-out glass, was at first cylindrical, and then, becoming swollen or varicose owing to surface tension, was broken up into drops, each drop being connected with the cylinder by a thin ligament before it was separated. The vibrations of a tuning-fork caused the column of water to break into drops at an earlier period. The ligament itself was afterwards formed into one or two drops. Mr. Chichester Bell and Mr. Boys had observed these effects by taking instantaneous photographs of the shadow of the jet. When, however, a jet of any fluid is forced into a vessel containing another fluid the jet becomes sensitive, and is broken up into a series of coils. Under the vibrations of a heavy tuning-fork, the jet becomes unstable nearer the nozzle. Under less pressure, and with regular vibrations, the jet forms a sinuous band, with a horn at the summit of each wave. Such a jet always gives way by becoming sinuous, whereas the jet of water issuing into air gives way by becoming varicose. A soap film might be photographed in the act of breaking, but as this occupied less than $\frac{1}{10}$th of a second, it was more difficult to photograph than jets of liquid. A dry shot was shown to pass through a soap bubble without breaking it, but a shot wetted with alcohol would break the film at once. By means of the dropping of weights suspended from an electromagnet, it was possible to make the breaking of the film and the flash of the spark simultaneous, and thus photograph the film in the act of breaking.

Reviews.

TRAITÉ DE PHYSIQUE INDUSTRIELLE. Par L. Ser, Ingénieur, Professeur à l'Ecole Centrale des Arts et Manufactures. Tom. II., 1re Partie. Paris: G. MASSON, Editeur. 1890.

Some time ago M. Ser published the first part of what was intended to be a very complete treatise on industrial physics, and especially on the production and utilisation of heat. That volume treated of general principles, of furnaces and other receivers of heat, of chimneys, venti-

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THE MALLECO VIADUCT, CHILI.

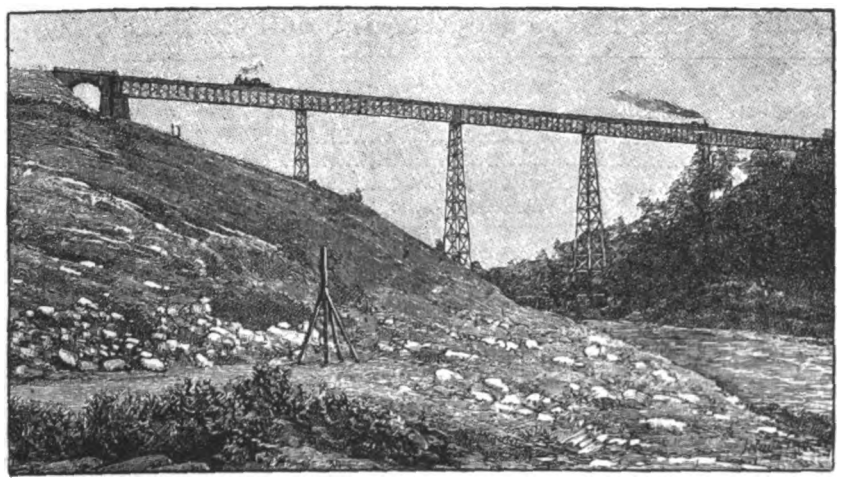


Fig. 1.

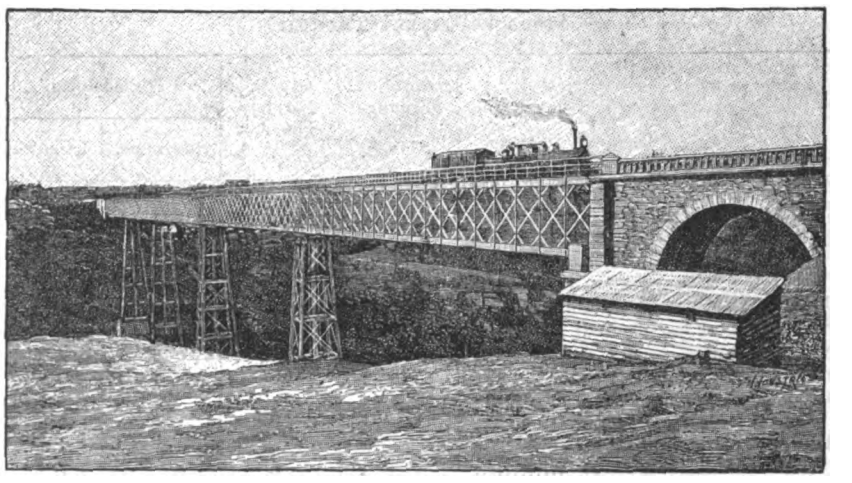


Fig. 2.

lators, &c., and of the theory of thermodynamics. It was one of the most complete of its kind, and supplied the most recent information. Since that work appeared, M. Ser has died prematurely, before he was able to complete the task to which he had set himself. The present volume is the first instalment of the second part of the work, and has been edited by MM. Carette and Herscher from the materials left by M. Ser, and treats of steam boilers, distillation, evaporation, drying, and disinfection. Some years ago, before engineering had received the special developments of the present day, treatises on industrial physics and mechanics were somewhat common, especially in France. At the present time the tendency is to have general treatises on physics and mechanics, and special treatises on the different departments of engineering. Although M. Ser's work will be useful to practical engineers, it is intended primarily for students of technical schools, and for this purpose it is admirably adapted, and forms a most useful introduction to the more practical treatises. After a preliminary *résumé* of the chief laws of heat as applied to vapours, a description is given of varieties of boilers and the apparatus connected with them. Results of experiments, methods of construction and of observation, and a considerable amount of miscellaneous information is also given which will be of use to the student and the engineer. This first chapter occupies more than half of the volume, and is practically a treatise on boilers. The second chapter is taken up with distillation, and contains a description of the most recent apparatus for the distillation of water and of mixed liquids of different kinds, with an account of the theory of the operations involved. The third chapter is on evaporation, and treats of liquids of various kinds and the special applications to sugar refineries and to other manufactures requiring the concentration of liquids containing solid matter. We observe, however, that the most recent and one of the most important developments—the Yaryan evaporator—has not been mentioned. This omission may be explained by the fact that it is an American invention, and the apparatus is manufactured solely by American and British engineers. The two last chapters, which are short, are taken up with the subjects of drying and disinfection, and give descriptions of methods and apparatus which apply to a great many different cases. The concluding part of the work will deal with refrigeration, the heating of solids, of liquids, and of gases, and the heating and ventilation of buildings, and the whole will form a very complete treatise on heat and its applications.

Geometrical Drawing for Art Students. By I. H. Morris. London: Longmans, Green, & Co. 1890.

This little work is issued to meet the geometrical need of such students as are following an art course only, but it appears to us worthy of a more extended use. It is a rationally arranged collection of nearly six hundred examples, with appended figures and exercises. Two-thirds of these deal with plane geometry, and include some excellent examples of practical application to architectural and constructive work. Other examples show the use of scales, and there are some problems with restricted and peculiar conditions, all of which are of special value, not only in teaching the use of the subject, but in forcing upon students the more valuable educational factor of personal thought. The chapters on solid geometry deal almost entirely with the projections and sections of the simple solids under varying conditions, not introducing "planes," the examples being well chosen and affording useful exercise in drawing. We think possible confusion would be avoided had the author referred to the fact of their being *four* dihedral angles in the "planes of projection." We find, however, the weakest part of the book in the definitions, which, generally speaking, are not up to the latest geometrical standard. We especially dissent to the division of "quadrilaterals," in which the terms "rhomboid" and "trapezoid" are given to figures which have for some time been called "parallelograms" and "trapeziums" by the best authorities. In many problems references are given to Euclid's proofs, but we see room for a useful increase in these, since we believe it to be an excellent thing to show the practical use of Euclid whenever possible, especially as that is so pertinaciously discredited by students generally. We also notice the absence of sizes in the problems, which is very likely to cause delay in commencing.

Speaking generally, we consider the book will be a useful possession to the self-teaching student, and likewise to the teacher of classes, provided he can prevent his students being tempted by the completeness of the diagrams to copy them without a comprehension of their meaning.

THE MALLECO VIADUCT, CHILI.

The above illustrations, Figs. 1 and 2, for which we are indebted to our contemporary *La Nature*, represent a viaduct which was opened for traffic in October last, and which conveys the Chilian State Railway across a deep valley, at the bottom of which runs the River Malleco, near Collipulli, in the southern part of Chili. The viaduct, which is constructed entirely of steel; has a height of 333ft. from the level of the river, and is composed of five spans, each 232ft. in length. The total length of the viaduct is 1,419ft., the length of the steel portion being 1,160ft. The depth of the girders forming the superstructure of the viaduct is 23½ft., while the rails are laid at a height of about 327ft. from the level of the river. The total weight of the viaduct is 1,550 tons. The designs were prepared by a Chilian engineer, Mr. V. Aurelio Lastaria, and the whole of the steel work, which was erected under the supervision of Mr. E. Vigneaux, was supplied by Messrs. Schneider & Co., Le Creusot, France.

The great difficulty of this undertaking was due to the extreme steepness of the banks of the ravine, and a great deal of time was taken in getting the material into position.

THE ELECTRIC TRANSMISSION OF POWER.*

The lecturer commenced by explaining that before energy could be applied it must be transmitted, and that its transmission could be divided under two heads, the first being transmission over short distances measurable in feet or yards, and the second transmission over long distances measurable in thousands of feet or miles. The electric transmission of energy is generally used over long distances; the chief case in which it is employed over short distances is in the running of machine tools by means of electromotors which are supplied by dynamos fixed in the workshops.

The transmission of energy over long distances only was considered in the present lecture, and it was shown that it could be further divided into the two subdivisions of transmission of "live" energy by means of electrical conductors, wire rope, &c., and of transmission of "stored" energy by means of coal, corn, or falling water. The energy of falling water may be used to charge secondary batteries or to compress air, and the batteries or reservoirs of compressed air may be carried away, and the stored energy of the falling water may be transmitted to the place where it is required. It may easily be seen how corn may be carried from the field to a distance, and there used to feed horses, which will in return do useful work; or how coal may be taken from the pit's mouth to a distant city and there used to produce steam power. The value of any system for the transmission of stored energy depends upon the capital outlay and upon the working expenses, the latter in turn depending upon the storage efficiency, which is the ratio of the useful energy obtained at the end of the transmission to the total energy absorbed by the system. The transmission of stored energy by the transport of secondary batteries was then compared with a similar transmission by means of compressed air, and the following results given:—

Total efficiency with batteries, 58 per cent.; weight of batteries, 100lb. per horse-power hour.

Total efficiency with compressed air, 26 per cent.; weight of steel reservoirs and compressed air, 300lb. per horse-power hour.

The transmission efficiencies of stored energy transmitted by means of coal, corn, or secondary batteries are given in Table III. Taking the case of the batteries and electromotor working on a tram line, it will be seen that if a car, itself propelled by the storage batteries it carries, is occupied in carrying charged batteries from the source of energy, say, a waterfall with generating machinery to a distance, and taking them back when discharged, and the loss of energy in taking the batteries there and back is to be 10 per cent. of the energy originally stored in the battery, then the distance must be 10 miles there and 10 miles back, or 20 miles altogether. The distances given in the table are the theoretical distances, and are too great, as practically there would be considerable losses in inclines on the journey, and in starting and stopping: for these reasons the figures should be looked upon as merely approximations. From the table, it will be seen that the distance over which energy stored in coal can be transmitted with a given efficiency of transmission is enormously greater than the distance in the case of batteries. In the last column the coal transmission is no less than fifty times more efficient than the battery transmission. Besides the greater loss, the capital outlay for batteries is very large, and the depreciation 15 per cent. per annum. The figures in Table IV. are based upon steam power at £10 per horse-power per annum, the steam power being used to generate the electricity for the batteries or direct mains. This table shows that for a transmission of 5 h.p., battery transmission costs more than "live" transmission by overhead conductors, but that it costs less than live transmission by underground conductors (except

* Abstract of Cantor Lecture delivered at the Society of Arts by Mr. Gisbert Kapp, M.Inst.C.E., on the 16th inst.

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THE ELECTRIC TRANSMISSION OF POWER.

TABLE I.

STORAGE BATTERY TRAMCARS.

	Birmingham.	Barking Road.	Philadelphia.	
			Small Car.	Large Car.
Weight of car (in tons)	—	3·275	2·500	3·620
„ motors and gear (in tons)	—	1·360	·980	1·140
„ batteries (in tons)	2·850	2·400	1·770	2·450
„ passengers (in tons)	3·300	3·600	2·230	3·600
Total rolling weight (in tons)	10·50	10·03	7·48	10·81
Percentage of paying load	31·5	34	30	33·2
Number of cells	96	96	84	116
Maximum current	—	70	70	80
Maximum energy at battery terminals (electrical horse-power)	—	19	14	23
Average energy at battery terminals (electrical horse-power)	—	6	4·8	5·4
Maximum energy per 10 tons of rolling weight (electrical horse-power)	—	17·8	18·7	21·3
Average energy per 10 tons of rolling weight (electrical horse-power)	—	5·65	6·42	4·95

TABLE II.

RUNNING EXPENSES, BARKING ROAD TRAMWAY, 100,844 CAR MILES PER ANNUM.

	£	s.	d.	Pence per Car Mile.
Wages at depôt	677	6	0	1·612
Drivers	601	14	1	1·432
Fuel	433	19	9	1·033
Oil, grease, acid	64	10	0	·153
Depreciation and repairs—				
Steam plant, 5 per cent.	88	7	3	·213
Shed, 2½ per cent.	5	5	3	·012
Shafting and belting, 2½ per cent.	4	12	0	·011
Dynamos, 5 per cent.	50	0	0	·018
Switches, cables, 5 per cent.	28	10	0	·067
Gearing, 50 per cent.	72	0	0	·171
Batteries, 66 per cent.	1,184	0	0	2·818
Motors, 33 per cent.	180	0	0	·428
Total	3,390	4	4	8·068

TABLE III.

TRANSMISSION OF STORED POWER.

Source of Power.	Distance in Miles Attainable with 90 per Cent. Efficiency of Transmission over—		
	Road.	Tram.	Rail.
Coal and steam engine...	115	270	1,300
Corn and horse	52	170	440
Storage battery and electromotor	4	10	26

TABLE IV.

TRANSMISSION PLANT FOR 5 HORSE-POWER.

Distance of Transmission in Miles.	Annual Cost per Horse-power Delivered, if the Transmission is—		
	By Batteries.	Direct.	
		Overhead.	Underground.
	£	£	£
1	36·1	22·8	33·6
2	37·6	25 6	47·2
3	39·1	28·0	60·0
4	40·6	30·6	74·0
5	42·1	33·0	87·0

TABLE V.

POWER DERIVED FROM A CENTRAL STATION.

Cost of Board of Trade unit	Pence 1	2	3	4	5	6	7	8
Cost of annual brake h.p. for 3,000 hours	£12·9	23·3	33·5	43·9	54·2	64·5	75·0	85·4

TABLE VI.

COST OF BARKING ROAD INSTALLATION.

	£	s.	d.
Engine shed and foundations	210	11	0
Steam plant (two 40 horse-power under-type)	1,767	5	0
Charging dynamos (two 50 KW)	1,000	0	0
Shafting and belting	184	0	0
Switch-board and instruments	30	0	0
Car shed and charging appliances	282	0	0
Twelve sets of batteries (1,200 cells)	1,776	0	0
Six cars, fitted:—			
Gearing £24			
Switches, cables 43			
Motor 90	942	0	0
£157			
Total	£6,191	16	0

where the distance is about one mile or less). The cost of coal transmission for the distances mentioned in Table IV. would vary from £20 to £40 per annum per horse-power delivered. Where large steam engines are used at the end of large coal transmissions the cost per annum per horse-power delivered will be about £10. Tables I., VI., and II. relate to the working of ordinary electrical passenger tramways where secondary batteries are used on each car and charged at particular charging stations.

The lecturer then went on to discuss the transmission of live energy from an electric light central station. In such a station the load due to the lighting varies greatly; during a few hours in the evening the station will probably be worked up to its full capacity, and then the production of electrical energy will be very economical, as all the capital outlay will be actively employed, and also the efficiency of the plant is greater when doing full work than when running light. During the early morning the load on a station may not be more than 10 per cent. of its full capacity, and during the daytime the output is very small; now, if, during these hours of minimum demand, the plant could be run at its full capacity, and the surplus energy distributed to electromotors, the working expenses would be only slightly increased, while the income of the station would be largely augmented.

In cases where motive power is required continuously, as, for example, in a small manufactory working ten hours per day, or 3,000 hours per annum, it would not pay the manufacturer to use electrical power obtained from electric-light mains, as compared with steam or gas power, unless it was supplied at 3d. or less per Board of Trade unit of 1,000 watt hours. Table V. shows the connection between the cost per unit and the cost of a brake horse-power for 3,000 hours. To obtain his power from a small steam engine, the manufacturer would have to pay from £20 to £40 per brake horse-power for 3,000 hours, and the cost of the corresponding electrical energy supplied from electric-light mains at 3d. per unit would be £33·5, as will be seen from the table. Now, the cost of a Board of Trade unit varies from about 4½d. to 12d., the average in London being from 7d. to 7¼d. But in many cases power is only required intermittently, and then electrical power is much more economical and convenient than steam or gas power. Take, for example, the case of a carpenter requiring to run a lathe for, say, two hours. If supplied with electrical power, he merely turns a switch, and the lathe is in motion, while, if a steam or gas engine is used, much valuable time is spent in starting, stopping, oiling, &c. Electrical energy, supplied by central electric light stations, may also be advantageously employed for driving small domestic machines, such as sewing machines, mangles, knife cleaners, &c. At the conclusion of the lecture, Mr. Kapp showed several such small machines, supplied by the Keys' Electric Company, in motion. The first of these was a pump worked by an electromotor, and it was pointed out that in case of fire such a pump would be of great service to increase the pressure in the water mains. The other machines shown comprised a smith's blower, a ventilating fan for hot climates, a washing machine, a churning machine, a knife cleaner, and a boot cleaner. All of these were put in motion, and worked very satisfactorily. The next lecture will deal with the more technical part of the subject.

THE INSTITUTE OF CHEMISTRY.

II.

IN commencing this, our second and concluding article, it may be well to remark that recognition of the fact that no one takes the Institute of Chemistry, as at present administered, too seriously, and cognisance of the honesty of purpose characterising as a whole those acting as its executive, prevented us impeaching it formally in our article of last week.

Would-be reformers of the destructive type, generally with a personal grievance or cherished fad, have arisen from time to time and produced an impression precisely equivalent to their deserts—which, as a rule, may be estimated at zero. We in no way stand in any such position, acting purely as the mouthpiece of the bulk of those members alive to all that threatens the dignity and advancement of their profession, but as yet leaderless and inarticulate. There is not even, as might well be feared, a sharp line of demarcation between officials and private members in their attitude or desires. The best of both are anxious for the welfare of an institution which might be doing much useful work, and between them no petty jealousy exists.

These facts being admitted, we will now formulate some proposals for the enhancement of the usefulness of the Institute and the promotion of the welfare of its members which have long been latent in the minds of those who have considered the matter aright. Whenever any vital question arises in the history of a comparatively youthful institution, it is the merest commonsense to seek guidance from the conduct of older and successful bodies of analogous aims and constitution. Acting on this principle, and taking the most powerful and compact profession in existence—namely, that of law—we see a definite, laborious, and expensive method of entry prescribed, and absolute exclusion of all who have not complied with certain requirements. The result is that those duly qualified are efficiently protected from outside competition and the general standard of competency is raised to a high level. Such protection is a flagrant violation of those economic principles on which healthy trade depends, but is justifiable on the ground of expediency, inasmuch as members of the community at large, being unable to discriminate between good and bad law, submit to the incubus of a close profession for the sake of the guarantee that its members will be reliable

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in point of knowledge. This, then, would be the boldest and best way out of the present slough, the obtainment of compulsory powers excluding from the practice of chemistry everyone who is not or does not become a member of the Institute. It may be urged that success is unlikely. But is it not worth trying for? It is illegal for an unregistered person to style himself a surgeon-dentist, and the change from an open to a close profession is, in this case, of comparatively recent date. What can be done by a body of men eminently skilful in their craft, but not seriously to be compared in mental calibre as a body with trained and competent chemists, can be done by the Institute. Once convince the public that its interests would be advanced by the compulsory compliance of would-be chemists with a high standard, and the goal is within measurable distance. In this connection public analysis—if its functions and value were properly insisted upon, not only in the technical, but in the lay press—would serve as a powerful platform cry. Show the average human being that his earthly welfare, if not existence, is imperilled by the adulteration of his food and drink, and that adequate check on such adulteration can only be kept by the appointment of men of high ability and probity, and he will promptly clamour to be protected. The path is plain, the means not difficult, the goal attractive, and its attainment is worth a vigorous effort.

It would be folly to neglect to indicate a good course because the best is rejected. Supposing for a moment that the policy just enunciated fail to commend itself to the less enterprising, who may conceivably oppose an inertia too great to be overcome, another may be conscientiously advocated. Taking as a type the largest and most powerful of the purely voluntary societies—the Institution of Civil Engineers—we find that the advantages accruing to the profession which it represents have led kindred professions to form similar associations conducted on parallel lines. Such a testimony to its merit is sufficiently striking, and is warranted by the facts. Although it is open to any unqualified person to put "C.E." after his name, and to compete with men of acknowledged competency, yet the absence of the magic title "Member of the Institution of Civil Engineers" is a tangible drawback. The weight attached to membership in this body is indicated by the fact that its lower qualification, that of Associate Member, is by no means to be despised. What Associate of the Institute of Chemistry, possessed of a grain of professional acumen, fails to suppress the damning title until such time as he has attained the Fellowship? It would be otherwise if the profession and its qualification were raised to the rank that is its right. On examining the regulations of the Institution of Civil Engineers, one is struck by the insistence on a *practice qualification*. No mere intellectual sponge, who can absorb a certain minimum of information and yield it again (somewhat sullied) under the pressure of the examiner, can hope to find admission to its ranks. It is to the credit of the Institute of Chemistry that a step in the same direction has been made in the shape of a requirement, as laid down in the regulations for the admission of the Associateship of students of the Institute, that each candidate shall have been engaged for "four years in the practice of chemistry in the laboratory of a Fellow of the Institute." This is, however, an alternative course, and three years' study in the subjects of theoretical and practical chemistry, physics, and elementary mathematics in any one or more of the Universities or chartered or incorporated colleges or schools approved by the Council is, with child-like naïveté, declared its equivalent! A careful unprejudiced study of the policy adopted by the older and more successful institution would be most opportune and salutary.

We have here completed the consideration of what the aims of the Institute of Chemistry should be. To recapitulate in very brief terms, they are:—(1) The acquisition of compulsory powers converting the practice of chemistry into a close profession, or, if timidity prevail, as a temporary measure; (2) the adoption of a qualification either purely of practice, or of one in which practice largely preponderates, and the consolidation and control of the profession, until the title "F.I.C." becomes the solidest possible guarantee of efficiency.

These aims are impossible of attainment under the present *régime*. Attention must be turned from them, essential as they are, to the humbler but still more immediately necessary task of internal reform. Reverting for a moment to our former article, we would call to mind the fact that we there showed that the sole reason for the existence of the Institute is the advancement of "the profession of analytical and consulting chemistry." The Institute having this object should be administered exclusively by members of that profession; members of other professions, such as that of scholastic and collegiate chemistry, should be welcomed as guests, and, if of sufficient eminence, admitted as honorary members, but should have no voice in the management of its affairs. To transfer the burden of government to the shoulders of such guests or honorary members is a confession of the veriest imbecility; it is neither courteous nor politic, and no professional chemist can contemplate its perpetration without a certain feeling of personal degradation. When the Institute was originally formed, its birth and subsequent existence were sufficiently humble and obscure, and, like a suckling child, its constant cry was for food; all was fish that came to its net, and every deputy assistant demonstrator's *locum tenens* was eagerly absorbed. Times have changed and the Institute of Chemistry is not anxious for such recruits; those already installed cannot well be expelled, but their influence should be neutralised, their action rendered nugatory, and their number not increased. In the present period of tribulation there is a considerable number of professional chemists, many of them men of the highest eminence and commanding ability, who, however, have not a shade of a notion of the accuracy, originality, technical knowledge, and executive faculty absolutely essential for a successful consulting chemist, and who would be as incompetent to do his work or even understand it, as he theirs. Round these is a crowd of budding professors eager to stand well with their masters, imbibing their prejudices, and acting in their interests. It is nothing short of monstrous that the conduct of an association charged with the duty of protecting the profession of analytical and consulting chemistry should be influenced by such as these.

There is one plain rational course to adopt, and that involves an entire change in the constitution of the Council. The election of that body is effected from among those nominated about six weeks before the election takes place. This somewhat lengthy period leads members to overlook the imminence of the elapse of the time available for nomination. It is only a week or two before that they begin to bestir themselves. Such lethargy is inexcusable. Nominations should be made in good time, those nominated being, of course, analytical and consulting chemists of good repute, who are able to find time for regular attendance at Council meetings. A necessary corollary is, of course, that they must be chiefly drawn from those practising in London. With a Council composed of such members, and legislating as it certainly would legislate, speedy alterations for the better would ensue.

Let us consider what action a reformed Council might be expected to take. It would, to begin with, turn its attention to its executive officers, knowing how dependent upon their ability and zeal the welfare of an institution inevitably is. Societies which many could name owe their pre-eminence almost wholly to the character of their secretary. It would be the care of the new Council to see that its secretary was at once a man of ability, standing, and energy; not merely one who would do his duties conscientiously, but zealously and with discretion. It is a misfortune when posts of the kind are filled by men of unblemished integrity and animated by the best intentions, who, through feebleness, vacillation, or native narrowness, allow the affairs under their charge to drift aimlessly or remain stagnant, as their idiosyncrasy directs. A good secretary once secured, other reforms would follow; the Council would instruct that officer to put himself in touch with the leading technical journals and secure their co-operation for the publication of the proceedings of the Institute in their pages. He would further be required to keep the Institute continually *en évidence*. A young institution striving to gain public recognition must not fail to let its doings be known as widely as possible. In particular must it put itself into official communication with all public bodies controlling appointments open to its members; it must endeavour to obtain from such bodies pledges that the appointments in their gift shall be restricted to such as hold the qualification it confers. Something in this direction the Institute has already done; much more remains to be done. Local authorities would, as a rule, be only too glad to have some trustworthy criterion to guide them in their choice, and if the value and importance of Fellowship in the Institute (which is even now considerable, and would be far greater with a rigorous practice qualification) were made known to them, they would assent freely to the necessity of its possession by their appointees.

Consonant with those aims would be the active supervision of its members by the Institute. Officers at present exist termed "Censors," and the idea involved in their official existence is excellent. The posts, however, are at present absolute sinecures. At first sight this appears to be a testimony to the immaculate character of the Fellows that is as rare as it is gratifying. Possibly the absence of any direct incentive to exercise the functions of the office may be a factor in its virtual abrogation. It is needless to say that censorship would be very real under an improved condition of things. Steps would be taken, warily and with frequent reference for instruction to the practices obtaining in older professions, to build up a code of chemical ethics, to formulate rules of professional etiquette, as well as to keep a watchful eye on malpractices, overt or covert.

In one thing, and perhaps only one, would the Council, as it should be, imitate its predecessor. It would *not*—at least in its early days—publish a Journal. For the present the Institute has no strength to spare for such work, excellent though it might be; all its forces are needed for winning its way, and every hour and every penny spent for other objects are so much waste effort. Nevertheless, as has been already indicated, it would avail itself of the co-operation of the press to publish its "Proceedings" to a larger audience than they at present reach, and by relying upon its friendly aid would at length gain the public ear. So alive are we to the interests of the profession for whose benefit we have given so much of our space, that we would endeavour to be the foremost in granting such facilities.

Let the Fellows of the Institute of Chemistry abandon their present inactivity in their own affairs, and their vicarious interest in those of the Chemical Society (if they cannot find energy for both), and make a strenuous effort to raise the Institute, and through it their profession, into a position of honour where it need yield precedence to none.

SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

At a meeting held on the 6th inst., Mr. Ivan Levinstein being in the chair, a paper was read by Dr. Carl Otto Weber, on "Magnesia Cement." After referring to the importance of the cement industry, which had now been carried on for more than seventy years, Dr. Weber said that although there were a great variety of cements not of much scientific or technical importance, there were a few which were worthy of more attention being paid to them. Among these were the magnesia cements, though he did not expect that they would seriously rival ordinary silicate cement. The hydraulic properties of magnesia had been observed long ago. Deville discovered that magnesium chloride and calcium carbonate formed a hard cement. The hardness of magnesia cements depended on the degree of compactness of the magnesia used. That prepared from $MgCl_2$ was of great density, though its cost prevented its general use. Dolomite had been tried, but afterwards this manufacture was abandoned. When at a low red heat the CO_2 of the $CaCO_3$ was given off, and a cement was formed. Sorel had discovered that magnesium oxychloride formed a quick-setting mass, having a high tensile strength equal to one ton on the square inch, or three times the strength of ordinary Portland cement. The magnesia must be of great density, and very free from CO_2. It was made by mixing MgO with an 80 per cent. solution of $MgCl_2$. A diagram was exhibited, showing the results obtained from different proportions of oxide and chloride of magnesia. It was seen that the tensile strength, which was greatest with equal proportions of the two compounds, decreased directly as the $MgCl_2$ increased. Experiments to determine the effect of water in the cement had shown that the tensile strength was inversely proportional to the amount of water present. The setting of Sorel's cement was due to the same cause as the setting of Portland cement—*i.e.*, assimilation of water, and the amount of water present formed an important factor. This cement, being acted on by water, was useless for outdoor work. Stones and emery wheels made from it had turned out failures. The author had tried to replace the $MgCl_2$ by some other body, and, after finding that the chlorides of the alkalies and alkaline earths were all objectionable, he had found that the best results were to be obtained with anhydrous silicic acid; 15 per cent. of silicic acid gave the hardest cement, though it was not suited for hydraulic work. His mixing was—

100 magnesia.
15 silicic acid.
9 magnesium chloride (80 per cent. strength).

This gave a tensile strength of 1,788lb. per square inch. He had used this cement sucessfully for engine beds, and strong building stones resembling polished marble had been made from a mixture of it with sand and gravel. He could not say that it stood the atmosphere very well, but possibly his further experiments would lead to still better results.

In the discussion Mr. Bell referred to the fact that magnesia was considered injurious in Portland cement, saying that contractors stipulated that cement should not contain more than 1 per cent. He had known concrete in large works to be all swollen up owing to magnesia. Dr. Gerland and Mr. Thomson inquired as to the formula of magnesium oxychloride.

Dr. Weber, in his reply, said that the magnesia in Portland cement acted differently than it did in magnesia cement. In the quick-setting Portland cement the setting took place before the magnesia was hydrated, and the bad effect of magnesia must no doubt be put down to unequal setting. With respect to magnesium oxychloride,

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he did not think there really was such a compound, but that it was a hydroxychloride. In reply to a query as to whether the cement was suitable for acid tanks, he could not say that it was, as, although it was unacted on by strong acids, dilute acids had considerable action on it.

LONDON SECTION.

At a meeting of this Section, held on the 16th inst., Mr. W. Mackean read a paper on "Incandescent Gas Lighting." He stated that, while all were agreed that the ordinary methods of illumination by gas left much to be desired, and that the electric light alone could claim to approximate to perfection, yet the expense of the latter would militate against its adoption for some time to come. If, therefore, a method of lighting could be devised utilising the existing supply of gas and giving a light comparable with that of an incandescent lamp, it would fill a place and be a practical success. Such a light was that produced by the incandescence of refractory materials heated by an ordinary bunsen flame. In the subsequent part of the paper the Welsbach light was chiefly referred to, though some information was given respecting the Clamond and other systems. The hoods or mantles of refractory oxides used in the Welsbach lamp are made of textile material saturated with a solution of a salt of the requisite rare earth, such as zirconia, and the organic matter burnt off before use by simply igniting the cotton threads near the top of the mantle and allowing it to burn downwards. The colour of the light, its amount for a given consumption of gas, and the lasting powers of the mantles greatly depend on the precise mixture of rare earths used. To hear names which one has associated with bodies exclusively interesting to the pure chemist uttered trippingly, as the mere raw material of an industry of no little importance, was as striking as it was instructive. Zirconium, lanthanum, didymium, thorium, yttrium, and cerium were spoken of with the freedom one uses towards their common brother, aluminium. In making the mantles the presence of alumina and magnesia is detrimental. The same is true of iron, complete freedom from that body being essential. As to the candle-power of such lights, it may be said that it varies considerably both with their nature and age; a good average result appears to be 4–5 c.p. per cubic foot of gas. The perfect combustion of the gas, when burnt in an incandescent light—in itself a distinct advantage—was adverted to. If used in a reducing flame the mantles deteriorate. At present complete success has not attended efforts to utilise water gas as the incandescing agent, but further experiments are being made in this direction, and Mr. Scudder, of the British Water Gas Syndicate, hopes eventually to arrive at better results.

In the discussion which followed, Mr. Dyer wished for further information about the rare earths used, and spoke of the deterioration of such incandescent burners as had come under his notice.

Mr. Allen inquired whether these earths became insoluble in acids on heating, as alumina does at high temperatures, thus militating against ease of re-working.

Mr. D. A. Sutherland spoke of the utility of the incandescent gas light in the laboratory for all operations needing nice discrimination of colour, a quality the existence of which Mr. Mackean in his reply confirmed.

Messrs. Cross and Bevan then presented a note on the "Volumetric Estimation of Alumina," of a controversial nature, relative to the dispute that has arisen between themselves and Professor Lunge as to the precise point at which neutrality is reached in titrating with methyl orange. They brought their views to the test by making titrations in presence of the assembly, first to the point they considered final, and then to that corresponding to Lunge's statements. There was ocular evidence thus afforded that the change took place when it should, according to their contention. The incandescent gas lights, which had been used for illustrating Mr. Mackean's paper, showed the change of tint admirably.

Mr. Bertram Blount remarked that the evidence on the authors' side appeared conclusive, and reminded the meeting that differences between different observers in titrating with methyl orange were sometimes due to slightly abnormal eyesight. Persons in the least degree colour blind, as many unconsciously were, failed to perceive the change from pink to yellow, and *vice versâ*.

Mr. Allen said that bad methyl orange was frequently sold, a statement confirmed by other speakers.

Mr. Bevan, replying, could advance no hypothesis to account for the discrepancy between their results and those of Professor Lunge. Samples of the indicator had been exchanged, and titrations made by independent observers, to no purpose; he hoped those sufficiently interested would try the experiment for themselves.

Dr. Johnstone, having read a note on the determination of glycerine by the permanganate method, the proceedings terminated.

Notes.

AGRICULTURAL EDUCATION IN SICILY.

In agricultural schools and colleges Sicily is much behind the age. The province of Catania is the most advanced—there is a school of viticulture at Catania, and one of agriculture at Caltagirone. In some districts agricultural education is taught in the communal school. In the neighbourhood of Palermo, near the Favorita, there is an agricultural college of imposing appearance founded by the Prince of Castelnuovo, but it does not as yet appear that any of these establishments have had any effect in raising the general character of Sicilian agriculture.

MINING IN ECUADOR.

A Foreign Office report from Ecuador states that the Zaruma Gold Mining Company continues the extraction of gold from the Portobello mine, getting out about 400oz. to 500oz. of gold per month, and a proposal has been made to augment the stamping power in order to increase the produce. Elsewhere, however, things are not so satisfactory. The works on the Quebrada mines have been entirely suspended. The mine has been flooded, and the whole of the capital of the company is said to be exhausted. The Telephono mines have not been actively worked either, and some explorations by English and French syndicates on other mining properties have so far given no definite returns.

BAUXITE AND KAOLIN IN ARKANSAS.

Dr. Brauner has recently reported to the Government of the United States that extensive deposits of bauxite exist in Arkansas in irregular patches. As this mineral has only hitherto been found in small quantities, and, with the exception of a single bed in Georgia, never before in the United States, the find is likely to prove a valuable one. The growing demand for the better class of refractory crucibles and tiles has lately caused an increased use of this mineral, and as it is also employed in some of the aluminium processes, and for the manufacture of alum and aluminate of soda, the discovery is of great commercial interest. The kaolin deposits occur in the same districts, but their extent has not at present been determined with any minuteness.

TRADE IN ECUADOR.

During several years the amount of exports from Guayaquil, in Ecuador, to Great Britain have shown a steady decrease, owing mainly to the fact that cocoa, which formerly came to this country for distribution to the Continent, now goes direct to Amsterdam, Rotterdam, Antwerp, and Hamburg. Trade between Ecuador and the United States is increasing. The waterworks for Guayaquil have not yet been completed, although the flexible tubing has been successfully laid across the bed of the Guayaquil river; the work on the reservoirs at Santa Anna hill have been actively continued; tubes have been laid throughout the city, and some progress has been made on the laying of the tubes from the source of the supply to Duran. The railroad has been but very little advanced, but trains are now running regularly from Duran, in front of Guayaquil, to Chimbo, at the foot of the Cordillera, and a special steamer belonging to the company makes the regular service from Guayaquil to Duran.

IRRIGATION WORKS IN PERU.

In a despatch from Lima to the Foreign Office, Sir C. R. Mansfield states that agricultural interests in Peru have to struggle against two deficiencies—the want of water in the first place, and the want of labour in the second. Where capital is at hand to promote irrigation vast tracts, now little better than deserts, might be rendered of great fertility. He says that a notable experiment in such a direction is in contemplation in the neighbourhood of Piura, in the department of the same name, where a company proposes to utilise the waters of the River Piura for the irrigation of some 400,000 hectares of land, at present a sandy waste and absolutely worthless. The department of Piura is the principal cotton field in Peru; the project is an important one, and the result will doubtless be highly remunerative, while, if such prognostigations be realised, other enterprises of a similar character will be set on foot in various parts of the Republic, in the department of Ica, for example, also a cotton district, and elsewhere.

THE RECENT DISCOVERY OF NATURAL GAS IN ENGLAND.

In his lectures on "Gaseous Fuel" (since published by Messrs. Whittaker & Co.) Mr. Thwaite gave it as his opinion that beneath the salt beds of Cleveland, Cheshire, and Ireland both natural gas and oil would be found. At Mr. Verdin's request, Mr. Thwaite elaborated his theory, which was in due course submitted to the Salt Union, with the result that the Salt Union decided to put the theory to the test of the drill, and borings have been proceeding simultaneously in Cleveland and Cheshire. It is reported that in the former district natural gas has been struck, and issues in great volumes. This discovery is of great national importance, as it may mean the conferring by nature on Cleveland all the natural advantages possessed by the great iron centre of Pittsburgh and district, and prove of enormous advantage to the metallurgic and chemical industries carried on in the North Yorkshire ironfield. We hope that the test in Cheshire may be equally satisfactory, and thus confirm to the full Mr. Thwaite's predictions.

CANDLE POWER OF INCANDESCENT LAMPS.

Much has been said recently as to what incandescent lamp should be considered the normal one. A general opinion is that 8 candle-power is best. Of course, electric light engineers naturally want to have the standard as low as possible, for if the public believes an 8 candle-power lamp gives as much light as a gas burner consuming 5 cubic feet an hour, of course it makes the electric light come out well as regards cost. With a good gas burner much more than eight candles can be got from 5 cubic feet of gas an hour. It must also be remembered that the usual way of measuring an incandescent lamp on the photometer is very much in its favour. An 8 candle-power electric lamp gives eight candles in a horizontal direction only, and sometimes only in one horizontal direction if the filament is flat. In a vertical direction the light may be only two or three candles. The mean light in all directions may be much less than eight candles. An 8-candle gas lamp, as the flame is transparent, gives the full light in all directions, except where the shadow of the burner obscures it. An 8-candle gas lamp is thus superior to an 8-candle incandescent light. Another advantage of gas is that the flame is generally used naked, while the electric light, even if not in an outer globe, gets slightly blackened or dusty, and loses a large proportion of its light. It is surprising what a large percentage of light is wasted by an almost imperceptible blackening or external soiling of the lamp bulb.

THE ENGINEERING SCHOOL, CORNELL UNIVERSITY.

Since publishing the article on this subject in our issue of the 30th ult. we learn that the number of students registered this year is something like 450, including a considerable number of graduates from other colleges, taking, in most cases, advanced work in research and higher engineering; and of the whole list, nearly one-half are selecting the electrical work in specialisation, the others dividing between general engineering, steam and naval engineering, and other special lines of work. The upper classmen, to the number of about 200, are all taking work in the mechanical laboratory, which is being considerably extended to meet this large demand. At the end of the year it will have its 200 men assigned to work in strength of materials, and other work of research in that general direction, to engine and boiler testing, and to a great variety of special investigations. The laboratory plant will include a triple-expansion 150 horse-power engine, which has been ordered from Messrs. E. P. Allis & Co., Milwaukee, to be used for experimental purposes in the mechanical laboratories. The engine is to be so arranged that it may be run single, double, or triple expansion, with or without steam jackets, &c., and will be fitted with all appliances necessary for experimental work. There will also be a number of smaller and specially constructed engines and boilers, including the 500 horse-power heating plant of the University; collections of steam pumps and injectors; a plant illustrating Hirn's analysis; several air and gas engines, including all the usual types; turbines and rotary pumps; several testing machines of 15,000lb. to 20,000lb. capacity, others of 40,000lb. and 50,000lb., one of 100,000lb., one of 200,000lb., and one of 300,000lb., which has been ordered from Messrs. Olsen & Co., of Philadelphia. This machine will weigh several tons, and extend up through three stories of the building.

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Patent Record.

APPLICATIONS FOR PATENTS.

The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

2nd February, 1891.

1845. Veale & Coon..... Regulating steam, water, and other engines.
1846. King, J..... Machine for drying, concentrating, or carbonising fertilisers, ochres, oxides, and other materials, and for concentrating and evaporating liquids.
1851. Shires, J..... Woollen condensers.
1858. Craig & Stevenson ..... Pipe-making machines.
1854. Heywood & Holland ... "Pegging" machines for finishing pile fabrics.
1877. Critchley, T..... Reeling, warping, winding, and gassing machines.
1880. Sykes, Jun., & Smith ... Railway signalling apparatus.
1893. Reverdy, E..... Decorticating or hulling machine.
1903. Abel, C. D..... Gas and oil engines (*The Gas Motoren Fabrik Deutz*).

3rd February, 1891.

1910. Sayer, R. C. ..... Gas engines.
1927. Begg, W. ..... Looms.
1935. Gaunt, J. W. ..... Automatic stop motions for slubbing and other drawing boxes.
1946. Allison, H. J. ..... Platform elevators (*Ruddell*).
1947. Woodsum & Woodsum... Engine attachments.
1961. Menelly, C. D..... Roller bearings.
1966. Yole & Muirhead ..... Stamping machines.
1973. Cole, W. ..... Harvesting machines.
1974. Bickle, T. E. ..... Valve for rock drills.
1976. Masterman & Woodhouse & Rawson United, Ld. ..... Oil filter.
1979. Roberts, J. ..... Carpet-cleaning machine.
1990. Imray, O..... Ore concentrators (*Bertenshaw*).

4th February, 1891.

2003. Fox, G..... Railway couplings.
2004. Sutcliffe, W. ..... Looms.
2006. McCallum, D. ..... Float-feed lubricators.
2014. West-Field, E. S. ..... Gas engines.
2020. Wynne, W. R. ..... Shaft bearings.
2037. Fraser, G. ..... Ore crushing mills.
2053. Gray, A. ..... Vaporisers for hydrocarbon engines.
2057. Reilander & Topham... Self-acting forging machine.
2068. Lockwood & Adamson Apparatus for dyeing, washing, or scouring tops, or slubbing warps.
2071. Blanks & Lefebure..... Brick-making machine.
2073. Munns, W. H..... Traction engines (*Pond*).
2076. Munns, W. H..... Turbine water-wheel (*Elmer*).
2077. Munns, W. H..... Well-drilling machines (*Miller & Canman*).
2080. Munns, W. H..... Stone-crushing machines (*Clair & Varich*).
2084. Richardson, J. ..... Multitubular boilers.

5th February, 1891.

2090. Whitehead, J. ..... Caps used in spinning and twisting machinery.
2091. Hacking, W. A..... Shuttle-box motions for looms.
2146. Lake, H. H..... Boiler and other furnaces (*Hawley & Sapp*).
2149. Ladds, P..... Boilers.
2150. King, F. J. ..... Apparatus for making metal boxes.

6th February, 1891.

2166. Wigzell & Pollit ..... Boiler feed pump for steam engines.
2167. Laidler & Thompson ... Adjustable pitch reversing propeller.
2178. Hartung, H. ..... Water gauge valves.
2185. Adams, W. R. M. ..... Magazine guns.
2208. Isherwood, A. ..... Wood picking sticks for looms.
2210. Hartley, J. W..... Gas engines.
2213. Storch, E. ..... Slide valves.
2221. Edward & Edward ..... Machinery for covering telegraph and telephone cables and wires with lead.
2230. Allin, S. S..... Apparatus for dry concentration of ores.

7th February, 1891.

2262. Burt, T. P..... Weft forks and picking motions of looms.
2263. Burgess, Ledward, & Crompton ..... Looms.
2264. Chambers, R..... Steam boiler furnaces.
2292. Needley, F. ..... Thrashing machines.
2295. Dèmoulin, G. M. ..... Valves and valve gear for steam engines.

ELECTRICITY.

2nd February, 1891.

1905. Atkinson, L. B..... Electrical distribution.

3rd February, 1891.

1908. Maxwell, D. ..... Switches.
1912. Lewis, J. S..... Galvanometer.
1913. Lewis, J. S..... Bells.
1923. Binswanger, G..... Switches.
1963. Dewey, M. W. ..... Apparatus for soldering cans and the like.
1968. Lake, H. H..... Lamps or lighting apparatus (*Macquaire*).
1969. Lake, H. H..... Signalling apparatus (*Burrell*).
1987. Clark, A. M. ..... Lamps (*Easton*).
1988. Imray, O. ..... Autographic telegraphs and automatic switches for same (*The Writing Telegraph Company*).

4th February, 1891.

2010. Berg, E. ..... Signalising telegraphs.
2033. Lowrie & Hammond..... Dynamos.
2040. Müller, H. ..... Switches for secondary batteries.
2045. Hutchinson, R. R..... Ore stamping and pulverising apparatus.
2061. Thompson, W. P. ..... Lamp holders (*Moore*).
2067. Baur & Dieselhorst ... Transformers.
2068. Siemens Brothers & Co., Ld. ..... Semaphore signal apparatus (*Siemens & Halske*).
2069. Siemens Brothers & Co., Ld. ..... Apparatus for working semaphore signals (*Siemens & Halske*).
2081. Gisborne, C. A. ..... Multiple circuit telegraphy (*Keeley*).

5th February, 1891.

2115. Dean & Jubb ..... Brushes for dynamos.
2152. Woodburn, J. C. ..... Switches.
2155. Nebel, J. ..... Armatures for dynamos.

6th February, 1891.

2199. Cox, Robinson, & Gritton ..... Automatic switches.
2200. Attenborough, E. ..... Motors.
2201. Spagnoletti, J. E. ..... Laying and insulating underground mains.
2219. Lever, E. E. ..... Arc lamps.
2225. Berlier, J. B. ..... Motors for electric railways.

7th Feburary, 1891.

2289. Siemens Brothers & Co., Ld. ..... Block signalling apparatus (*Siemens & Halske*).
2293. Horn, W. W. ..... Cut-out fuse (*Whittingham*).
2297. Hazeltine, C. W. ..... Arc lamps. (9th July, 1890)

CHEMISTRY.

2nd February, 1891.

1883. Willcox, B..... Manufacture of dyestuffs of anthracene and anthraquinone (*Farbenfabriken vormals Friedrich Bayer & Co.*).

4th February, 1891.

2000. Hart, P. ..... Treatment of composite ores containing zinc.

5th February, 1891.

2089. Johnson, J. ..... Manufacture of steel (*Blair, Jun.*).
2134. Greenwood, J. ..... Production of caustic soda.

6th February, 1891.

2224. Lake, H. H..... Manufacture of chromates, bichromates, and other chromium compounds (*Massignon & Watel*).
2234. Parkes, H. ..... Manufacture of ferruginous alloys.

MISCELLANEOUS.

2nd February, 1891.

1855. Moseley, J. ..... Woven bands and belts.
1871. Ambler & Branter ..... Moulding hollow ingots and other tubular articles.
1889. Sebor & Schulz ..... Belt fasteners.

3rd February, 1891.

1922. Purkis, H. S. ..... A communicator and fire alarm.
1986. Sparr & Sparr ..... Screw propellers.

4th February, 1891.

1995. Hield, R. ..... Hinges.

6th February, 1891.

2178. Davies, R. ..... Adjustable spanner.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

4. Cory.
180. Edwards (*Cassalette & Kunhardt*).
1816. Ewens.
1976. Steel.
2176. Brown.
2219. Rudolph.
2267. Jones, Jones, & Jones.
2296. Richardson & Holland.
2298. Gardiner.
2481. Ritchie & Gibbon.
2628. Boult (*Lansiaux & Merville*).
2861. MacDonald.
2984. Lazarus.
3245. Bohm.
3255. Donald.
3433. Williams & Taylor.
3556. Thomas.
3630. Bale & Sims.
3681. Holgate.
3741. Wilkes.
3749. Blakeley & Beving.
3935. Howarth & White.
4030. Darby.
4047. Brooks.
4120. Laing.
4168. Spanoghe.
4242. Siemens.
4419. Clampett.
4463. Packer.
4597. Horne & Whinfield.
4698. Meyhew.
4728 Reade.
4767. Sherrin.
4792. Rylands & Husselbee.
4858. Kapp.
4913. Caddy & Messrs. Caddy & Co., Ld.
5098. Stead.
5113. Stilling.
5171. Kerry.
5176. Chorlton & Scott.
5188. Dixon & Dixon.
5207. Huelser (*Ludt*).
5212. Wolfsky.
5217. Greenwood.
5226. Thompson (*Krause*).
5263. Porter & Johnson.
5277. Kirkaldy.
5317. Vagner.
5436. Dewé.
5561. Urquhart.
5609. Riddel.
5818. Howson.
6554. Kendall.
8202. Thompson (*Dammann*).
9242. Thompson (*Cook*).
11397. Pujos.
11753. Lanigan.
11777. Vincent.
12156. Fraser & Palmer.
13151. Bishop.
14188. Balbian.
14197. Lake (*The Thomson Houston International Electric Company*).
16478. Blount.
17123. Glazer.
17516. Noton.
17615. Mitchell.
17709. Aiken.
18409. Davies.
18632. Rittersbach & Rittersbach.
18993. Prokhoroff & Fahlberg.
19182. King & Wainwright.
19187. Valiant.
19425. Saunders. (28th April, 1890.)
19565. Cussen.
19604. Attwater.
19835. Allison (*The National Salt and Chemical Company*).
20134. Fawcus & Cowan.
20272. Donald.
20307. Dahlgren & Svensson.
20462. Bildt.
20528. Fairfax (*Christian Ferdinand Christoph & Christian Rudolph Unmack*).
20977. Meier.
21189. Henderson.
176. Imray (*Moerchen*).
1753. Walton.
1774. Thomson & Thomson.
1939. Bougault.
2010. Bacon.
2177. Lee.
2246. Russell.
2273. Postlethwaite.
2297. Richardson & Holland.
2337. Postlethwaite.
2620. Grognet.
2658. Braham.
2803. Smith.
2955. Propfe.
3088. Haddan (*Haut*).
3246. Bohm.
3393. Foxlee.
3555. Sahlström.
3580. Bartholomew & Godson.
3725. Lake (*Müller, Schwarz, & Scheid*).
3915. Schwager.
3995. Dosmond & Rozes.
4041. Jaques & Johnston.
4049. Calvert.
4163. Savours.
4185. Barr & Stroud.
4384. Pitkin & Holden.
4484. Meldrum & Meldrum.
4492. Lanham.
4612. Slater & Smith.
4699. Kellogg.
4746. Joseph & Citron.
4778. Curr.
4811. Davidson.
4912. Martin.
5041. Buckley.
5095. Tom Bell Burns & Richard Henry Lee.
5145. Miller.
5172. Ferguson.
5177. Morice.
5201. Every.
5211. Lye.
5215. Beauchamp.
5220. Comerford.
5255. Cooke.
5271. Saleha.
5278. Kirkaldy.
5374. Nisbet.
5508. Haddan.
5577. Pitcairn.
5699. Heckford & Robinson.
6445. Smith.
7851. Bowman.
9076. Brodie.
9831. Edmund James Arnold & Naboth Hall Osborne.
12077. Allison (*Bohlig*).
12882. Nussbaum.
14067. Schubert.
14189. Planchon.
14809. Oldham & Oldham.
15457. Thompson (*Plummer*).
16076. Bendall.
17093. Curtis. (28th April, 1890.)
17560. Iliffe & Barton.
17707. Mewburn (*Low*).
17787. Hattersley.
18559. Revel.
18690. Boult (*Eichbaum*).
18739. MacDonald.
19062. Cumming.
19178. Imray (*The Mosquera Julia Food Company*).
19394. Torrance & Fraser.
19428. Baudisch & Heine.
19446. Dwight, Hutchinson, & Ownsworth.
19673. Felbel & Steigel.
20099. Kingsbury (*The Western Electric Company*).
20108. Lake (*The Ross Valve Company*).
20289. Bottome.
20377. Grey.
20511. Streeter.
20533. Brennan.
20584. Hodges.
20677. Michaud.
20704. Mills (*Conn & Seidel*).
21001. Harrison.
21230. Barker.

1891.

3. Wood.
63. Fernandez.
156. Kiesow.
222. Crowe.
247. Hughes (*Pickhardt*).
46. Hornstreiner.
87. Leadbetter.
186. Thorp.
227. Bickerton.
291. Potter.

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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

GAS ENGINES.—*C. D. Abel, London.* (*Die Gas Motoren Fabrik Deutz, Köln, Deutz, Germany*).—The object of this invention is to provide means of preventing the premature explosion of the explosive charge immediately on its introduction into the cylinder of engines working with a cycle of four or two strokes. For this purpose the inventors introduce into the cylinder, during the exhaust stroke, a quantity of steam or a spray of water. The water is at once converted into steam, and, after cooling the residuary products of combustion, as is also the case with steam when used, escapes through the discharge valve. The steam or water is introduced through a suitable pipe during the discharging period under suitable pressure, the supply being governed by a suitable valve normally held closed by means of a helical spring and operated by a cam on a countershaft of the engine through the medium of a bell-crank lever. When using water, the passage admitting it is provided with a projecting perforated nozzle directed towards the cylinder. Three claims are made.—No. 3774. March 10th, 1890. 6*d*.

STEAM ENGINE CUT-OFFS.—*A. J. Boult, London.* (*G. Fussell, Lockport, New York, U.S.A.*—Referring to the accompanying illustrations, Fig. 1 is an elevation and Figs. 2 and 3 details of an engine fitted with the improved cut-off. The valve box A is divided horizontally, the feed pipe communicating with the upper part, and the exhaust with the lower part. Two ports communicate with both sides of the partition and each end of the cylinder, and valves sliding between gibs on the upper and lower faces of the partition, and are connected with rods B C operating said valves. To the rod C is hinged a second rod operated from any

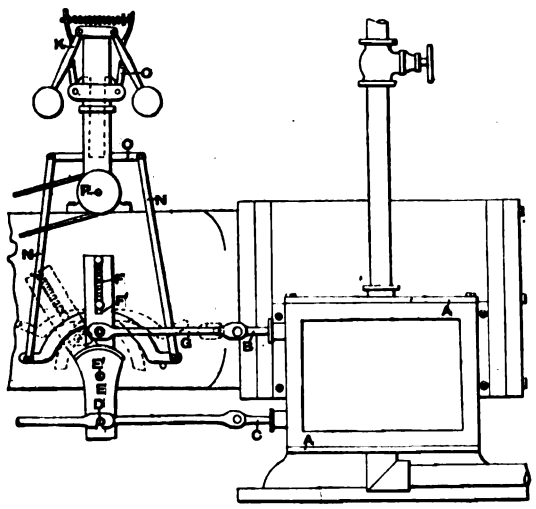


FIG. 1.

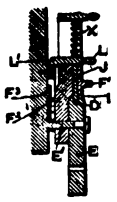


FIG. 2.

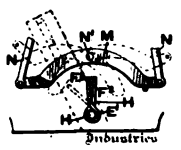


FIG. 3.

part of the engine by suitable rod, and one end of each of said rods embraces a stud D on an arm E pivoted to the engine frame at E^1. A second arm is mounted at E^1, having a pin F^1 to which is connected the link G connected to B. On the back of this arm (Fig. 2) is a pin F^2, and above it is a second pin F^3 fast in the frame of the engine, and bearing on both sides of these pins are the ends of a spring H coiled around a stud H (Fig. 3). The second arm is provided with a shoulder I overhanging the top of E, and is provided with a sliding dog J forced downwards by a spring X into a hole in the top of E, out of which it can be raised by a handle L. At the back of L is a toe L^1 riding over two cut-off segments M (Fig. 3), pivoted to the engine frame at N^1 and connected at their outer ends by rods N to the slides O of a governor constructed substantially as shown (Fig. 1), and driven from P. The action is as follows:—So long as the engine runs at its normal speed, dog J connects E and F, but, as the speed increases, the governor slides rise, so raising J through M and N and releasing E from the second arm. The spring H now comes into play, and tends, through stops F^2 and F^3, to hold E perpendicularly, so cutting off the steam supply. The exhaust valve continues to operate through E, and this operation continues until the engine speed is properly reduced, when the dog J is allowed to fall, so connecting E and F. Eleven claims are made.—No. 18090. November 10th, 1890. 8*d*.

STEAM BOILERS.—*E. Jones, Leeds.*—The invention relates to apparatus for separating water from steam as the latter passes from the boiler. This apparatus consists of a tube, preferably square in cross section, and formed in two parts, longitudinally, each part having a series of inclined transverse blades or deflectors. These blades are so arranged that when the two parts are put together the projecting ends of each of one set of deflectors extend a slight distance between each pair of the other set of deflectors, so forming a sinuous course for the steam. The blades are at such a distance apart that the area of the passage between them is about equal to the area of the exit pipe, to which one end of the apparatus, which is fixed inside and to the upper part of the boiler, as is well understood, is fixed, the other end opening into the boiler. The upper blades are inclined in the direction the steam has to travel, the lower series being parallel therewith. When the separator is fixed horizontally in the bottom of the tube near the point of junction of each blade, an opening is formed for the escape of water. These openings may diminish in area as they near the exit, but the total area of all the openings should not exceed that of the inlet to the separator. Claims: (1) The apparatus for drying steam as described; (2) adapting to the steam pipe of a boiler a box or chamber having two series of transverse deflectors, the one series arranged intermediate of the other, and against which the wet steam strikes, the watery particles being thereby deflected downwards to suitable openings. —No. 4594. March 24th, 1890. 6*d*.

SIGHT-FEED LUBRICATORS.—*W. A. G. Schönheyder, London.*—In the annexed illustrations Figs. 1 and 3 are vertical sections, and Fig. 2 a sectional plan of a lubricator constructed according to this invention, and operated in the usual manner by means of condensation water. Fixed to the oil container A is the screwed

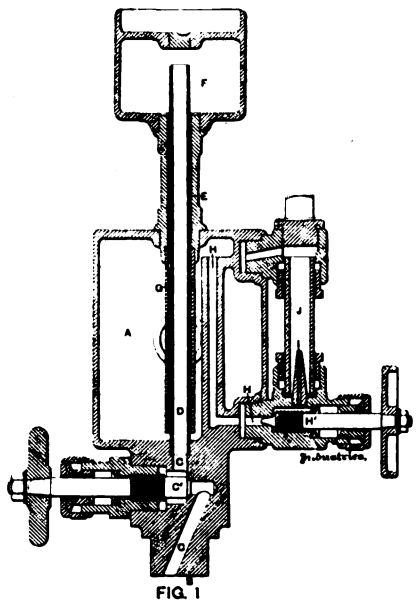


FIG. 1

shank B, by means of which the lubricator is attached to the cylinder to be lubricated. A channel C governed by valve C^1 passes through B and is connected to a pipe D, passing through A and a sleeve E into the condensing chamber F. The pipe D does not fit E so that connection is formed between the chambers F and A, which connection is made at the lower part of A by means of a tube G. A passage H governed by valve H^1, opening into the upper end of A, leads to a nozzle I in the glass tube J, which is filled with water. From the top of J a passage K through the plug K^1 leads to a second passage L (Figs. 2 and 3), leading to the passage C. The operation is as follows:—The valve C^1 being opened steam is allowed to pass to chamber F, where it condenses, and passing down through tube G enters A, so causing the oil to rise and flow into passage H, thence through valve H^1 and nozzle I, through the water in J, and passages K and L into C, and thence to the cylinder, the flow being regulated by valve H^1. Suitable plugged openings are made in the top and bottom of A for emptying out the condensation water and refilling with oil. Claims: (1) In a sight-feed lubricator, the combination with the oil chamber A, nozzle I, glass tube J, passage C, valve C^1, and tube D of passages H and L formed in the body of the

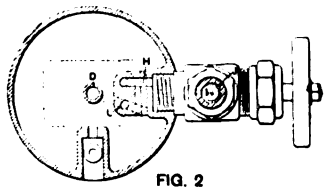


FIG. 2

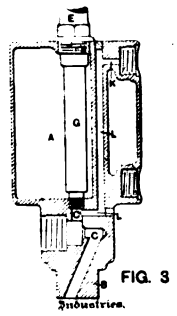


FIG. 3

chamber A, of which H establishes a communication between the chamber A and the nozzle I, while L establishes a communication between the top of the glass tube J and a passage leading to the part to be lubricated; a condensing chamber F carried by an extension E above the oil chamber A, into which the steam tube D passes, and an annular passage surrounding the tube E leading from the bottom of the condensing chamber to near the bottom of the oil chamber, substantially as described. — No. 3525. March 5th, 1890. 8*d*.

RAILWAY CHAIR KEYS.—*E. Parsons, London.*—The invention has for its object an improved lock for fastening railway chair keys. This lock consists of a flat metal bar of steel or other suitable metal, one part of which is bent back over the other part to form a spring. Formed at each end of this second part are hubs between which the chair fits, and formed on the other or spring part are a number of teeth or serrations. The railway chair key is driven between the rail and this lock, which is held rigid by means of the hubs thereon embracing the arm of the chair, and which holds the key rigid by means of its teeth or serrations, the said toothed part entering a longitudinal slot in the key. Claims: The combination with a double resilient bar with two ends adapted to embrace the chair of a toothed face adapted to bite the key as set forth.—No. 3573. March 6th, 1890. 6*d*.

ENGINE GOVERNORS.—*G. H. Firth, Clayton, Manchester.*—The invention relates to a differential speed regulating apparatus for steam and other engines. Referring to the annexed illustrations, Fig. 1 is a front elevation, Fig. 2 an end elevation, and Fig. 3 details of such an apparatus. The apparatus is mounted upon a base-plate A provided with a socket A^1 for fixing the same on a pillar or stand, or upon a similar suitable bracket or plate. The plate A carries bearings B^1 B^1 for the shaft B upon which the worm B^2 is fixed and gears with the worm-wheel C. The shaft B is driven from the crank-shaft of the engine and rotates the worm-wheel C at a reduced speed. The worm-wheel revolves on a collar D^1 of the hollow stud D, the section of which is indicated on Fig. 1. The stud is fixed on the base-plate A by means of the nut D^2. The bevel wheel E is cast with or fixed to the worm-wheel C, and rotates with the same. Facing the wheel E another bevel wheel F of the same size is mounted upon the stud D and rests on a shoulder of the same. The wheel F is formed with a clutch F^1 at its back, into which the projections G^1 of a sliding clutch G enter. A shaft H passes through the hollow stud D, and is supported at the top in the cross-rail I carried by the pillar I^1 and bracket M fixed upon the base-plate A. A clutch H^1 is fixed on the shaft H, into which the teeth G^2 of clutch G enter when the latter is held up in the position shown on the illustrations by the pins N^1 of the forked lever N which enter a groove G^3 of the clutch G. The shaft H receives a uniform rotation from a motor independent from the engine to which the apparatus is applied, and drives through the clutches G^1 and G^2 the bevel wheel F in a contrary direction to the wheel E, and at a constant speed corresponding to the speed of E when the engine is driving the crank-shaft at its normal speed. Between the wheels F and E a third bevel disc or plate-wheel L is placed upon the stud D. The plate of L contains an opening and bearings for the bevel wheel L^1 to run in. This wheel L^1 is in gear with both wheels E and F as shown. When the latter are rotated in opposite directions at the same speed, the wheel L^1 simply rotates, and no movement of the wheel L takes place, but when the speed of the engine and wheel E increases, the wheel L^1 rolls on wheel F, and the wheel L is turned in the same direction as wheel E, while, if the speed decreases, the wheel L^1 rolls on E and the wheel L is turned in the same direction as F. These motions are transmitted through the bevel pinion K running in a boss on bracket M and the clutches K^1 K^2 to the shaft O. The shaft O is utilised to adjust the length of one of the rods connecting the governor with the throttle valve or automatic ex-

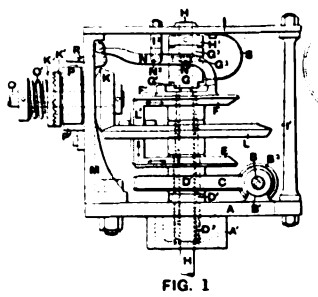


FIG. 1

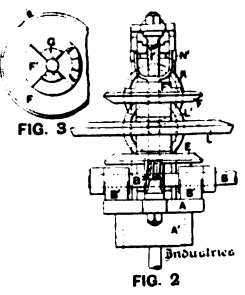


FIG. 2

pansion gear so as to increase or reduce the pressure or admission of steam. To prevent the rotation of O, and so breakage, when the engine is stopped the wheel K is fitted loosely on O and carries a serrated collar K^1, against which a second collar K^2 sliding on but rotating with O by means of a spring O^1 is pressed. Thus, when O is stopped and K continues to revolve, K^1 and K^2 will be forced out of gear. For the purpose of stopping the engine from any part of the building an electromagnet P supported on a bracket P^1 is used. Above P is a bell-crank lever R on a stop on one arm of which rests one end of a lever N pivoted at N^2. A stud N^1 works in a groove in G, and the end of N rests on F, and a spring S tends to force N downwards. Thus if the circuit around P is closed R is drawn downwards, so releasing N, which then engages the cams F^1 and F, so stopping F and drawing G downwards out of gear with H^1. Four claims are made.—No. 2851. February 22nd, 1890. 8*d*.

STEAM BOILER FURNACES.—*H. C. Paterson, London.*—The object of the inventor is to provide means for preventing or consuming smoke, and so economising fuel in steam boiler furnaces. To this end the inventor forms in the front part of the furnace or in the door thereof passages, receiving air from outside the furnace at their lower ends, and conveying it upwards and delivering it into the upper part of the furnace, a transverse section of these passages being of a form somewhat resembling the letter S, the outlets however being curved so as to direct the air towards the part above the fire. A deflecting plate is pivoted on studs at each side of the furnace in the upper part thereof by means of slotted arms fixed thereon, and this plate, by means of nuts on the ends of the supporting studs, can be fixed at or altered to any position until the most beneficial direction of the air is obtained. Claims: In furnaces a passage or passages in the door or front of the furnace receiving air at its lower part and discharging it into the upper part of the furnace beneath a deflecting plate, by which it is directed downwards into the fire, as described.—No. 1101. January 21st, 1890. 6*d*.

RATCHET SPANNERS.—*P. Mitchell, West Hartlepool, Durham.* —The spanner constructed according to this invention consists of a circular box or socket, in one end of which is formed a recess adapted to fit the nut to be turned. One half of this socket is of a larger diameter than the other, and around the smaller part is placed a loose ring, which is prevented from slipping off by means of a washer fixed to the end of the socket, and of a slightly larger diameter than said end. A suitable lug is formed on the periphery of this ring, to which is hinged a lever, having formed on it, beneath the fork by means of which it is hinged to said lug, a tongue or knife edge, which, when the lever is brought to such

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a position that it stands out at right angles to the axis of the socket, enters one of a number of slots formed in that part of the socket which is of the larger diameter and parallel to the axis of the latter. When, however, the lever handle is raised so that it stands at an angle of, say 30°, to the axis of the socket, the tongue will be disengaged, so that the lever, together with the ring, may be moved without moving the socket. Claims: A wrench or spanner, comprising a box or socket designed to receive the nut to be turned, and a lever pivoted to a ring on one part of the said socket, and provided with a tongue adapted to engage with slots on the other part of the said socket, as described; (2) the manufacture and use of the improved wrench or spanner, as described. —No. 17617. November 3rd, 1890. 6*d*.

ROLLING MACHINES.—*S. Fox, Leeds.*—The invention relates to machines for rolling articles of channelled or trough-like sections from mild steel plates, and which are constructed as follows:—Fixed to a suitable base are two vertical supports placed at a suitable distance apart. Running in bearings in the lower part of these supports is the shaft carrying the stationary roll of a shape similar to the interior of the channelled article to be formed. In the upper part of the supports are formed vertical slots, in which slots slide bearings carrying the spindle of the movable roll of a form similar to the back of the channelled article to be formed. Screwed spindles are attached to these sliding bearings by means of swivel joints, which pass through the upper part of the supports and carry suitable internally screwed worm-wheels actuated by means of a horizontal spindle running in bearings on the upper end of the supports and carrying worms. By means of the above arrangement, the upper roll can be raised to allow of the insertion of the end of the plate to be rolled, and then lowered and the rolls revolved in the ordinary manner, so drawing in and channelling the said plate. Claims: The manufacture of articles of channelled or trough-like sections from mild steel plates by rolling as described.—No. 20330. December 12th, 1890. 6*d*.

PRESSURE GAUGES.—*A. Lusuardi & A. Falco, both of Turin, Italy.*—The invention relates to the combination with a pressure (or vacuum) gauge of a counter capable of registering the variations of pressure above a given limit, and of preserving the indication of the sum of all these variations. In the annexed illustrations Fig. 1 is a rear elevation, Fig. 2 a vertical section, and Fig. 3 an elevation partly in section of a gauge constructed according to this invention. Within a box A is a pressure gauge tube B that operates by a link the needle C which indicates the pressure on a dial at the front of the apparatus. The pivot C^1 of this needle carries an arm C^2. When the pressure reaches the predetermined limit this arm C^2 comes into contact with a pin projecting from one end of a lever D mounted so as to turn with very little friction on the shaft of a ratchet-wheel E. A pawl F fixed to D engages the teeth of E and causes it to turn with the lever when the latter is moved by the arm C^2.

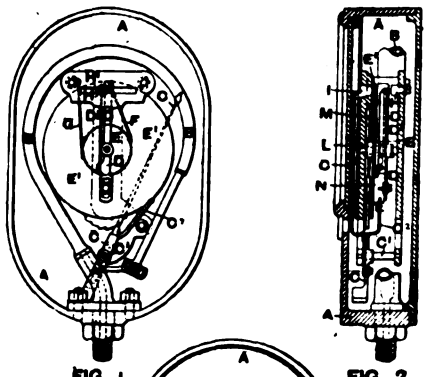


FIG. 1.

FIG. 2.

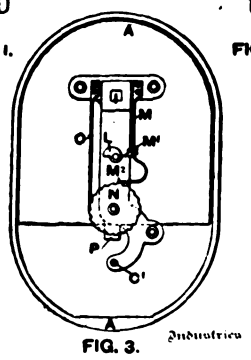


FIG. 3.

When D moves back F slides over the teeth of E which cannot turn backwards by reason of the detent G. The position of D, when the arm C^2 is not touching it, is regulated by means of the stop H, against which it is brought by the spring D^1. The stop H can slide in a slot H^1, within which it can be fixed at any desired point. The ratchet-wheel E is connected to a disc or dial E^1 that carries at its front side a graduated scale which can be observed or read off through an opening I (Figs. 2 and 3) in the dial of the pressure gauge. To register the revolutions of E^1 a cam L is fixed on the shaft thereof. This cam, at each revolution, operates one end of an elastic lever M, the opposite end M^2 moves a wheel N forward, one tooth of the wheel N being prevented from turning backward by a spring detent O. A graduated scale is fixed upon N to indicate the revolutions of E. Three claims are made.—No. 20792. December 27th, 1889. 8*d*.

MANUFACTURE OF SPIRAL SPRINGS.—*J. Melli, Hemishofen, Switzerland.*—The machine for producing springs of varied pitch is constructed in the following manner:—Two suitable metal plates are bolted together by means of two bolts, which also act as distance pieces to hold the two plates at a suitable distance apart. Sliding on these two bolts is a slide which is actuated by means of a screwed spindle running in bearings in the end plate and placed intermediate and parallel to the bolts. Through the slide are formed passages for the passage of the wire on to a second spindle, placed slightly above the screwed spindle, but which also passes through a lug fixed on to the upper portion of the slide. This second or core spindle is geared with the screwed spindle and revolves in an opposite direction thereto. The thread on the screwed spindle is broken up so as to form a series of short screws which are connected together by screw threads of less pitch. The slide is caused to follow the varied pitch of these screw threads by means of a set screw screwed into said slide and the end of which projects into and follows said screw thread. Three claims are made, embracing the machine for the manufacture of spiral springs of various pitch, substantially as described. —No. 20303. December 12th, 1890. 6*d*.

CRUSHING MACHINES.—*G. Norman, Sheffield.*—The machine is for crushing ore, quartz, road metal, and the like. In the annexed illustrations Fig. 1 is a side elevation with one side removed, and Fig. 2 a plan of a machine constructed according to this invention. A is the body or framework, in which is fitted fixed and rocking jaws E and C. The rocking jaw C is constructed with bearings to carry a roller B either bearing on its axis or against antifriction roller bearings at the back of it. The jaw is hung upon the axis D and is inclined towards E. At the back of the roller B is fixed the driving shaft F, carried in bearings and fitted with the usual driving pulley G and one or more fly-wheels H. Inside the body or frame A, and centrally on the shaft, is an

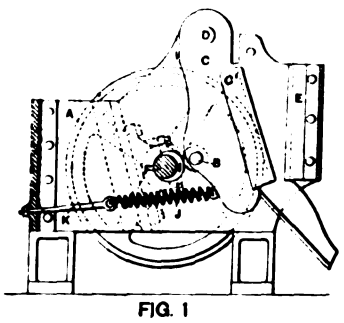


FIG. 1

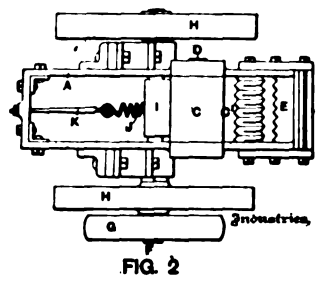


FIG. 2

eccentric or cam I, which corresponds in width with the roller B, the peripheries of both being brought in contact. The rocking jaw C is hung upon its axis so that after being forced forward it follows the receding movement of the eccentric by gravitation, but to render such return movement more certain a coiled spring J is used secured to the back of the jaw at one end and to the frame or body at the other end by means of a bolt K, so that the tension may be adjusted. Claims: (1) A crushing machine having a frame or body of convenient form, with fixed and rocking jaws E and C, the rocking jaw having a roller B for the purpose specified, a driving shaft with a cam or eccentric I to engage with the roller B, and with or without a coiled spring J, all the said parts arranged as shown; (2) in crushing machines for the purposes before specified, the arrangement of a direct acting eccentric or cam I, having its periphery in contact with a roller B carried by the rocking jaw, as described.—No. 3259. March 1st, 1890. 6*d*.

MIXING MACHINES.—*R. Hartmann, Dinglestadt, Germany.*—The invention relates to means in connection with the conveying granular or pulverulent substances under treatment in mixing machines. The device for this purpose consists of a hopper, the interior of which is divided into three parts, by means of two partitions disposed near to and parallel to two sides thereof. Revolving in slots in these partitions at suitable intervals in the depth thereof are the operating rollers, working in pairs, and being so placed that their peripheries project beyond both sides of the supplementary partitions into the central and side spaces of the hopper. Ranged in a direction coincident with the vertical axis of the hopper, and in its central division, are a series of bars of any suitable configuration in cross section, such as triangular. These bars run longitudinally and are parallel with the above-mentioned rolls, and serve as deflectors to assist in transporting to the rolls the granular or pulverulent substances fed into the top of the hopper of the mixing device. The rolls are geared together and operated so that each one of each pair revolves in an opposite direction to the other one of that pair. Claims: In a mixing machine of the type above specified, the combination with the pairs of rolls, the hopper with supplementary divisions of the deflecting bars placed centrally in the central division thereof, and means for imparting motion to the various parts of the apparatus as set forth.—No. 14769. September 18th, 1890. 6*d*.

ELECTRICITY.

INCANDESCENT LAMP-HOLDERS.—*J. W. Edmundson & W. Clarke, both of Gateshead-on-Tyne, Durham.*—The lamp-holder constructed according to this invention comprises two circular porcelain blocks, between which are secured four or more springs or prongs bent over the periphery of the lower block, and so shaped as to embrace the neck of the lamp, the grasp of these springs being aided by an elastic ring, such as a helical spring, embracing the outer ends thereof. The upper block is provided with a suitable cap, having in, and projecting from, its centre a hollow screw, by means of which it can be attached to a bracket or pendant, and through which passes the twin flexible connecting wire, the ends of which are connected to binding screws in the upper block. The two blocks are suitably bolted together, and have holes formed through them at diametrically opposite positions for the passage of the lamp wires to the terminals in the upper block. Claims: A holder for incandescent lamps, comprising two blocks of porcelain or other suitable material, perforated for the passage of the lamp wires, and holding between them spring arms shaped to embrace a lamp neck, and an elastic ring arranged to surround the spring arms and cause them to embrace and hold the lamp as described; the improved holder for incandescent lamps, substantially as described.—No. 993. January 20th, 1890. 8*d*.

ALTERNATE CURRENT TRANSFORMERS.—*G. Kapp, W. C. Johnson, & S. E. Phillips, all of London.*—The invention relates to transformers with a closed iron circuit. The core consists of a number of flat strips of iron, a number of which are placed side by side, but insulated from one another, so as to form a rod of square section, four of these rods being placed together, but insulated from one another, so as to form a bar of square cross section. Around this bar are wound alternately coils, forming the primary and secondary circuits. The ends of the core project beyond the coils, and have fixed to the upper and lower sides thereof the yoke or shell, consisting of rings of a suitable shape formed of thin band iron wound upon itself with strips of insulating material intervening between each layer. These yokes rest upon the core so that the edges of the layers of one rest on the edges of the layers of the other. Claims: In a transformer with a closed magnetic circuit—(1) the use of "yokes" made by winding a continuous strip of soft iron to a ring shape in combination with a straight core laid diametrically across the "yoke" rings, so that the surfaces of the core strips and yoke strips cross at right angles or nearly so; (2) in combination with "yoke" rings and core as above described, insulated copper wire coils surrounding the middle portion of the core and surrounded by the corresponding portion of the "yoke" rings; (3) the construction of transformers as described.—No. 3913. March 12th, 1890. 8*d*.

DYNAMOS.—*R. Kennedy, Kilmarnock, N.B.*—The invention relates to dynamos for producing alternating currents. Referring to the accompanying illustrations, Fig. 1 is an elevation of the polar end, Fig, 2 a side elevation of the complete apparatus, Fig. 3 being a second end elevation. The field magnets of the machine are energised by currents from a magneto machine without the use of a rectifying commutator in the exciting circuit. Referring to Fig. 1, A B is the permanent magnet field, built up of steel plates fixed by binding screws, C is the magneto armature wound in twelve sections, D E is the neutral line diameter of each coil, each coil reversing its induced current when passing same. The armature C of the dynamo, with coils C^1, wound on a Gramme ring armature, has twelve coils. The field magnet coils are connected each to a section of the magneto armature winding by wires G. The field magnet is enclosed by the fixed armature C, and is keyed on to the shaft H, as also is the magneto armature; the circular

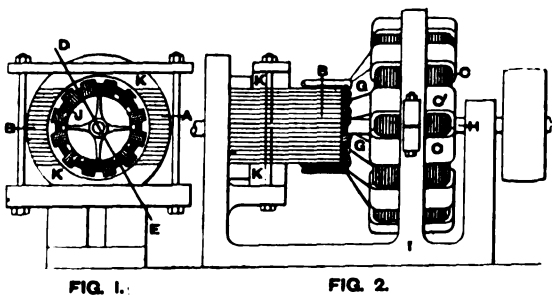


FIG. 1.

FIG. 2.

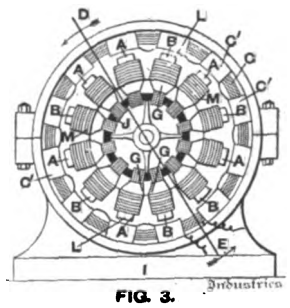


FIG. 3.

frame I binds the armature of the dynamo in place. The steel field magnets A B are of plates laid together to form semi-circular poles, embracing the armature J at one end, and being joined magnetically by an iron yoke of circular shape to fit the circle of the steel plates; these plates are bound by iron bolts and plates with wood packing pieces K (Figs. 1 and 2). In Fig. 3 is shown the arrangement of parts in elevation. The fixed dynamo armature C, with twelve generating coils C^1, is bound into the frame I. The field magnet L, with twelve radial poles A B, moves freely inside; the exciting coils M are each connected to a section on the magneto armature J by connecting wires G, to form the field magnet poles A B A B all round; the reversal of the exciting currents on the line D E produces alternately two S. poles and two N. poles, one on each side of this line, but the poles are maintained of the same polarity during their rotation from A to B and from B to A—that is, during a half revolution, so that they act inductively on the fixed coils C^1, and producing alternating currents therein. Three claims are made.—No. 18491. November 17th, 1890. 8*d*.

SECONDARY BATTERIES.—*H. H. Lake, London.* (*G. E. Hatch, Cambridge, Massachusetts, U.S.A.*).—The object of the invention is to construct a storage battery which shall have all the advantages of those batteries in which the peroxide of lead is held to the lead plates by perforating or forming projections on the latter,

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and in which the thickness, and consequently the cost, of the lead plates may be considerably reduced. This the inventor accomplishes by using a stiff porous material, honeycombed or provided with holes, pits, grooves, or depressions, as separators and supporters of the metal plates, and in applying the active material of the battery to these porous plates instead of to the lead plates as hitherto. Claims: A storage battery, (1) having intermediate plates of stiff porous material alternately with its conducting plates; (2) consisting of alternate conducting plates of metal and intermediate plates of earthenware or similar material to which intermediate plates the active material of the battery is applied; (3) consisting of alternate conducting plates of metal and intermediate plates of earthenware, provided with recesses on either side thereof, and to which is applied the active material of the battery; (4) a separating and supporting plate composed of earthenware, and provided on either side with grooves, pits, or depressions, for the reception of the active material of the battery as described.—No. 19155. November 25th, 1890. 6*d*.

Semi-incandescent Lamps.—*F. R. Boardman, Manor Park Essex.*—The invention relates to semi-incandescent lamps, such as referred to in patents 1704 of 1880 and 10833 of 1887. In the annexed illustrations, Figs. 1 and 2 are respectively a vertical section and an elevation of a lamp intended for a series lamp and constructed according to this invention, and Fig. 3 is a vertical section of an automatic lighting and regulating gear. The block A is of marble and of a cylindrical shape, with three

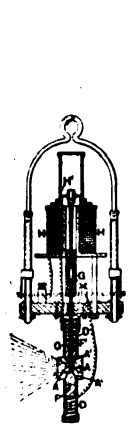


FIG. 1

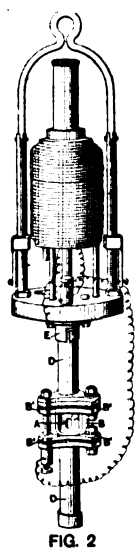


FIG. 2

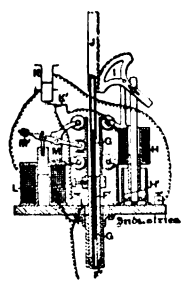


FIG. 3

conical openings formed symmetrically with one another, and a central hole A^1 for the carbons. This block is held in a circular box B (Fig. 2) similarly cut away, on the top and bottom flanges B^1, of which are bolted other flanges, the flanges being insulated from one another on the tubular holders D. A pin on one of these holders D engages with a bayonet joint E secured to the base of the lamp. Springs are placed in D to keep the carbon electrodes F F^1 up to their respective seats in A. The pencil carbon G for lighting lamp is automatically advanced or withdrawn through F^1 by means of one or more electromagnets as described in a prior patent No. 10833 of 1887. In the case of a lamp to be worked in parallel, and having the automatic gear above the block A (Fig. 3), three electromagnets are used. The lighting coil A is wound to form a resistance approximately equal to that of the refractory block A when incandescent, and its core extends below and fitted to form the piston of the dash-pot H^1. The core is also prolonged upwards and engages with a toothed sector I pivoted as shown, actuating a vertical rack J, to which the pencil carbon G is secured in any convenient manner, and by which it is advanced or withdrawn through the tubular carbon electrode F^1. When the current is switched on to the lighting coil H, the core of the latter is drawn upward, and so the pencil carbon G downward, until electrical contact is made between the carbons, and the current passes. At the same time the cut-out coil K has become energised by current passing through the same from the upper carbon-holder, and draws up its core, which is arranged by the cut-out K^1 to cut the lighting coil H out of the circuit. The weight of the core of the coil H draws the rack J and pencil carbon G upward, and the speed of withdrawal is controlled by the action of the dash-pot H^1, thus striking the arc, and lighting the lamp. In the event of the current becoming excessive the coil L comes into play, and its core caused to raise the carbon F^1 and its holder by the intervention of the lever M adjusted by counterweight M^1. The arc is so lengthened and the current reduced to its normal quantity, the opposite action taking place when the current becomes too small. Seven claims are made, embracing the apparatus as described, together with various modifications.—No. 3133. February 27th, 1890. 8*d*.

Wire Joints.—*C. H. McIntire, Newark, U.S.A.*—The object of the invention is to provide a joint of increased tensile strength for connecting telephone and telegraph wires, and for joining electric wires so that the conductivity of said wires is not obstructed. For this purpose the inventor uses a metal rod somewhat greater in width than in thickness, and of a suitable length. Longitudinally through this rod are formed two holes of a diameter equal to that of the wires to be joined, the holes being formed parallel to each other. Through these holes, at the opposite ends thereof, are passed the ends of the wires to be joined, the projecting ends being bent over. The cover, and so the wires, is then twisted, so giving the wires a better grip without interfering with the conductivity thereof. Claims: (1) A joint for uniting electric or other wires, consisting of a covering, having longitudinal perforations therein, into which the said wires are inserted oppositely, and said covering and the inserted wires twisted, as and for the purposes set forth; (2) a joint for uniting electric and other wires, consisting of a covering composed of two tubes soldered together, into which the said wires are inserted oppositely, and the covering and the inserted wires twisted spirally; (3) a covering for telegraph and other wires, having therein a series of separate bent or twisted passages, formed longitudinally to receive the ends of the wires for the purpose set forth.—No. 18117. November 11th, 1890. 6*d*.

Electrical Distributors.—*Siemens Brothers & Co., Limited, London.* (*A. M. Taylor, Baroda, India.*)—The invention relates to an automatic apparatus for compensating variations of current in conductors, a number of which are supplied from the same source, but proceed to different places. The apparatus for this purpose consists of a ring of soft iron, preferably made up of wire or laminæ, having wound on it several convolutions of each of the conductors to be compensated, the convolutions belonging to the several conductors occupying different parts of the circumference of the ring. Those of the conductors which have to convey electricity farthest have the fewest convolutions, and the others have the number of their convolutions properly proportioned according to their conditions, those which have the least resistance in their course having the greatest number of convolutions. As the currents pass through these coils, the ring is converted into a closed maguet, offering a back electromotive force to the current in each conductor, so that as the current in any one of these increases or diminishes, the currents in the whole will be proportionally increased or diminished. Claims: For automatically compensating variations of current in a number of electric conductors fed from the same source, a soft iron ring having wound on it separate coils forming parts of the several conductors, each having the numbers of its convolutions suitably proportioned as described.—No. 3841. March 11th, 1890. 6*d*.

Electric Meters.—*S. C. C. Currie, Philadelphia, U.S.A.*—The meters constructed according to this invention are for the purpose of measuring the strength of either direct or alternating currents, and are constructed as follows:—In a suitable casing are fixed two solenoids placed at a suitable distance apart and connected together and with the circuit the current passing through which it is desired to measure in series. Pivoted in plates fixed to each side of the casing and passing between these solenoids is a horizontal spindle, carrying at one end of it a suitable index finger arranged to move over a suitably graduated dial. Fixed about the centre of this spindle is an armature in the shape of a rod or bar of a compressed mixture of iron filings, chips, or shavings, and an insulating adhesive substance, as silicate of soda, or an analogous substance. A coil spring, one end of which is fixed to the index finger spindle, and the other end to one of the pivot plates, tends always to keep the pointer at zero on the graduated scale, and the armature in a position slightly at an angle to the plane of the winding of the solenoid when no current is passing, so that when the current is permitted to pass the armature will tend to set itself in a line with the axis of the solenoids, so moving the index finger along the dial, as is well understood. The inventor also describes a modification of the above-described apparatus in which the armature swings between the cores of two electromagnets, and is held, when no current is passing, in a nearly vertical position. Six claims are made.—No. 16653. October 20th, 1890. 6*d*.

CHEMISTRY.

Treatment of Scrap Tin or Terne Plates.—*W. P. Thompson, London.* (*E. Carez, Brussels, Belgium*).—The object of the inventor is to so clean the coating of tin off the iron of scrap tin or terne plates that the iron is fit for re-use. For this purpose the inventor uses either the sulphurets of sodium residues from the soda manufacture (Leblanc process) or the polysulphides of calcium mixed with hyposulphite of calcium transformed by means of carbonate of soda into sulphuret and hyposulphite of soda or of sulphurets of sodium mixed with a little nitrate of sodium, resulting from the manufacture of nitrate of barium by means of sulphide of barium and nitrate of barium or any other sulphuret of sodium more or less pure, and the sulphides, more or less sulphureted, are transformed into polysulphide by boiling them with a slight excess of sulphur. The polysulphide of sodium thus obtained is concentrated to about 30° Bé. in a vat heated by steam, and maintained at a temperature of 50°–70° C. for 2–3 hours. Chloride of ammonium is then added to this solution. The addition of this salt is necessitated by the solubility of sulphuret of iron in the polysulphide of sodium; it counteracts this dissolution and also any attacking of the metallic iron by the alkaline sulphide. The scrap tin plate is immersed in this solution for 3–4 minutes, and is then washed in water. The tin is given up in the form of sulphide of tin obtained by decanting the solution, and can be regained by the addition of a little hydrochloric acid. Claims: The process of treating and utilising scrap tinned iron by means of solution of alkaline polysulphide and chloride of ammonium, and separating the tin as a sulpho-stannate or sulphide as described.—No. 1913. February 5th, 1890. 6*d*.

Production of Aluminium.—*G. Shenton, London.* (*M. J. Berg, Paris, France*).—The inventor effects the above object in the following manner:—A mixture of coke dust or charcoal dust, nitrate of soda or potash, and a substance containing alumina, such as cryolite, bauxite, websterite, sulphate of alumina, crude clay or brick dust, in a finely pulverised state, are placed in a plumbago crucible between two carbon electrodes. Through this mixture an electric current of a tension of 20–50 volts, and an intensity of 1,000–10,000 amperes is caused to pass. The presence of the carbon dust renders the charge conductive, the aluminiferous substances melt, and metallic aluminium is deposited at the negative pole and remains melted, its presence in the liquid condition acting as an accumulator of heat. At the same time the foreign metals and the silica resulting from the employment of clay or bricks are burned by the nitrates and disappear in the state of oxides. Three claims are made, embracing the process as described with modifications.—No. 2002. February 6th, 1890. 6*d*.

Manufacture of Steel.—*W. P. Thompson, London.* (*M. F. Coomes & A. W. Hyde, both of Louisville, Kentucky State, U.S.A.*).—The object of the inventors is to carburise malleable cast iron and steel having a low percentage of carbon, and thereby convert them into a steel having a high percentage of carbon. For this purpose the inventors use a bath composed of the following ingredients:—First, a saturated solution of chloride of sodium is made; second, to this solution is added sugar up to saturation point, and then to this double saturated solution is added chloride of ammonium until it will hold no more. For carburising, the metal is plunged into this triple saturated solution at a white heat, but for tempering only at a dull cherry-red heat. Claims: (1) In the manufacture of steel the process of carburising malleable cast iron and low carbon steel consisting in placing metal raised to a white heat in a bath composed of water, sugar, chloride of sodium, and chloride of ammonium, as described; (2) as a tempering and carburising bath, the triple saturated solution of water, sugar, or other similar saccharine substance, chloride of sodium, and chloride of ammonium, substantially as described.—No. 18171. November 11th, 1890. 4*d*.

Reduction of Metallic Ores.—*G. Simonin, Libourne, France.*—The invention relates to a method of the reduction of ores by roasting more especially applicable to the treatment of the ores of antimony and zinc. For the purpose of reducing the sulphides, carbonates, and other metallic compounds of these ores to oxides the inventor employs a revolving reverberatory furnace. The ores are treated in such revolving furnaces until roasted or oxidised, and in some cases the oxides may be carried over and condensed or deposited in suitable chambers. The ores may, if desired, be treated with reducing agents whilst in the revolving furnace. Claims: (1) The treatment of metallic ores in a revolving reverberatory furnace as described; (2) the process of the treatment of the ores of zinc and antimony with the aid of a revolving reverberatory furnace as described; (3) the reduction of the ores of zinc and antimony in a revolving reverberatory gas furnace and the recovery of the volatilised oxides, substantially as described.—No. 3275. March 1st, 1890. 4*d*.

MISCELLANEOUS.

Manufacture of Cast Iron.—*J. B. Renshaw, Hartford, Connecticut, U.S.A.*—The inventor treats grey iron, for the purpose of eliminating surplus graphitic carbon and a substance called "kish," in the following manner:—Iron oxide in a pulverised form, and sawdust, shavings, straw, or other vegetable fibre, are mixed together, the latter substance having been previously saturated with water in the proportion of about 3lb. water to 1lb. fibre. The whole is then dried, and preferably packed in paper bags until used. When it is desired to eliminate graphitic carbon from molten iron a suitable amount of the above mixture is placed upon the iron before melted, or in the iron when melted, or in a ladle into which the melted iron is to be poured, the proportion of the mixture used being about 3lb. to every 100lb. of iron. The action of the mixture is as follows:—As the fibre burns, the oxide is released in separate particles by the action of the heat, and the oxygen in the iron oxide mixes with a corresponding quantity of the graphitic carbon in the iron, so forming carbonic acid gas, which escapes into the air. Claims: The process of eliminating graphitic carbon or "kish" from melted iron, by means of iron oxide, which consists in first mixing vegetable fibre, or its equivalent, with pulverised iron oxide, and then adding the compound to the iron to be melted, or being melted, or previously melted, as described.—No. 16724. October 21st, 1890. 4*d*.

Substitute for Fire-clay.—*J. Lever, J. Holland, & W. H. Todd, all of Manchester.*—The material is for use in steam boiler and other furnaces for burning smoke as a substitute for fire-clay and other refractory materials hitherto used. For this purpose the inventors use alumina or hydrate of alumina in as pure a state as can be economically obtained. This material is pressed first into moulds of a suitable shape, and then heated to incandescence for two or three hours, whereby the alumina sets or becomes more or less hard. The object of using moulds is to keep the alumina in the required shape until the action of the heat of the furnace fire causes it to harden. Claims: The use of alumina or hydrate of alumina as the material for the manufacture of appliances for burning smoke in steam boiler furnaces.—No. 3676. March 7th, 1890. 4*d*.

Manufacture of Coated Aluminum Plates.—*W. P. Thompson, London.* (*C. H. Land, Detroit, Michigan State, U.S.A.*).—This invention has for its object the manufacture of a compound aluminum plate which can be united, under the application of heat, to other metal plates. This the inventor does by coating the aluminum with tin by immersing the former in the latter in a molten state and rubbing the surface of the former whilst so held. The aluminum thus receives a thin coating of tin upon its surface, to which any other metals, such as copper, brass, galvanised iron, &c., formed into plates, and having a coat of tin adhering to their surface, can be joined by pressing the tinned surface of the aluminum plates and that of the other metal plate together under the application of heat. Claims: (1) A compound metallic plate or other metallic body consisting of aluminum provided with a tinned surface; (2) the process, as set forth, of manufacturing a compound aluminum plate or other body provided with a tinned surface consisting in burnishing tin upon a surface of the aluminum at a desired temperature; (3) the process of attaching aluminum facings to various surfaces consisting of tinning the face of the aluminum in the manner described, and attaching the same to the said surface as set forth.—No. 18915. November 21st, 1890. 6*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE "INVINCIBLE" THREE-CYLINDER SAND PAPERING MACHINE.

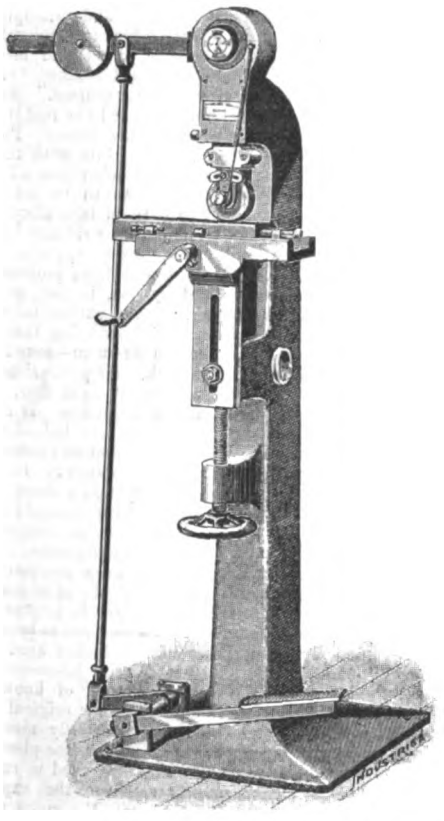
For some time Messrs. Thomas Robinson & Son, Limited, Rochdale, have been giving their attention to machinery for sand-papering and polishing woodwork. The want of really efficient machinery of this kind has long been felt. The machine we now illustrate is the latest improvement in machinery of this type. It embodies several new features which have been suggested by practical working, and gives results as near perfection as can be generally wished. The machine has three sand papering cylinders. The first is covered with a coarse grade of paper, and has a cutting action on the wood similar to that of revolving cutters. When operating on framed work for doors or parquetry, it will cut away all the uneven surfaces without breaking away the edges or plucking the cross-grained parts, and leaves an even surface for polishing. The second cylinder is covered with a somewhat finer paper for sand-papering. The third cylinder is for finishing the work. It has a very soft fine cushion for the paper, which just touches the work, and imparts to it a very high polish.

Each cylinder is independently adjustable—either when running or standing—to any desired cut, by simply turning the hand-wheels shown at the front of the machine. In fastening the paper to the cylinders screws and bolts are entirely dispensed with. A simple and positive device is used, which holds the paper with great firmness, and which also takes up the stretch which occurs in the paper. With this arrangement the paper can be put on in one-third the time formerly required, and it is said to effect a saving of 25 per cent. in paper. Each drum is made to oscillate by means of an ingenious crank motion, so constructed that it has no lost motion or wear, and consequently causes no jar or tremor to the machine.

Messrs. Thomas Robinson & Son, Limited, are now constructing a special machine of this type for door finishing. This machine is 5ft. wide, and will allow the largest doors to be passed through the machine diagonally, thus enabling the cross rails and all parts of the framing to be polished with the most perfect finish.

AN IMPROVED METAL MARKING MACHINE.

The accompanying illustration, for which we are indebted to our American contemporary the *Iron Age*, represents the Dwight marking machine. This machine is adapted, by means of steel dies, to impress on flat or



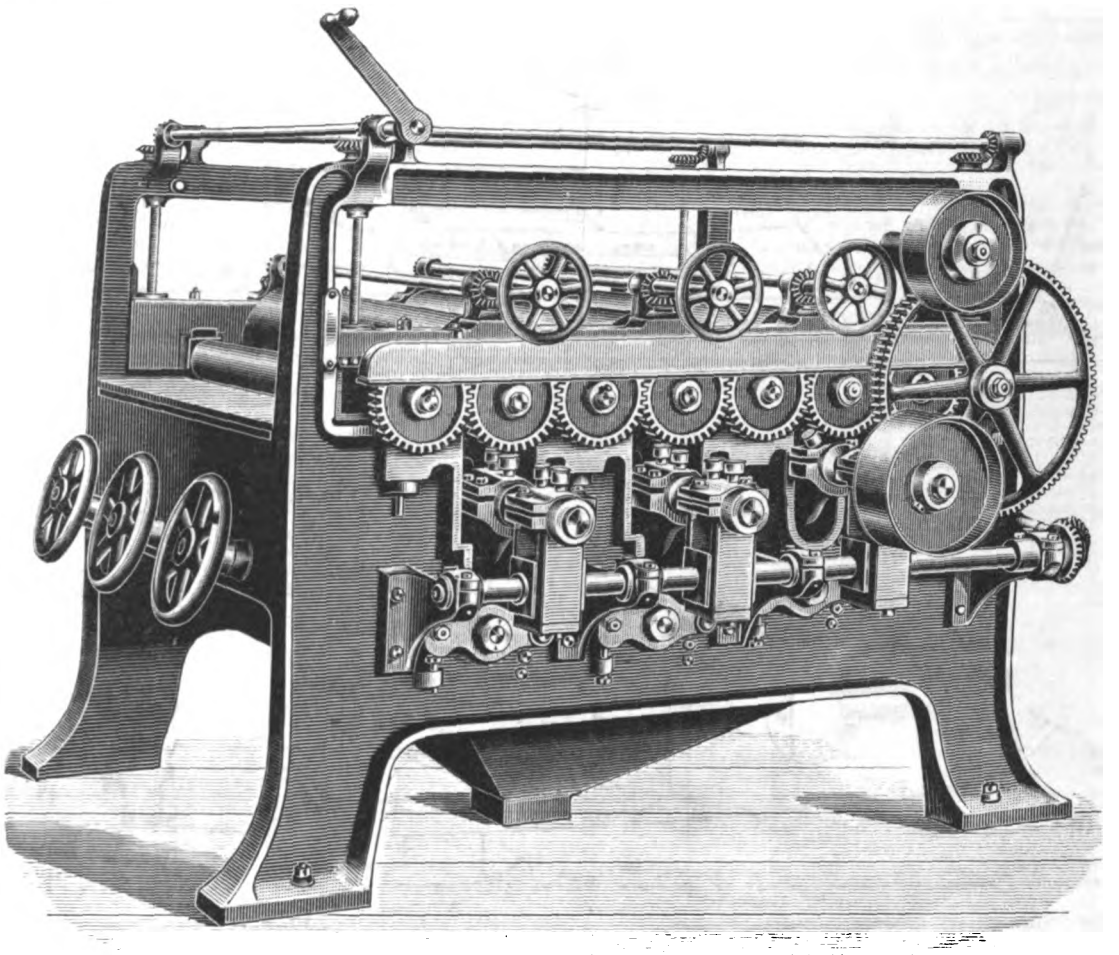
round finished metal surfaces letters, numbers, trade-marks, &c. The die holder is held in the lower end of a square slide, the upper end of which is connected to an eccentric or cam shaft. To the cam shaft the weighted arm is keyed, which, as shown, is further connected with the foot lever. On the front end of the die shaft a groove is turned, in which one end of a cord connected with a light spring is wound up as the die is doing its work. When contact of die and work is broken, the shaft and die are revolved by the tension of the spring until a fixed pin in the shaft comes in contact with a pin in an adjustable washer. This washer, which fits on the shaft and is held in position by a circular slot and set screw, is shown in the illustration. The adjustment secured by this washer and pin enables the operator, when setting up the machine, to bring the character on the die which should strike the work—first to a position at right angles with the face of the work, and afterwards ensures its returning there after each impression by means of the spring. The work to be marked is fixed on the sliding table, which is moved by a rack, pinion, and crank under the die. The travel of the table is regulated by a projecting dog and the two adjusting screws shown, which should be so set as to stop the movement of the table as soon as the die has revolved far enough to bring the last character to a position of full impression.

The die and slide, when standing at their normal height, are at their lowest position, and the office of the foot lever is to raise the die so that work can be inserted. The position of the weight on the arm determines the amount of impression when the work varies in thickness. When work is got out to uniform thickness, a set screw that will regulate the drop of the weighted arm is provided, and the impression can be sunk to an exact depth each time. When the work varies in thickness, the impression will depend on the adjustment of the weight. When marking round work, such as reamers, taps, &c., a flat die is used, the work being placed against a little angle piece to ensure its resting at right angles with the die; the die is brought in contact with the work and the table given a movement that causes the work to revolve. This method of using the dies requires but comparatively little pressure, and hollow tubes, valve bodies, &c., can be marked without danger of springing. The extreme travel of the table is 6in., and the distance from the centre of the die to the frame is 3½in.

The machine is made by the Dwight Slate Machine Company, of Hartford, Conn., U.S.A.

THE "INVINCIBLE" THREE-CYLINDER SAND PAPERING MACHINE.

Constructed by Messrs. Thomas Robinson & Son, Limited, Rochdale.



General View.

THE DUTCH GOVERNMENT WARSHIP "PRINSES WILHELMINA."

The illustrations, Figs. 1, 2, and 3, on page 194, represent, in elevation, plan, and cross-section, the projected design for a new turret ship of the above name for the Dutch Navy. This vessel, now in construction, is a steel unarmoured twin screw, with a protective deck and a ram bow. The length over all is 330ft.; moulded breadth, 49ft.; depth from underside of keel to top of upper-deck beam, 29ft.; displacement to load water line, with 450 tons of coal on board, 4,600 tons; greatest draught at that displacement, 19ft. 6in. The protective deck extends over the whole length of the vessel, from the round stern to the stem, and is 16in. above water in the centre and 3ft. 6in. below water at the sides, and gives protection to the vital parts of the ship. The mid part of the ship is double-bottomed. Between the protective and 'tween-deck a cellular arrangement is adopted. The cellular belt, with a breadth of 2ft. 6in. in the midship section, is filled with cellulose. There are ten watertight bulkheads below the protective deck, and seven above it, all cross bulkheads. The engine-room is divided in two parts by a watertight bulkhead running fore and aft. The armament consists of one 28-centimetre breech-loading No. 2 gun, of 30 kilos., placed forward, with a train from ahead to 150° at both sides, fitted in a revolving turret. A 21-centimetre breech-loading pivoted gun of 35 kilos. is placed aft, with a train of 148° from astern to both sides. Two 17-centimetre breech-loading guns, with centre pivot, and 35 kilos. long, are placed at both sides of the ship, with a complete broadside train, firing also from right forward to right abaft. Six revolving cannons and eight rapid-fire guns of 3·7 centimetres are disposed on the hurricane deck and in the military tops. Two torpedo-launching tubes are on the 'tween-deck in the sides of the ship, each having a train from broadside to 17° forward and 70° aft. Another torpedo tube is fitted in the stern. All torpedoes are launched above water. The turret is protected by com-

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THE DUTCH GOVERNMENT WARSHIP "PRINSES WILHELMINA."

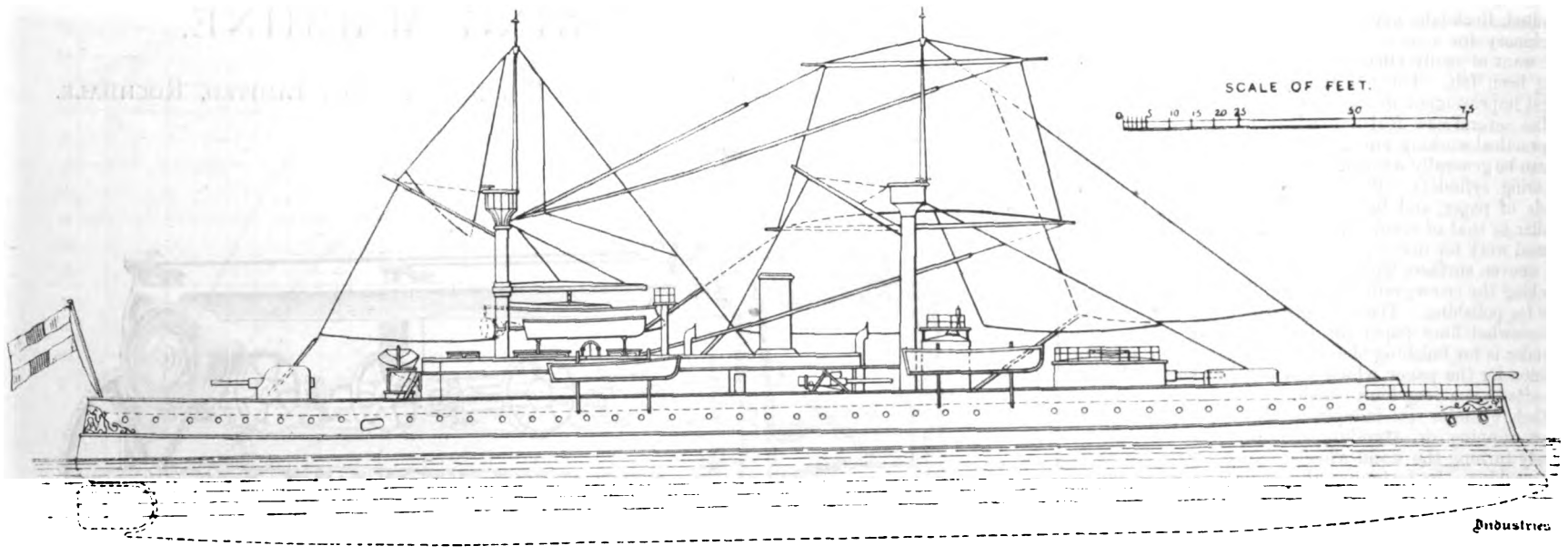


FIG. 1.—ELEVATION.

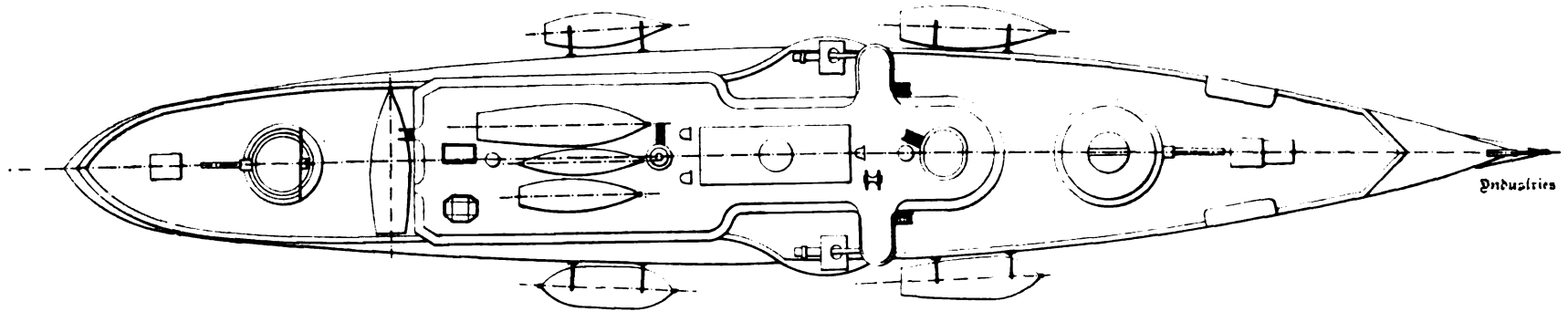


FIG. 2.—PLAN.

pound armour-plates of 28 centimetres with a 22-centimetre teak backing, and covered with a steel cover of 38 millimetres. It can be turned round in 45 seconds by hand and steam motion. A conning tower, armoured with 28-centimetre compound plates, is placed forward, and fitted with all the apparatus necessary for steering, telegraphing, turret, and gun-motion. As the conning tower is located on the central superstructure of the ship, an armoured tube, 28 centimetres thick, runs from this tower to the protective deck, to protect the steering gear and speaking tubes. The ship is lighted throughout by electricity, and is also provided with two electric search lights.

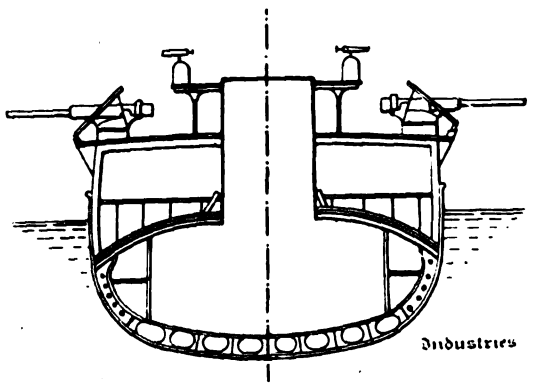


FIG. 3.—CROSS SECTION.

The hull of the ship is made of steel, the stem and stern posts of manganese bronze. The brackets for the propeller shafts and the rudder frame are also of manganese bronze. The armour, or protective deck, slopes fore and aft and to the sides. The top is flat and 2in. thick, the slope being 3in. The whole deck is constructed of steel plates 1in. thick, so arranged that one layer forms edge strips and butt straps for the other. The casings above the engine and boiler room are protected with compound armour plates. All watertight doors in the bulkheads below the armoured deck are to be handled from the upper deck and from the 'tween-deck. As will be seen, the vessel is rigged with two masts with military tops, provided inside with clamps and apparatus for hoisting ammunition. Each mast has a wooden topmast. The foremast has two yards with a topsail. The vessel is provided with two separate pairs of vertical triple-expansion engines, one of each pair of which is capable of driving one of the propellers, and is constructed to work with or without condensers. It is estimated that one pair of these engines will have a capacity of 5,000 horse-power, with a pressure of air in the boiler rooms equal to a 5-centimetre column of water. The diameters of the cylinders are respectively 19in., 31in., and 51in., the stroke is 27in., and the number of revolutions about 170. The four condensers are cylindrical, with a total cooling surface of about 8,000 square feet. The shafts are of steel. The propellers are four-bladed, of delta metal, with a diameter of 11ft. and a variable pitch from 11ft. to 14ft. There are four cylindrical return tubular boilers of steel, made to withstand a pressure of 170lb. per square inch. The furnaces are to be made of Purves' corrugated flues. The estimated speed is 16½ miles per hour, with 4,400 tons displacement. The number of the crew is 325. The stores provide for a ten weeks' cruise, whilst 32,000 litres of fresh water are to be carried. We are indebted for the illustrations and description to *Marineblad*.

THE UNIVERSITY TRAINING OF ENGINEERS.*

(*Concluded from page* 171.)

I CONCEIVE that one of our first aims in furthering the advancement of the School of Engineering in Cambridge should be to secure the establishment of an Engineering Laboratory. I have the satisfaction of knowing that this was Professor Stuart's wish, as it is mine. It may not be out of place, then, to give a brief account of the character and uses of an engineering laboratory. If its inception is mainly due, in one sense, to the enthusiasm of a single teacher, in another it is essentially a product of the time. It is the application to engineering of an idea that has permeated all our higher teaching of science—the idea that the student must be brought face to face with *things*. There is nowadays no need—least of all is there any need in modern Cambridge—to eulogise laboratory training, to tell how it stimulates interest, how it fosters exactness, how it creates habits of observation and of independent thought, how it makes the dry bones of a science start into life. Facts and principles learnt from the text-book or the lecture-table are colourless and dull: in the laboratory they become vivid and memorable. "We study nature in books," says a great teacher, "and when we meet her face to face she passes unrecognised." Study her in books we must, but if our knowledge is to be real it must be of the kind that a face-to-face acquaintance brings. Put a good student into a laboratory, and you inspire him with the enthusiasm of the investigator; put a good teacher into a laboratory and you ensure that he will never cease to be student. In regard to engineering the rapid growth of laboratory teaching is itself fair evidence of its value: if other evidence be wanted it will be found in the uniform chorus of approval which is heard alike from academic teachers and from professional engineers. The engineering laboratory has, in fact, gone far to bridge whatever gulf may be said to have existed between professors and practitioners. It teaches something that is learnt neither in the workshop nor in the lecture-room—something that connects the knowledge gained in both. Its professional utility is great; but more than that, and apart from that, it claims your attention as a genuine means of education. It has found a place in the great continental schools, where, indeed, it existed, though only as a means of research, even before Professor Kennedy gave it form as an educational appliance. In America, where the initiative was independently taken about the same time by Professor Thurston, there are now several fine laboratories, among which that of the Massachusetts Institute is distinguished by its great extent and lavish equipment.

The objects of an engineering laboratory are threefold. It gives the student practice in those kinds of experimental work which he may afterwards have to perform in professional life. Further, it teaches him how investigations are to be conducted, and gives him some experience in this higher kind of work. And lastly it endeavours, as all university laboratories endeavour, to contribute to the common stock of knowledge by furnishing opportunities and appliances for original research. The work which is done in it is essentially measurement. Measurement of the strength, the elasticity, the plasticity, and other properties of the materials that are used in engineering construction—such measurements as form the experimental foundation of the theory of structures. Measurements of the power of prime movers: measurements of "efficiency"—of the relation, for example, between the heat that is supplied to a steam engine and the work that is done; measurements of friction, and the losses of energy that proceed from it, of the accuracy of apparatus, of hydraulic constants, and a host of other things which it would only weary you to have me enumerate. The work trenches, to some extent, on the work of a physical laboratory; but even where it is most like that in general character the work of the engineering laboratory is done

* Abstract of an introductory lecture delivered at Cambridge on the 20th ult. by Professor J. A. Ewing, F.R.S.

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with a somewhat different intention and on a larger scale. To carry it out with anything like fulness requires the provision of costly plant; some of it may, however, be done with rough and inexpensive appliances. We may, at least, make a beginning with them at once, and it is my hope to do so, but in doing that I trust I shall be acquitted of any intention to rest content until a laboratory is provided that will be worthy of the University of Cambridge.

In the existing workshops we have a nucleus about which a laboratory may very naturally grow. Whether a university school of engineering ought or ought not to give its students any systematic instruction in the manual processes of the workshop is a question in regard to which experts are by no means agreed. On one hand it is urged that the college workshop is necessarily small, that practice in it cannot (and this all will admit) entirely take the place of pupilage in a manufacturing establishment; that time for it can be ill spared from the more necessary parts of the curriculum, and that the pupil will have a better opportunity of learning the same things in his subsequent experience at the works. On the other hand it may fairly be pleaded that if the subsequent apprenticeship is to be shortened—as we contend it may—the pupil will do well to learn what he can of the use of tools during his college course; that much that is useful *can* be effectively taught even in a small way; that the workshops gratify a healthy instinct and that the time spent in them is an agreeable recreation in the midst of severer studies; that some acquaintance with the ordinary mechanical operations is of service even in the earliest stages of college training; that the workshops are of benefit to students who do not mean to be engineers—a consideration of special weight in Cambridge; and, above all, that a workshop forms a most important adjunct to an engineering laboratory. In any case, it seems to me that the question of the workshops is no more than a detail, and perhaps not even a very important detail, in a much larger question. The larger question is how are we to secure anything like a fully-organised school of engineering?

The engineering school must be accepted as an integral part of the University system. The work done in my department must be closely interlinked with that done in other departments; the teaching of applied mechanics must go hand-in-hand with the teaching of mathematics, physics, chemistry; the students of engineering must receive such academic encouragement as will attract the best men. What precise form the recognition of engineering should take, in your scheme of examinations, it is not for me at present to suggest (I must first learn the alphabet of your language), but even a very slight knowledge of the matter is enough to show that the recognition now given is far from adequate. For the subject of applied mechanics I claim no more than is due to its intrinsic importance and its educational value as a field of scientific thought—apart from its professional uses; but in claiming that I claim the warmest possible welcome for my subject at the hands of the University. At Victoria University an honours degree is conferred in the department of engineering, and I venture to say, after having been examiner there for three years, that no one who will acquaint himself with the style and scope of the course there pursued can doubt that the subject is worthy of a place among university studies and of all the support that academic recognition can give. Applied mechanics does not now knock at the doors of the universities, supplicating admission. The question is not whether a school of engineering is a legitimate part of a university, but whether a university is reasonably complete without a school of engineering. And at the risk of repetition let me add that a school of engineering does not mean an isolated professorship. We must have a department working in the closest association with collegiate tuition and other spheres of University activity, amply furnished in respect of buildings and plant, secure of University favour, and forming an accepted avenue to University distinction. The student who comes here with the serious intention to study engineering must be prepared to follow, and we must be prepared to find for him, a connected course carefully planned to be at once educative and professionally useful, which will engage his full attention during the usual period of academic residence.

Engineering, with the sciences that bear upon it, forms so large a subject that if the course is to be complete it must be engrossing. The student must, in a sense specialise from the very first. His course should comprise mathematics, mechanics, chemistry, and physics—especially heat and electricity—the strength of materials, the theory of structures, the theory of the steam engine and other prime movers, the theory of mechanism, hydraulics, surveying and levelling, practical geometry, and engineering drawing. In several of these subjects the work of the lecture-room must be supplemented by work in the drawing-office, the laboratory, the workshop, and the field—work that exacts no little time and attention. To enable him to pursue such a course the student may fairly ask for the freedom that is allowed to the specialists of the triposes: and having pursued it he will not be denied some claim to a degree. Without an organised engineering school, Cambridge must lose many good men who intend to be engineers, who forego the benefits of University residence and the unrivalled advantages which this University offers to mathematical students, in order to seek elsewhere the special training their profession demands. The schools of mathematics, physics, and chemistry will profit by association with a school of engineering. And again, among the men of mathematical bent who in any case would come to Cambridge there must be a few whom an engineering school would draw into a congenial profession which they otherwise would miss.

There is still another aspect of the matter, too important to be passed without brief mention. Apart from its service to professional students, an engineering school has work to do in the training of those whose business in life will be to teach Applied Mechanics. This is a career that now gives occupation to a very great number of men in the colleges, in the technical schools, in the numerous classes that are conducted in all industrial centres under the auspices of the Department of Science and Art. The training of these teachers is a work of national importance in which the University of Cambridge may surely take a share. When a college or a school wants a professor or teacher of mathematics or physics it turns to Cambridge. The same thing holds good, to an increasing extent, of the natural sciences. It appears, however, that the University goes beyond its bounds to find even its own professor of engineering. I, for one, have no reason to regret the fact; but is it too much to hope that in time the Cambridge graduate may become as acceptable a teacher in this subject as in others?

The introductory address of a Professor of Engineering would be incomplete if it did not conclude with the cry of the horse-leech. I address the cry of "Give, Give," not only to those whose business it is to sit upon the lid of the University Chest, but to all friends of Cambridge, to all friends of engineering education. Is the school of engineering at Cambridge to be as complete, as well furnished as any existing school? Where are we to look for the £10,000, the £20,000, which has supplied the wants of Manchester, of Leeds, of Liverpool? I was cheered to read in the address of the Vice-Chancellor to the Senate his expression of belief that, should the establishment of an engineering laboratory be held to be in itself desirable, pecuniary help from non-resident as well as resident friends of the University was not likely to be refused. I appeal for that help earnestly and confidently, convinced that a laboratory is not simply desirable, but indispensable.

ROPE DRIVING.

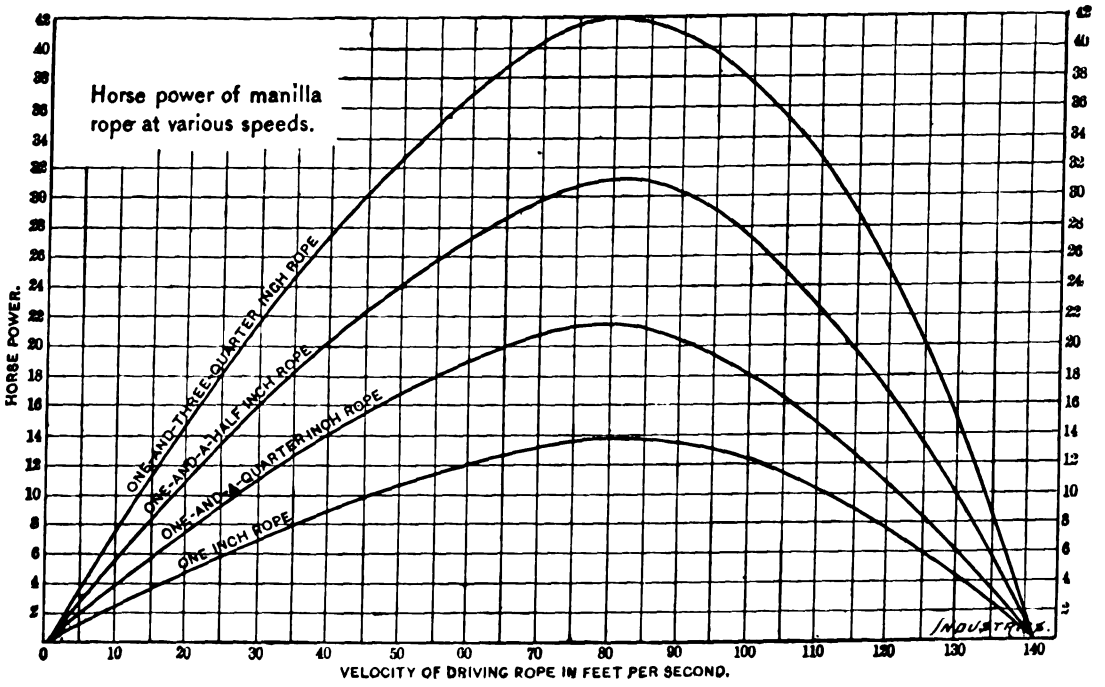


FIG. 1.

ROPE DRIVING.*

THE transmission of power by cotton or manilla ropes was a few years ago an experiment. It passed the experimental stage, and its use has spread with remarkable rapidity, both in England and the United States, and promises, at the present rate of increase, to become a formidable competitor with gearing and leather belting for use where the amount of power is large or the distance between the power and the work is comparatively great. The most prominent questions which the engineer who proposes to make an application of rope driving wishes to have answered are those relating to the horse-power, wear of rope, first cost of rope, and catenary.

These questions cannot be answered with precision in a general essay, but it is the purpose of this paper to give the general limitation of this method of transmitting energy in order that an engineer may make a close approximation, and then, in the case of a large installation, make such supplementary calculations as the importance of the case demands. It will be assumed that the conditions are favourable to this mode of driving, leaving abnormal cases for such special treatment as the engineer may at the time think best to use. The subject is so new that but few accurate data are available, arising from the long period required in each experiment, a rope lasting from three to six years. In many of the early applications so great a strain was put upon the rope that the wear was rapid, and success only came when the work required of the rope was greatly reduced. The strain upon the rope has been decreased until it is approximately known what it should be to secure reasonable durability. Installations which have been successful, as well as those in which the wear of the rope was destructive, indicate that 200lb. on a rope 1in. in diameter is a safe and economical working load. When the load is materially increased, the wear is rapid. For the purpose of this paper, this load of 200lb. for the normal fibre stress of a manilla rope 1in. in diameter will be assumed to be the one which it is advisable to use, and the horse-power and relative wear at different speeds will be estimated. Farther experience may modify this assumption, but at the present time it is the best obtainable, and the changes which may be made hereafter will affect but slightly the estimates here given.

To ascertain the average breaking strength of commercial rope, I lately purchased four pieces made by different cordage works, and had them tested on the Fairbanks testing machine in New York. They varied slightly in diameter, but when reduced to the equivalent of a rope 1in. in diameter, had an average breaking strength of 7,140lb. Expressed algebraically, the breaking strength, weight per foot, and the working strains are—

$$W = 720\,C^2\,(1);\quad P = \cdot 32\,C^2\,(2);\quad w = 20\,C^2\,(1)$$

in these and the following equations:—

C = Circumference of rope in inches.
D = Sag of the rope in inches.
F = Centrifugal force in pounds.
g = Gravity.
H = Horse-power.
L = Distance between pulleys in feet.
P = Pounds per foot of rope.
R = Force in pounds doing useful work.
S = Load in pounds on rope at pulley.
T = Tension in pounds of driving side of the rope.
t = Tension in pounds on slack side of the rope.
v = Velocity of the rope in feet per second.
w = Working load in pounds.
W = Ultimate breaking load in pounds.

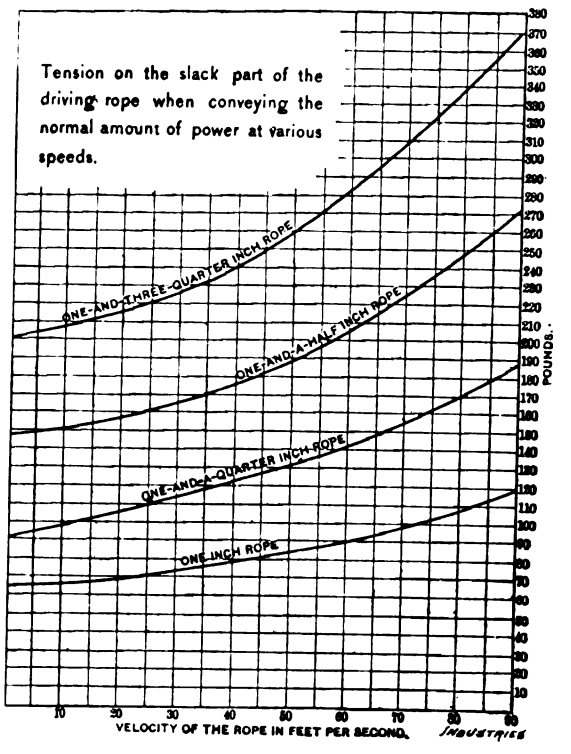


FIG. 2.

This makes the normal working load equal to one-thirty-sixth of the breaking strength and about one-twenty-fifth of the strength at the splice. The actual loads are ordinarily much greater, owing to the vibrations in running, as well as from imperfectly adjusted tension mechanism.

We will assume that the load on the driving side of a rope is equal to 200lb. on a rope 1in. in diameter, and that the rope is in motion at various velocities of from 10ft. to 140ft. per second. Under this assumption, we will have in all cases a fibre load of 200lb. on the driving side of a 1in. rope, and an equivalent load for other sizes. The centrifugal force of the rope in running over the pulley will reduce the amount of force available

* Abstract of a paper read at the Richmond meeting of the American Society of Mechanical Engineers, by Mr. Chas. W. Hunt, of New York. We are indebted for the illustrations to our American contemporary, the *Engineering and Mining Journal*.

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THE OLSEN TESTING MACHINE.

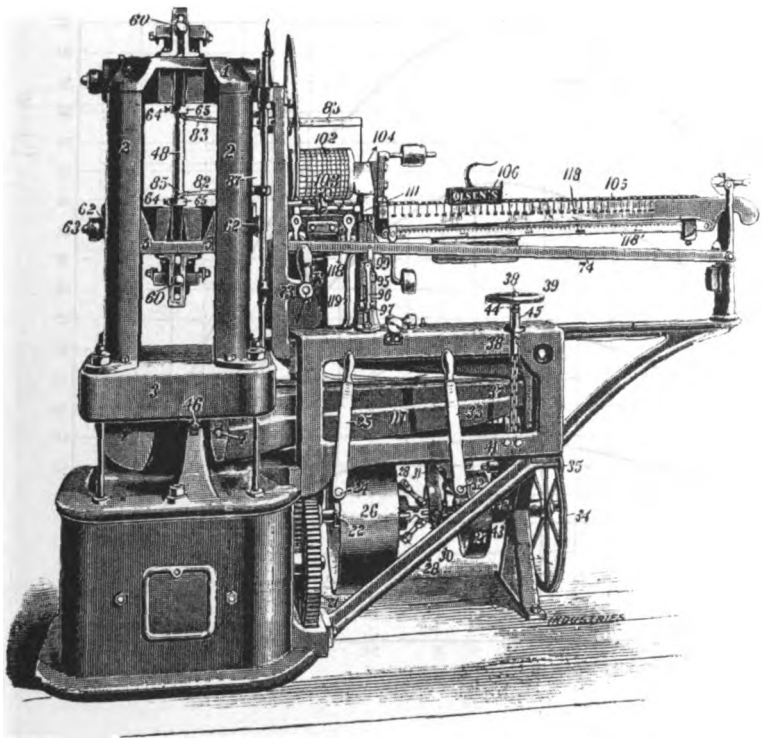


FIG. 1.

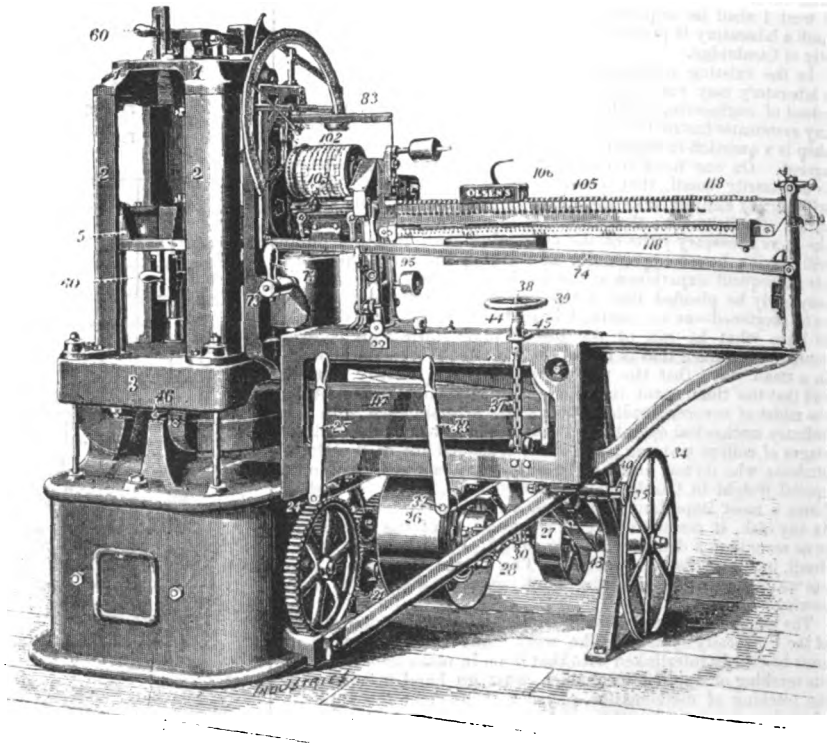


FIG. 2.

for the transmission of power. The centrifugal force of the rope is computed by the formula—

$$F = \frac{P\,r^2}{g}. \qquad (2)$$

At a speed of about 80ft. per second, the centrifugal force increases faster than the power from increased velocity of the rope, and about 140ft. per second equals the assumed allowable tension of the rope. Computing this force at various speeds and then subtracting it from the assumed maximum tension, we have the force available for the transmission of power. The whole of this force cannot be used, because a certain amount of tension on the slack side of the rope is needed to give adhesion to the pulley. What tension should be given to the rope for this purpose is uncertain, as there are no experiments which give accurate data, and at the present time a decision must be made partly from analogy and partly from experience.

If the rope be considered as a belt on a plain pulley, the friction would be substantially the same as a leather belt at the same tension; but as ropes are frequently lubricated to reduce the wear, the coefficient of friction must be materially reduced. There have been no experiments to decide with accuracy what this reduction is, but it is known from considerable experience that when the rope runs in a groove whose sides are inclined toward each other at an angle of 45° there is sufficient adhesion when the ratio of the tension is

$$\frac{T}{t} = 2. \qquad (3)$$

For the present purpose T can be divided into three parts:—Tension doing useful work, tension from centrifugal force, tension to balance the strain for adhesion. The tension t can be divided into two parts:—Tension for adhesion, tension from centrifugal force. It is evident, however, that the tension required to do a given work should not be materially exceeded during the life of the rope.

There are two methods of putting ropes on the pulleys; one in which the ropes are single and spliced on, being made very taut at first, and less so as the rope lengthens, stretching until it slips, when it is respliced. The other method is to wind a single rope over the pulley as many turns as needed to obtain the necessary horse-power and put a tension pulley to give the necessary adhesion and also to take up the wear. The tension t required to transmit the normal horse-power for the ordinary speeds and sizes of rope is given in Fig. 2, computed by formula (6). The total tension T on the driving side of the rope is assumed to be the same at all speeds. The centrifugal force, as well as an amount equal to the tension for adhesion on the slack side of the rope, must be taken from the total tension T to ascertain the amount of force available for the transmission of power.

I have assumed that the tension on the slack side necessary for giving adhesion is equal to one-half the force doing useful work on the driving side of the rope; hence the force for useful work is—

$$R = \frac{2(T - F)}{3}, \qquad (4)$$

and the tension on the slack side to give the required adhesion is—

$$\frac{(T - F)}{3}. \qquad (5)$$

Hence,

$$t = \frac{(T - F)}{3} + F. \qquad (6)$$

The sum of the tensions T and t is not the same at different speeds, as the equation (6) indicates.

As F varies as the square of the velocity, there is, with an increasing speed of the rope, a decreasing useful force, and an increasing total tension t on the slack side. With these assumptions of allowable stresses, the horse-power will be—

$$H = \frac{2\,v\,(T - F)}{3 \times 550}. \qquad (7)$$

Transmission ropes are usually from 1in. to 1¼in. in diameter. A computation of the horse-power for four sizes at various speeds and under ordinary conditions, based on a maximum load equivalent to 200lb. for a rope 1in. in diameter, is given in Fig. 1. The horse-power of other sizes is readily obtained from these. The maximum power is transmitted, under the assumed conditions, at a speed of about 80ft. per second.

The first cost of the rope will be smallest when the power transmitted by it is greatest, and, under the assumed conditions, will be a minimum for a given power when the velocity of the rope is about 80ft. per second. The ratio of the first cost of the rope running at any other speed will be—

$$\text{Ratio of first cost} = \frac{H \text{ at 80ft. per second}}{H \text{ at required speed}}. \qquad (8)$$

The wear of the rope is both internal and external; the internal is caused by the movement of the fibres on each other, under pressure in bending over the sheaves, and the external is caused by the slipping and the wedging in the grooves of the pulley. Both of these causes of wear are, within the limits of ordinary practice, assumed to be directly proportional to the speed. Hence, if we assume the coefficient of the wear to be k, the wear will be kv, in which the wear increases directly as the velocity, but the horse-power that can be transmitted, as equation (7) shows, will not vary at the same rate.

If we divide the value for wear at a given speed by the horse-power that the same rope will transmit at other speeds, we get the relative wear of the rope in transmitting 1 horse-power. The higher the speed, up to about 80ft. per second, the more power will be transmitted, but it is accompanied by a more than equivalent wear.

The rope is supposed to have the strain T constant at all speeds on the driving side, and in direct proportion to the area of the cross-section; hence the catenary of the driving side is not affected by the speed or by the diameter of the rope.

The deflection of the rope between the pulleys on the slack side varies with each change of the load or change of the speed, as the tension equation (8) indicates. The deflection or sag of the rope may be computed for the assumed value of T and t by the parabolic formula—

$$S = \frac{P\,L^2}{8\,D} + P\,D, \qquad (9)$$

S being the assumed strain T on the driving side, and t, calculated by equation (6), on the slack side.

It is to be regretted that accurate data are not available to determine the constants needed in the equations for wear and for friction on the pulley. No estimate has been made, as this paper is intended to state the general limitations of this mode of transmitting energy rather than to give details of its application.

THE OLSEN TESTING MACHINE.

(From our New York Correspondent.)

THE Olsen testing machine is one of the well-known type in which the specimen to be tested is placed between drawheads, one of which is moved by screws actuated by gearing from a shaft driven from any source of power, while the other rests on the levers of a weigh-scale. In the illustrations the drawheads are represented at 1 and 5. The drawhead 1 is carried on columns 2, which are secured to the platform 3. This platform 3 is carried on pivots shown at 4 on the double lever 117, the fulcrum of which is shown at 46. At the right hand end of lever 117, as shown in Fig. 1, this lever is suspended from a second lever, whose fulcrum is seen just to the right of 38 in the same figure, the other end of the lever being carried at the bottom of the link 119, the top end of which is attached to the short arm of the scale beam 118. The other drawhead 5 has attached to it in each corner inside the columns 2 large square-threaded screws, which are not allowed to turn, but inside the base are fitted with nuts driven from the power shaft through gearing shown at the bottom of the machine. 26 and 27 are the driving pulleys, one fitted with a straight and the other with a crossed belt. Both are loose on the shaft, but either may be connected by shifting the handle 33, which, through the fork 31, throws in either of the friction clutches 28 or 29. A change of speed when running in either direction can be obtained by moving the lever 25, which, operating a sleeve 19, throws either of two gear wheels into action, thus changing the speed. The nuts inside the base of the machine are driven from the shaft of the spur wheel 21. There is another very slow speed on the machine by which the time of testing an ordinary wrought-iron or steel specimen can be extended to probably an hour. On the end of the driving shaft, on which 26 and 27 turn freely, is a narrow grooved wheel shown at 34. To the wheel 27 is attached a pulley 43, turning with it, and, of course, also loose on the shaft. A belt connects this pulley with a pulley 41 on one end of a tilting shaft 40. The other end of this tilting shaft carries a small wheel, which, when in contact, drives 34, and thus the gears to 21. By means of the hand-wheel shown at 39 and the chain 37, the tilting shaft is moved so that the wheels 35 and 34 are in contact. Slacking off the wheel 38 allows the tension on the belt 42 to draw the wheels apart, and thus stop the machine.

The automatic method of moving the weight is ingenious. On the scale beam, and extending its whole length, is a square-threaded screw, shown at 105. This screw carries a friction wheel, into which a second can be made to gear. This second friction wheel is driven from a cord which leaves the scale beam vertically exactly in the line of its knife edges, and the cord receives its motion from the driving pulley 27 through the driving cord, shown in Fig. 3, between the number 41 and the belt on pulley 43. An electromagnet serves to throw the friction pulleys on the scale beam in and out of gear. The circuit through the electromagnet is closed as the beam rises by the touching of the contact points on the end of the scale beam and on the beam guard. Should the beam rise excessively the circuit is closed through the electric bell, shown in Fig. 3, warning the attendant. Any desired speed can be given to the screw 105, as the cord is driven through a set of three friction wheels, the position of the centre of the middle wheel being adjustable at will with regard to the centres of the others, thus regulating the speed transmitted.

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THE OLSEN TESTING MACHINE.

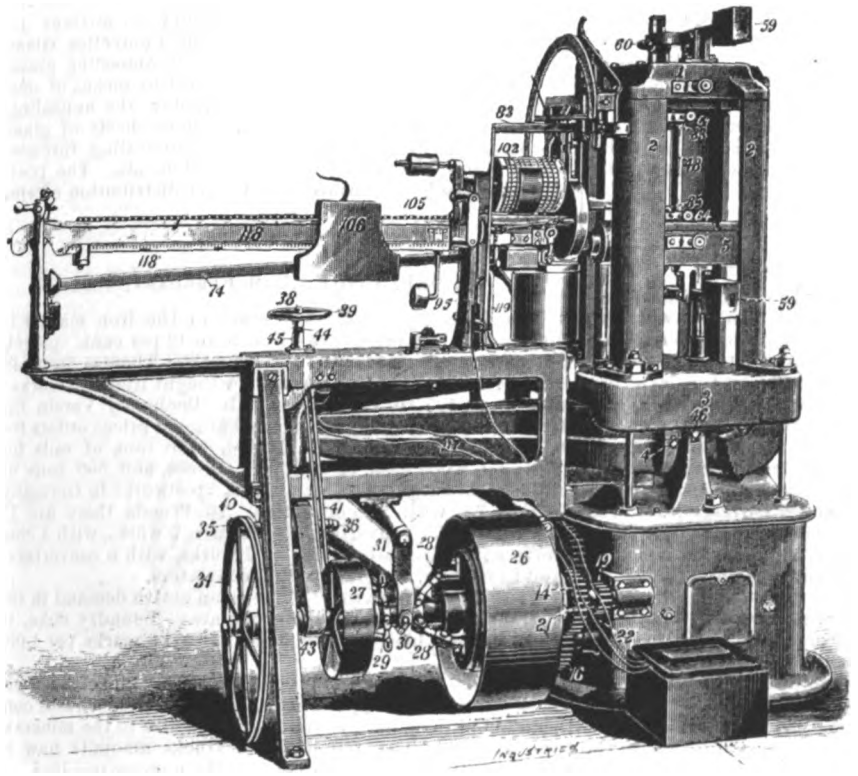
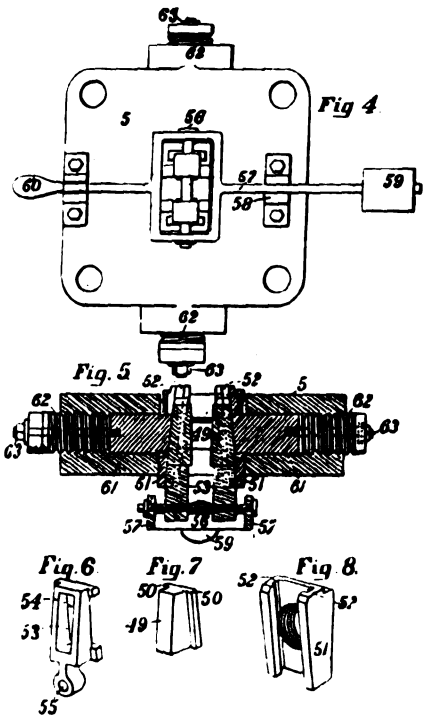
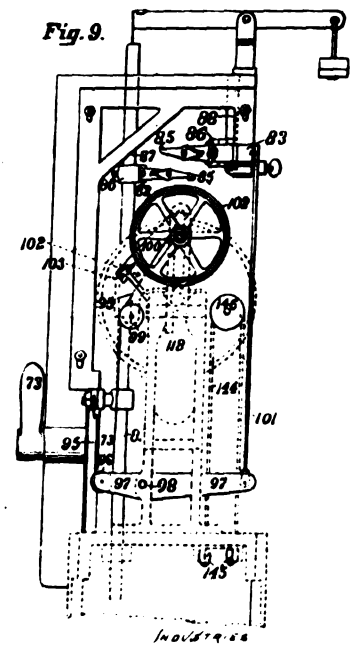


FIG. 3.

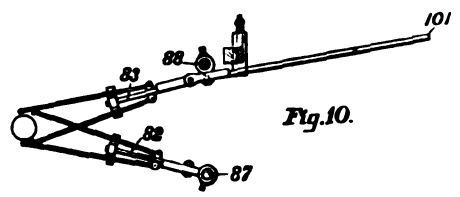


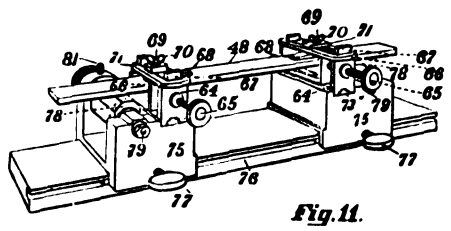


The method of rapidly taking hold of the specimens is shown in the large figures and in detail in Figs. 4, 5, 6, 7, and 8. In the illustrations a piece is shown in the machine to be tested in tension. After the piece is prepared, as described later, it is put between the jaws, the collar 65 resting on the lower jaws. The handles marked 60 are then drawn towards each other with considerable force, and the piece is clamped. The jaws are shown in Fig. 7, 49 being the gripping face. These jaws are carried in the slotted slides shown in Fig. 6, the gripping face extending through the opening shown, the projections on the back of the slide and the projecting flanges 50 of the jaws fitting into the grooves 52 of the block slide 51 of Fig. 8. These block slides are carried on the ends of the screws 62 of Fig. 5, by the aid of which the distance between the faces of the grips, or the size of the specimen taken, can be adjusted for. The slides carrying the jaws have an eye 55 (Fig. 6), by which they are secured by the bolt 56 to the handles 60 already spoken of, which are used to bring the grips against the specimen.

In addition to the automatic adjustment of the weight on the scale beam, the machine also automatically draws the diagram showing the change in length of the specimen and the load. The diagram is drawn on paper placed on the drum 102; the pencil 103, which is actuated from the screw 105, or rather from the same mechanism that operates 105, moves to the left, as shown in Figs. 1 and 2, proportionally to the load. The extension of the specimen causes the cylinder 102 carrying the paper to turn.

The method of preparing the specimen for use in the machine is shown in Fig. 11. A base block 76 carries two pieces 75, which can be set at any desired distance apart. Each of these pieces carries a spindle 79, having flat faces on it, as shown at 78, so laid out that if the specimen is laid on the face marked with the thickness of that specimen the centre line of the specimen is exactly parallel to the base. On a second projection 73 is then laid the clamps, the centres of the screws 65 of which are exactly on the centre lines of the specimen, and by tightening these screws the clamps are firmly attached to the specimen, and always at exactly the correct distance apart, so that with this apparatus specimens of various thicknesses and breadths can be almost instantly prepared for the machine. The specimen is then put in the machine, and the hand levers 60 are used to tighten the jaws and hold it in place. The fingers 82 and 83 are then shifted vertically on the rods 87 and 88 carrying them, until one bears on the top of the bottom collar or clamp, and the other bears against the bottom of the top clamp, as shown in Fig. 1. A view of these fingers is given in Fig. 10, where it will be seen that each finger has a bearing on both sides of the specimen, and is so arranged that only the mean of the movement on the two sides of the specimen is transmitted. As shown in Fig. 9, the bottom finger 85 is attached by the clamp 86 to a vertical sliding bar 87. This bar carries a projection, to which is attached a cord 95, which first passes over a pulley 96, and thence upwards to a pulley 99 in the line of knife edges of the scale beam, and to a pulley on the recording drum, shown at 100. A light spring holds the drum against the cord. The other finger 85 is connected to the upright rod 88, and also to a link 101, which takes hold of a lever 97, which is pivoted at 98, and carries on the other end the pulley 96, over which the cord from the other finger 85 leads. If we suppose now that the finger attached to 87 moves downward, the cord 95 would pass around the sheave 96, and the wheel 100 would wind up the same amount of line. If, at the same time the end of the upper finger moved downward the same distance, the lever 83–100, turning about the centre A, shown in Fig. 10, would cause 101 of Fig. 9 to move upwards the same distance, the right hand end of the lever 97 to move upward the same distance, and the left hand end or the wheel 96 to move downward one-half the distance, and the same amount of cord taken off the drum as the movement of the other drum allowed to go on, the result being that no extension would be recorded as should be the case.





By means of a multiplying device the elongation is indicated on a large scale by a pointer moving over a sector of large radius, as shown at the top of Fig. 2. As the divisions on the scale beam 105 are small for large increases of load, the left hand end of the actuating screw, as shown in Fig. 2, carries a dial on which the smaller divisions are placed, only one of which can be seen at a time through a covering plate, shown down and to the left of 103. The machine is so arranged that transverse, compression, or torsional tests can be made and diagrams drawn by the machine.

TABLE OF REFERENCE NUMBERS.

1 Entablature
2 Columns
3 Platform supporting columns
4 Pivots
5 Lower moving head
14 Spur wheel
16 Idle wheel
19 Pinion
21 Spur wheel on sleeve 22
22 Sleeve on driving shaft
24 Rock shaft operating lever shifting 22
25 Hand lever operating 24
26 27 Pulleys rotating driving shaft
28 29 Friction clutches engaging 26 with driving shaft
30 Sleeve operating clutches
31 Forked lever controlling sleeve 30
32 Shaft
38 Hand lever operating 30
34 Grooved wheel on driving shaft
35 Small wheel turning 34
36 Arbor to 35
37 Chain
38 Adjusting screw
39 Nut
40 Tilting bearing
41 Band wheel
42 Endless band
43 Pulley turning with pulley 27
44 Helical spring
45 Support for 44
46 Fulcrum of lever 117
48 Specimen under test
49 Gripping jaws
50 Projecting flanges on jaws 49
51 Block slide
52 Grooves in 51
53 Slotted slide supporting 49
54 Opening in 53
55 Eye in 53
56 Bolt connecting 53 and 57
57 Lever to open and shut jaws
58 Fulcrum of 57
59 Counterweight
60 Handle of lever 57
61 Plungers for slides 51
62 Screws for 61
63 Screw bolt
64 Collars or clamps for calliper bearing
65 Set screws in 64
66 Detachable cap on clamps 64
67 Tenons fitting 66
68 Guiding plates
69 Screws to 68
70 Nuts to screws 69
71 Washers to 69
72 Guiding block
73 Cam
73′ Handle of cam
73″ Grooves in clamps 64
74 Lever moving 87
75 Sliding blocks
76 Supporting guide to 75
77 Set screws for 75
78 Polygonal prism in 75
79 Shaft for 78
81 Pins for holding 79
82 88 Callipers
85 Arm of calliper
86 Clamps
87 88 Upright bars or rods
95 Cord operating recording cylinder
96 Pulley
97 Lever
98 Fulcrum to 97
99 Pulley or sheave
100 Drum or winding barrel of 102
101 Link
102 Recording cylinder
103 Pencil
104 Screw
105 Screws shifting 106
106 Poise or weight
111 Balancing pivot of beam
117 Force multiplying lever
118 Weighing beam
118′ Slide to small poise on 118
119 Link
144 Endless band for moving poise
145 Guiding pulleys
146 Grooved wheel

ELECTRIC MOTORS FOR GUNNERY PURPOSES.

THE Société des Forges et Chantiers de la Méditerranée have been experimenting with the application of electric motors to heavy guns for elevating and depressing and for moving them into direction. A separate motor is used for the two purposes, and it has been found that a considerable saving of time is effected in getting the gun into position as compared with other systems. The guns for three men of war, which are now being completed in France for the Government of Chili, are to be fitted with such motors, which are lighter and cheaper than the hydraulic apparatus hitherto used. It is intended to run the motors from the electric light circuit.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 24th February, 1891.

Iron.—The iron market continues inactive, but the prospects of increased business will, no doubt, be realised in course of time. The Western Railway Company (Chemin de Fer de l'Ouest) are on the point of ordering several hundred coal waggons, the recent frost having proved the deficiency. This company have also given a contract for 3,000 tons of rails to the Jœuf Steel Works at 94s. per ton. The State Railways (Chemins de Fer de l'Etat) are going to order 50,000 tons of various permanent way material. The nominal quotations fixed by the Paris Syndicate remain unchanged—viz., 128s. 6d. and 136s. 6d. respectively for bars and joists. The commercial prices are 120s. 6d. for bars, and 132s. 6d. for joists per ton. Castings stand firm at 112s. 6d., and old rails at 67s. 6d. In the Haute-Marne the iron works are fairly busy, but there is no improvement in prices. Reports from the Meurthe-et-Moselle and the Nord show a continued want of animation in affairs. The Northern Railway Company have given the following orders for execution in the latter district:—Fifty 4·20 metres turntables at 158s. 3d. per ton, and 514 sets of signalling apparatus, of which the prices vary between 337s. 6d. and 482s. per ton. The situation seems to be improving in the Ardennes, where the men who were out on strike are resuming work; in this district the demand for iron work for railway carriages is very brisk, also the nailmakers are commencing to have plenty of work.

A Large Hydraulic Press.—The Forges et Aciéries de la Marine have just put up a hydraulic press which will exert a pressure of 4,000 tons. It was constructed by Croyet & Co., of Chambon, and the cost of the installation is said to amount to nearly £60,000.

New Bridges at Lyons.—The greater part of the bridges across the River Rhône in and about Lyons being old and insufficient for the present requirements of traffic, the municipal authorities decided some time ago to replace three of them with new and modern bridges of steel. Two of these, the Pont du Midi and the Pont Moraud, are now completed, while the other, the Pont Lafayette, is expected to be ready very shortly. The contracts for the two first bridges have been carried out by the Compagnie Fives-Lille and Schneider & Co., Le Creusot. For each of the bridges 3,000 tons of iron and steel were required.

Electricity.—The use of the telephone for the hearing of theatrical performances is meeting with continued success here. There are now over thirty different clubs, hotels, and cafés connected up with the Théâtrephone Company's lines, and others are daily joining.—Mr. Julien, who has successfully formed several companies in the United States and the Brazils for working his patents relating to electric traction and accumulators, is on the point of forming a company here for the same purpose. This may give an impulse to the use of electricity as a tractive power in Paris, where, up to the present, this method has been but little employed.

French Shipbuilding.—The Government has put in hand, at Cherbourg, the cruiser "Bugeaud," making, with the "Fleurus" and the "Chasseloup-Laubat," a total of three vessels commenced since the 1st of January in the above yards.

BERLIN, 23rd February, 1891.

Electric and Gas Lighting in Berlin.—The following statistics have been collected by the Berlin Electricity Works with reference to the progress of electric lighting in Berlin, including the lights served by its own system and by other installations, the numbers being taken on the 1st April of each year:—

	1889.	1890.	Increase in 1889–1890.
Arc lamps	3,778	4,944	1,166
Incandescent lamps	62,876	80,788	17,912

Of this number the Berlin Electricity Works supplied the following proportion by means of their central stations:—

Arc lamps for private and public lighting	970	1,832	862
Incandescent lamps	31,417	43,215	11,798

The remaining 3,112 arc lamps and 37,573 incandescent lamps were supplied from 262 installations, for which the motive power is given by steam engines and gas engines as follow:—

Steam engines	158	171	13
Gas engines	79	91	12

The 5 arc lamps and 6,163 incandescent lamps in the two Royal theatres are included in the number given as supplied by the Electricity Company. On the supposition that one arc lamp is equal to six incandescent lamps, and each incandescent lamp is equal to one gas lamp, the total number of electric lamps on the 1st of April, 1890, gave light equal to 110,452 gas lamps, of which 54,207 was the amount supplied by the Berlin Electrical Works, and 56,245 by private installations. The total number of electrical lamps at the end of the working year, as reckoned on the above supposition, showed an increase of 29 per cent. over the previous year, whilst the electrical works showed an increase of 46 per cent., and private installations of 16 per cent. The district hitherto lighted by the electrical works is one of the most favourable in Berlin, since it includes many important business establishments, the Royal theatres and bank premises, as well as large private houses, to the owners of which cost of lighting is of small importance. Notwithstanding the extension of electric lighting in this district, there has been an increased use of gas during the past year, and if the same proportion should be maintained in the two other districts, where central stations are to be opened, an enlargement of the gas works plant will be necessary.

VIENNA, 23rd February, 1891.

The Iron Market.—Prices showed a continual decrease up to the first part of last week. The Bohemian Syndicate of Iron Works were obliged to diminish the price of bar iron by 5fl. per ton, in order to compete with German works, and the price of bar iron is now 112·50fl. per ton. During the past few days negotiations between the Austrian Syndicate and the German Union of Rolling Mills have resulted in the agreement being prolonged to the end of 1893. It is therefore expected that the iron market will shortly resume its former condition. An important order for 14 locomotives, 13 tenders, 53 passenger carriages, and 128 goods waggons has been placed by the Austrian State Railways. The Austrian Waggon Loan Company has resolved to increase its rolling stock by 300 carriages, and its capital is to be increased by 500,000fl.

The Coal Market.—The coal market still continues very active. At a recent meeting of the Salgo Tarjan Coal Mines and the North Bohemian Coal Company, which are two of the most important coal mines, a report was presented to the shareholders. During the past year the Salgo Tarjan Mines made an output of 660,650 tons of manufacturing coals, which amounts to 58,327 tons more than in the previous year. The profits were more than 700,000fl., and a dividend of 20fl. will be paid, as compared with 16fl. in the previous year. The North Bohemian Company made a profit of 336,000fl., and pays a dividend of 16fl., or 8 per cent. on its capital. Its total production amounted to 834,355 tons.

Electrical Engineering.—During the past week the "Neubad" (Vienna) central station, belonging to the firm of Messrs. Siemens & Halske, with its cable system 16 kilometres in length, was taken over by the General Austrian Electricity Company. All the duties and privileges with regard to this station were transferred by the municipality to the new company.—The Budapest central station of this company, by means of which the street railway is worked, will be considerably enlarged, and will supply power for the industrial undertakings along its route.—Weisskirchen, a town in Moravia, has determined to erect a central station for the electrical lighting of the streets, squares, and public buildings. Engine power of about 300 horse-power will be used in the working of it.—Chotzen also, a town in Bohemia, intends to erect a central station for electric lighting.—The Hungarian State Railways are introducing electric lighting on the express trains. Up to the present time eight carriages have been provided with Tudor accumulators, and if the trial should prove successful electric lighting will be generally introduced.—The Vienna Stock Exchange and the larger railway stations have been recently lighted electrically.

Exhibition at Budapest.—A special Exhibition, in connection with the cement, earthenware, asphalt, stone, and marble industries, will be held at Budapest from May 15th next to June 30th. No charge will be made for space in this Exhibition, and a reduction in freight will be allowed by the German and Austro-Hungarian railways on all goods intended for this Exhibition.

BRUSSELS, February 24th, 1891.

The Iron Trade.—In consequence of the receipt of orders, and of the present price of raw material, makers have decided to keep up the prices. Erecting shops continue actively at work. The Liège rolling mills are receiving numerous orders, and a rise in the price of iron will necessarily follow. At Charleroi trade is not so favourable. There are better accounts, however, of trade in foreign countries, and it is hoped that the Chicago Exhibition will give a considerable impetus to business. The Bruges workshops have just obtained an order for a gasometer at Ostend. It seems probable that one of the oldest mines in Belgium will now be worked by a limited company.

The Coal Market.—The coal market is firmer than it was a week ago, and the lowering of prices seems to have stopped. Prices at Charleroi fluctuate largely, but large sales of second qualities at 11fr. to 12fr., and of small coal at 9fr. to 10fr. have taken place. At the Liège coal mines the production is very brisk. A year and a half ago the stock at the Belgian coal pits was at a very low ebb, but an improvement took place during the first half of the past year through an increase in the production. At Charleroi especially stocks have increased rapidly, and this circumstance shows itself in various ways. The coke market remains very favourable, and any immediate alteration is unlikely.

The Glass Trade.—The production is still in excess of the demand, which is, however, a little brisker. Prices continue to become lower, and some manufacturers offer goods at unremunerative prices. This system of cutting prices is injurious, since it causes buyers to wait for a still further reduction, and thus prevents the placing of orders. If sellers were to adopt a sounder policy the market would soon improve, and buyers would be anxious to place their orders for the spring. The Courcelles Glass Company are using a new method of annealing glass. The former method of heating one sheet by means of one furnace has been modified so as to allow the annealing of two sheets at the same time. These sheets of glass are arranged in pairs in an enlarged annealing furnace, which is provided with suitably placed hoods. The position of these hoods ensures the proper distribution of the heat.

DÜSSELDORF, 24th February, 1891.

The Iron Market.—The state of the iron market is unaltered. The prices are—For 10 to 12 per cent. spiegel, 59 marks; pig iron, No. 1, 54 marks; Thomas iron, 49 marks; hematite iron, 78 marks; wrought iron, 135 marks; fine sheet, 135 to 145 marks. The Bochumer Verein für Gussstahlfabrication has received at good prices orders for 8,000 tons of steel rails for Mexico, 6,000 tons of rails for Portugal, 2,000 tons of rails for Greece, and 500 tons of rails for Norway. The number of steelworks in Germany is now 22, with 83 converters. In Prussia there are 17 works, with 71 converters; in Bavaria, 2 works, with 4 converters; in Elsass-Lothringen, 2 works, with 6 converters; and in Saxony, 1 works, with 2 converters.

The Coal Market.—There is an active demand in the coal market. The prices of coke are:—Foundry coke, 16 to 18 marks; blast furnace coke, 13 to 14 marks, per 1,000 kilogrammes.

Transportation Difficulties.—The want of waggons, both here and in Upper Silesia, continues, and causes considerable injury both to the works and also to the miners in the district. The deficiency of trucks amounts now to 1,025, or almost to 23 per cent. of the number required.

The German Coal Export to Italy.—The export amounted to 119,760 tons in 1889, and to 71,260 tons in 1890. Of these amounts the Saar district accounted for the largest share, while the Westphalian district showed only 63,120 tons in 1889 and 48,230 tons in 1890. It is probable that the returns for the current year will be still worse if cheaper freights are not obtainable.

Siegen Sheets.—The production of thin sheets, which has for a long time past been successfully carried on in the Siegerland and some districts of the Lower Rhine, is estimated to be about 2,800 tons weekly. Until October of the past year all works concerned in the manufacture of this article were included in a syndicate which worked in a fairly satisfactory manner. At that date the syndicate collapsed, and prices suddenly dropped down from over 200 marks to 130 marks. As this selling price does not cover the costs of manufacture, endeavours to renew the syndicate are being made.

AMSTERDAM, 23rd February, 1891.

Railways.—The Minister of the Means of Communication has had to defend his administration in the two Chambers of the States-General against the attacks of several members, based upon the general breakdown of the railway service during the late severe frost. The Minister could not, of course, deny that such a paralysis of the whole train service had indeed occurred, but he denied that there was much connection between the lamentable stoppage of nearly all traffic on the railways and the recent reorganisation of the railway system, in consequence of the purchase of the Dutch-Rhenish Railway by the State. The Government had, on the contrary, a conviction that the severe winter was alone the cause of the general breakdown, and that the companies could not fairly be held responsible. The fact was that the vast majority of goods in the Netherlands were carried by water, and a small proportion only by rail. Goods, usually transported by steamers or barges, might upon occasions be delayed by frost for a few days without causing serious inconvenience. But the case became different when a persistent frost, like the one commencing last November, closed all navigation for many weeks. The fact that Flushing and Rotterdam were able to keep open their harbours the whole time—although very satisfactory in itself—only tended to increase the glut, as foreign transports competed with home transports. However, the difficulties were now a thing of the past, and the Minister stated he hoped a similar state of affairs would not occur again in Holland for the next twenty-five years at least. In connection with this subject, it has to be noted that the Government refused to support a project to connect Amsterdam and Ymuiden, at the mouth of the North Sea Canal, by rail—a scheme lately revived in consequence of the closure of navigation in the canal during the great frost. The above-named Minister declared in the First Chamber that he would not refuse to entertain a private concession for such a railway, but a State guarantee or subvention was out of the question.

The Industrial Art Museum.—The management of this institution at Haarlem has arranged for a series of special exhibitions by various large manufacturers of Holland. The whole will, therefore, form a kind of cycle of national industries in their latest developments.

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STOCKHOLM, 21st February, 1891.

Labourers' Share in Profits.—The Ystad Sugar Refinery has paid all its men a share in last year's profits. Their share is a cash payment of 3,086kr., which is equal to 27kr. per man, there being 125 men, and a sum of 9,260kr., which goes to the men's pension fund. This fund now amounts to 20,137kr., and is intended to provide a pension for those who have been at least ten years at the works. The pension has been fixed at 200kr., to begin at the age of 60 years for the men and at the age of 55 years for the women.

The Swedish-Norwegian Railway Company.—The King of Sweden in Council has now sanctioned the purchase by the Swedish State of the Swedish-Norwegian Railway Company's Lulea-Ofoten railway line for a sum of 6,500,000kr., for which the Swedish Parliament had already voted the purchase money. The debenture holders will now probably make overtures to the Norwegian Government with the view of their taking over the railway now in progress from Ofoten in the direction of the Swedish frontier. This section of the line is of no value to the company under the present circumstances, and the works already completed are bound to quickly deteriorate if left in their present state.

New Steamer.—The Göta Steamer Company, Gothenburg, has contracted with the Bergsund Engineering Company, Stockholm, for the building of a new steamer. The steamer is to be 900 tons, and is to be fitted with triple-expansion engines. The material is to be the best Swedish Bessemer steel, and the date of delivery is the 1st of August.

New Telephone Lines.—The use of the telephone is being extended to all parts of Sweden, and it is now proposed to connect several places in the Bohnslön Stargard by submarine telephone cables. This installation will probably be undertaken by the State Telephone Administration.

CHRISTIANIA, 21st February, 1891.

Proposed Extension of Bodö Harbour.—The extension of Bodö Harbour is now likely to be realised. The calculated cost is about 600,000kr., of which the greater portion will be absorbed by the building of a stone pier of 230 metres in length.

Export of Ice and Timber.—The shipments of ice and timber during the month of January have not exceeded half of those for the same month of last year. 3,618 tons of ice were shipped against 7,566 tons in January, 1890, and 39,058 cubic metres of timber against 65,462 cubic metres in January, 1890. The largest shipments of timber are from Frederikstad and Drontheim; of ice, from Brevik, Longesund, and Christiania.

Electric Light at Hammerfest.—Hammerfest, the most northerly town in Europe, is the first town in Norway to be lighted completely by electricity. The installation is on the Thomson-Houston principle, and the motive power is supplied by a waterfall at about a mile distance. The installation is satisfactory, and will be extended so as to light the harbour.

New Cargo Steamer.—The new steamer "Transport I.," which is being built for a Christiania syndicate, is of a somewhat unusual type. Its dimensions are:—Length, 120ft.; breadth, 20ft.; and depth, 9½ft. It is specially constructed with a view of being able to carry large and heavy articles, and the engine is placed right aft.

COPENHAGEN, 21st February, 1891.

Engineering.—The large establishment of Burmeister & Wain's Shipbuilding and Engineering Company has been kept fully employed during 1890. The dividend for last year will be 6½ per cent. The manufacture of cream separators will soon be further extended so as to comprise centrifugal appliances for the beer and wine industries.

The Beer Tax.—The vexed question of a beer tax, which is at present before the Danish Parliament, is likely to be satisfactorily settled. It is intended to tax only such classes of beer as contain a certain percentage of alcohol, and the technical difficulties seem now to have been partially overcome. That the new tax is strongly objected to by the brewers is only natural.

Iceland.—The works on the large bridge over Alvesoa are steadily progressing, and the materials for the bridge have now been brought to their destination. This was, however, no easy matter, as the larger pieces could only be conveyed on sledges. During the summer a number of engineers will arrive to fix it.

MADRID, 23rd February, 1891.

Exhibition of Wines at Badalona.—An Exhibition of wines and brandies and of implements and machinery connected with the cultivation of the vine is to take place at Badalona, in Catalonia, in March next. Considerable interest is shown in the success of the Exhibition, and liberal prizes are offered, in addition to those for produce and machinery, to those workmen who show most skill in the difficult manual operations connected with the culture of the vine.

Grain Market at Madrid.—The want of a grain market at Madrid has been seriously felt for many years, and, after much discussion, the work has at last been commenced. The market is situated midway between the two largest railway stations.

Ministerial Visit to the Province of Huelva.—The Minister of Public Works, who has under his charge the mining industries of the country, accompanied by the Minister of the Colonies, has just visited Huelva in order to make inquiries with regard to the fumes question, which is to be brought before the Cortes for settlement. The Minister favours the policy of the present Government in not wishing to interfere with the roasting of pyrites in the open air. At the same time he considers that the agricultural classes should have easy means of obtaining compensation for damage done to their crops. One of the alcades of the villages, which have been most injured by the fumes, had stated that some of the mines were quite satisfied with the results of having discontinued the roasting, but the Minister considers this argument to be of little weight. It is probable that in any event the amount of roasting will be diminished.

Railway from Linares to Almeria.—The new survey which has been made by the projectors of this railway has been approved of, and the construction of the line will now be rapidly carried out. The line could be completed in two years if the money were readily forthcoming, since short tunnels are to be substituted for the long ones previously projected, and none of the work requires a lengthened time for its construction. Under all the circumstances it seems probable that the work will be completed in four years.

Sugar Industry in Spain and in Cuba.—The first manufacturers of beet sugar in Spain have met with so much success that it seems probable that eventually there will be enough made in the peninsula for the home consumption without importing any sugar cane from Cuba. This question has caused some jealousy to be felt by the planters in Cuba, who see that the success of the Spanish manufacturers is due to the existence of import duties. It has been overlooked that the continuance of the present crops can only be maintained by means of a large expenditure on manures. Many new factories are, however, being started, amongst which one is to be established at Aranjuez, where there is a large extent of land under irrigation. The Cuban planters demand that some measures should be taken to give them equal advantages with the Spanish manufacturers. The sugar cane plantations in Spain are losing credit by reason of the damage done by such cold winters as the present one.

ROME, 23rd February, 1891.

Florio and Rubattino United Steamship Companies.—The report presented to the shareholders of the Navigazione Generale Italiana (Florio and Rubattino United Steamship Companies) shows that in the year 1889-90 the net profits amounted to £116,910. It was decided to pay a dividend of 5 per cent., carrying forward £6,910. The gross income of the company amounted to £1,864,270, whilst the gross expenditure amounted to £1,747,360. During the past year the company has been compelled to reduce the sailings for South American ports, owing to the diminution of the Italian trade with those countries, and also had to give up the line to the Pacific as it was not remunerative. This loss has, however, been partly compensated by the Government charters for the Red Sea service, and by the starting of new lines to foreign ports. The company now owns 106 steamers, capable of carrying 102,989 tons, and their value is estimated at £2,466,800. The company has invested £72,000 in the building of dry docks at Genoa for the cleaning and repair of large steamers. The subventions paid to the company by the Governments during the past year amount to £376,274. The company also receives £2,080 from the British Government for the mail service. The passenger receipts for the various lines amounted to £562,492, and the freights to £798,114.

Commercial Museum at Rome.—Under the patronage of the Italian Government, a commercial museum has recently been established in Rome. The museum will be a permanent exhibition of the products of Italy and foreign countries. A charge is made for space, and the committee undertake the representation of those firms desiring to exhibit.

Roman Ship Canal.—As briefly mentioned a week or two ago, a project has been presented to the Minister of Public Works in Italy for the construction of a ship canal from Rome to the Tyrrhenian Sea. This canal will have a length of nearly fifteen miles, and its width will be about 270ft.

NEW YORK, 14th February, 1891.

Grand Central Station at Chicago.—The new Grand Central Station at Chicago, Ill., has a frontage of 680ft. on Fifth Avenue and 226ft. on Harrison Street. The train shed has a single arch span of 59½ft. radius, spreading out at the sides to make a total width of 146ft. over the platforms, which are 19ft. wide and 10in. high above the rail. The spaces between them are 23ft. wide, accommodating three sets of tracks. According to the *Engineering News*, it is lighted by sixty groups of incandescent lamps, ninety lamps of 32 c.p. at each end, and seven powerful arc lights high up in the roof. The main waiting-room is 71ft. by 267ft. and 25ft. high; ladies' waiting-room, 32ft. by 40ft.; dining-room, 53ft. by 73ft. The tower is of Connecticut brownstone; it is 27ft. square and 236ft. high. The clock face is 13½ft. diameter. There are three engines, aggregating 550 h.p., driving the electric light plant, which has a total capacity of 127,000 c.p. Compressed air is used to operate the switches, block signals, drawbridge, and all crossing gates within four miles of the station. It is in its general effect one of the handsomest and most luxurious stations in America, although in size it is not specially remarkable.

Chicago Street Railway.—During the past year the Chicago Street Railway Company carried a total of 68,734,969 passengers, receiving therefrom $3,436,748. The expenses of operation were $2,297,651, and the net was $1,139,097, or 18 per cent. on the capital. This company operates 152 miles of track, of which 34 miles are cable and 118 are horse lines. During the year 685 horses were bought at an average of $125 per head, and 268 were sold at an average price of $130. The daily cost for each horse, including food, attendance, depreciation, harness, was 47⅞c. The total number of cable-car miles was 12,740,480, and the working expenses per cable mile were 9·650c. The total number of horse-car miles was 4,859,200, and the working expenses per horse-car mile were 21·985c. Two hundred and eighty-two cases of damages by accidents were settled at a total expenditure of $30,809.

Immigration.—Immigration for 1890 compares with 1889 as follows:—

	1890.	1889.
English, Welsh, and Scotch ...	67,255	77,439
Irish ...	53,312	60,375
German ...	96,482	95,935
Swedish, Danish, Swiss, &c. ...	59,941	58,349
Italian ...	62,492	29,606
Austro-Hungarian ...	63,095	42,170
Polish ...	19,737	4,866
Russian ...	40,883	33,474
Dutch, French, and other ...	27,829	24,498
Total ...	491,026	426,712

The increase is entirely from the less desirable races of immigrants, which now constitute over 40 per cent. of the total, a fact which ought to lead to some provisions for judicious restriction of the privilege of immigration to those fit to enjoy it.

Marine Boilers.—The Cleveland Shipbuilding Company, of Cleveland, O., has received an order for two boilers 11ft. in diameter, by 10ft. 6in. in length, for the ocean steamship "Kinau," now lying at Honolulu, Sandwich Islands. The boilers will be completed at the boiler shop department of the Cleveland Shipbuilding Company, then taken apart, and shipped in plate form, with rivets, flues, &c., all complete for putting together in the steamer.

New Bridge.—The Smith Bridge Company, of Toledo, Ohio, has completed a bridge at Chattanooga, Tennessee, having three spans of 320ft. and three of 210ft., roadway 27ft. wide with two sidewalks 6ft. wide. Mr. Edwin Thacher was the chief engineer.

The Pennsylvania Steel Company.—The Pennsylvania Steel Company is making important additions to its plant located at Sparrow's Point, Baltimore, Md., and at Steelton, Pa. The frog, switch, and signal department, which now employs 300 men, is to be doubled. A bridge and structural department has been started, and placed under the management of Mr. Charles E. Billin, who was recently in charge of a similar plant at the Pencoyd Iron Works, Pa.

PHILADELPHIA, 13th February, 1891.

Sugar Refinery.—The sugar refinery at Curtis Bay, Baltimore, was formally opened yesterday. The machinery, which has been under test for the past six weeks, has been found to be in good order, and everything is working smoothly. For some time yet the refinery will be operated on a limited scale, but after April 1st, when the new Tariff Act relating to sugar comes into effect, making it free, the refinery will be worked to its fullest capacity, and will turn out from 1,200 to 1,500 barrels a day.

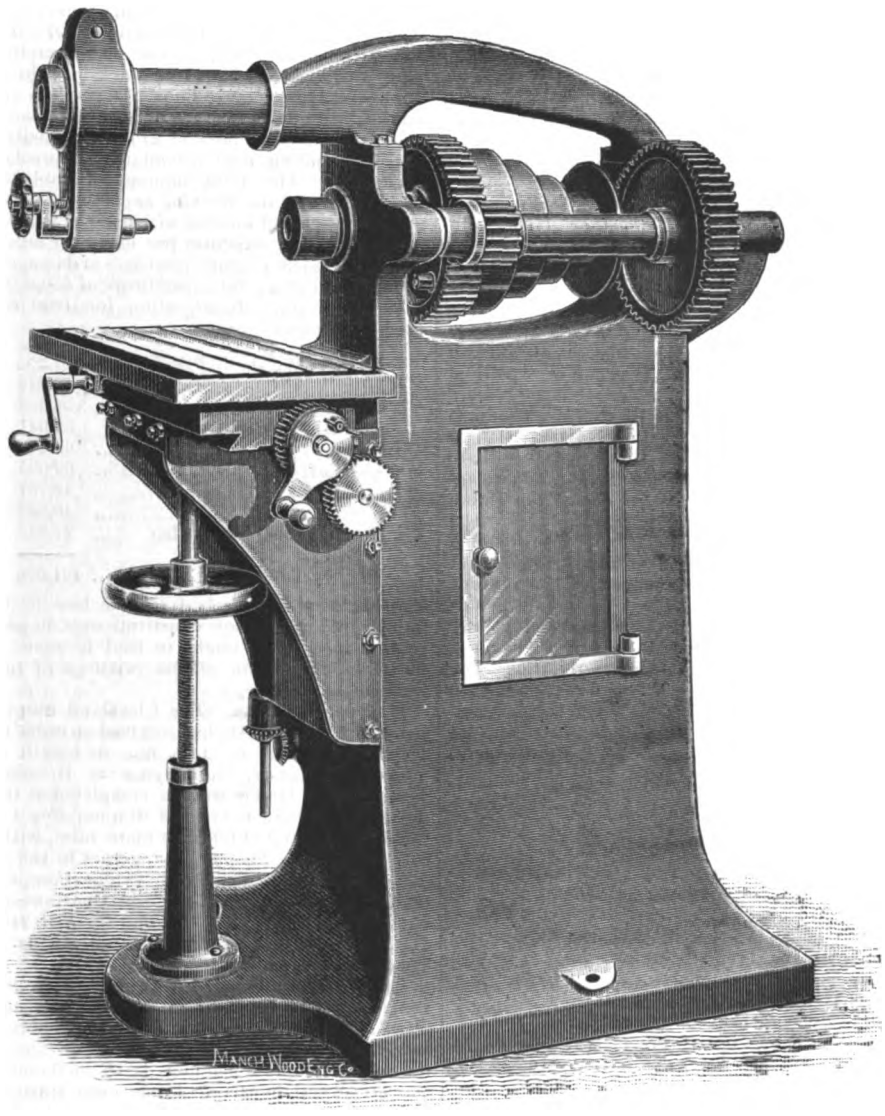
Railroad Consolidation.—Considerable interest has been manifested during the past ten days in a trip made through the South by a number of railroad men interested in Southern and Western railroads. It seems probable that all the principal roads south of the Pennsylvania and the Union Pacific Railroads will join in a friendly understanding as to rates and division of business. The plan provides for entrance into Philadelphia and New York over the Baltimore and Ohio, and a combination of roads north of the Ohio River, affording entrance into Chicago, Pittsburgh, and Western New York. The result promises to be the largest trunk line combination in the country, rivalling the New York Central and the Pennsylvania lines from New York to Chicago.

Coke Workers.—The threatened strike in the coke region has begun, and there are now about 16,000 men out on strike, the greater part of these going out on the 7th inst., the coke drawers, to the number of about 6,000 men, remaining at work until the 11th inst. It seems unlikely that the dispute will be settled, as the men ask for an increase of 12½ per cent., and the operators propose to reduce wages 10 per cent. There are about 16,000 ovens in the Connellsville regions distributed among about seventy plants. The past year has been an unusually good one, as shipments were the heaviest ever known, and work has been correspondingly steady at good prices. Efforts to prevent the strike have been made ever since the beginning of the year. The larger consumers have stored enough coke to last them for sixty days, but, as the strike is likely to last several weeks, many of the smaller iron-works will have to close.

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IMPROVED MILLING MACHINE.

CONSTRUCTED BY MESSRS. CUNLIFFE & CROOM, ENGINEERS, MANCHESTER.



GENERAL VIEW.

NEW BRITISH WARSHIPS.

ANOTHER of the second-class cruisers, the construction of which was authorised by the Naval Defence Act of October, 1889, was launched on the 10th inst. from the No. 5 slipway at Chatham Dockyard. H.M.S. "Apollo," the vessel in question, is built of steel throughout, and measures 300ft. in length, 43ft. in extreme breadth, and 25ft. in depth, with a displacement of 3,400 tons on a mean draught of water of 16·5ft. The vessel is of the protective deck type, and is provided with a double bottom extending over the engine and boiler spaces. Subdivision of the hull is a primary feature, there being no less than eighty watertight compartments, including those of the double bottom. The machinery consists of two sets of vertical triple-expansion engines, which are expected to develop 9,000 horse-power under forced draught, giving a speed of 20 knots. The coal supply at the load draught will be 400 tons, which will enable the vessel to cover a distance of 8,000 knots, without re-coaling, at a reduced speed of 10 knots. The "Apollo" will mount two 6in. quick-firing weapons, which are capable of piercing a 10in. armour plate at 500 yards, one being mounted on the forecastle and the other on the poop. In addition, there will be six 4·7in. 36-pounder quick-firing guns, eight 6-pounder Hotchkiss guns, one 3-pounder Hotchkiss, and four 5-barrelled Nordenfeldt machine guns. There are also four torpedo tubes, one at the bow, one at the stern, and two others on the broadside, capable of being trained through a very large arc of fire. In action the ship will be manœuvred from a conning tower, built up of 3in. rolled steel plates, and within which are placed the steering wheel and engine-room telegraphs. The vessel is to be rigged with two pole masts, carrying light fore and aft steadying sails. When complete, the "Apollo" will have a complement of 252 officers and men.

The leviathan first-class battle-ship "Royal Sovereign," building in the Royal Dockyard at Portsmouth, was launched yesterday, the launching ceremony being performed by Her Majesty the Queen. Yesterday, also, and from the same establishment, the first-class cruiser "Duke of Connaught," *ex* "Centaur," was launched. The "Royal Sovereign" is the largest vessel hitherto constructed for the British Navy, and when complete she will exceed in displacement the "Nile" and "Trafalgar," which have previously figured as the largest British warships, by fully 1,650 tons. She is one of a class of which there are seven, designed by Mr. W. H. White, Director of Naval Construction, to carry four heavy guns, *en barbette*, high above water. The remaining six vessels are at present under construction at the following establishments:—The "Renown" and "Repulse," at Pembroke Dockyard; the "Resolute" and "Revenge," at Jarrow, by the Palmer Shipbuilding Company; the "Royal Oak," at Birkenhead, by Messrs. Laird & Co.; and the "Ramillies," at Clydebank, by Messrs. J. & G. Thomson. The principal dimensions of the "Royal Sovereign" are as follow:—Length, 380ft.; breadth, 75ft.; mean draught of water, 27·5ft.; and displacement, 14,150 tons. In length she equals the "Warrior," "Black Prince," and "Achilles," the representatives of early armour-clad construction, while her beam is the same as that of the "Inflexible," hitherto the broadest ship in the navy. A belt of armour 8·5ft in breadth, with a maximum thickness of 18in., extends for 250ft. amidships. This belt is terminated by transverse armoured bulkheads, above which is built a 3in. steel protective deck. Above the thick armour belt the broadside is protected to the height of the upper deck by 5in. steel plates for a length of 145ft., while oblique bulkheads of armour stretch across the protective deck to meet the redoubt armour at the base of the barbettes. The armour on the barbettes is 17in. thick, and, in view of the development of high explosives, special protection has been afforded to the passing of the ammunition from the magazines, both to the barbettes and the central battery, where the auxiliary armament is located. With regard to speed this monster vessel is destined to outstrip all competitors, and in virtue of her greater length she will be capable of steaming a knot per hour faster than the "Trafalgar." In speaking of the relation of speed to power, and comparing the forms of the "Royal Sovereign" and "Trafalgar," Mr. W. H. White, in a paper read before the Institution of Naval Architects in 1889, says:—"The new ships are to be 380ft. in length, as compared with 345ft. in the 'Trafalgar.' They will be 14,150 tons displacement, as against 12,000 for the 'Trafalgar' as designed, and 12,500 tons for that ship as completed. Our model experiments show that for speeds from 10 knots up to 16 knots, the resistances of the two forms are, for all practical purposes, equal; the greater length of the new ships compensating for their greater displacement. But at speeds higher than 16 knots the longer form begins to gain sensibly on the 'Trafalgar,' and at 17 knots the 'Trafalgar' form would require about 12 per cent. greater power than the new ships. At 17·5 knots the 'Trafalgar' form, if it could be driven, would require at least 30 per cent. greater power than the heavier but longer ships. Now this speed of 17·5 knots is what is estimated as the maximum (forced draught) performance, with 13,000 horse-power in the new ships, while with 9,000 horse-power (natural draught) we hope to reach about 16 knots." The coal capacity amounts to 900 tons, and will enable the vessel to steam 5,000 knots at a 10-knot speed, or from 1,500 to 2,000 knots at her maximum speed. The armament of the "Royal Sovereign" will be of the most powerful description, and will consist of four 67-ton breech-loading guns carried in barbettes, while ten 6in. quick-firing guns will be placed in the central battery. In addition the auxiliary armament will be augmented by sixteen 6-pounder and eight 3-pounder quick-firing guns. The hull is pierced for seven torpedo tubes, of which two are submerged. According to the official programme, the "Royal Sovereign" is to be completed in December, 1893.

The "Duke of Connaught" is one of the first-class cruisers of the protective deck type which are being built under the Naval Defence Act. Between the perpendiculars she measures 360ft., in extreme breadth 60·7ft., and when complete for sea will have a displacement of 7,700 tons on a mean draught of water of 24·7ft. A watertight protective deck, 3in. thick, extends throughout the length of the hull, completely shutting off the frames below from those above, which are connected to the deck by steel angles and brackets. In this deck, which covers the vital portions of the ship, such as engines, boilers, magazines, &c., as few openings as possible are made, but where such are unavoidable, armoured shutters are provided, and where the cylinders protrude an armoured breastwork surrounds them, having a maximum thickness of 5in. An oval conning tower, built of steel plates, affords protection from quick-firing guns to the various engine-room telegraphs, voice tubes, directors, and steam steering wheel. The main armament will consist of two 22-ton breech-loading guns, and the auxiliary armament of ten 6in. quick-firing guns and sixteen 6-pounder and 3-pounder quick-firing guns. In addition, two above-water torpedo tubes and two submerged tubes are provided for the discharge of Whitehead torpedoes. Two sets of vertical triple-expansion engines are to be fitted, capable of developing collectively 12,000 horse-power under forced draught, and 7,500 horse-power with natural draught, the resulting speeds being estimated at 19·5 knots and 17·5 knots respectively. The normal coal supply is 850 tons. The total cost of the hull, machinery, and equipment of the "Duke of Connaught" will be about £328,000.

The "Hawke," a sister vessel to the "Duke of Connaught," under construction at Chatham Dockyard, is all but complete, and will be launched as soon as her boilers are received from the contractors for her machinery.

IMPROVED MILLING MACHINE.

WE illustrate above a milling machine for general work, which has been designed by Messrs. Cunliffe & Croom, engineers, Broughton Iron Works, Manchester. In general construction it resembles those commonly made, but special attention has been paid to rigidity, in order to get absolutely true work. With this object the vertical slide carrying the table has been strengthened and specially constructed, so that the horizontal surfaces of the slide are exceptionally broad, thus giving a good bearing for the table and ensuring steady work. The traverse of the tables in each direction is arranged to be self-acting, and disengaging motions are fitted by which the traverse may be stopped at any part of the stroke. Wherever miscellaneous work is being done, and one man is attending to more than one machine, these machines are found to be of great service.

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THE DUBLIN "LOOP LINE."

THE line of railway between Amiens Street Terminus of the Great Northern Railway Company and Westland Row Terminus on the Dublin, Wicklow, and Wexford Railway in Dublin, known as the "Loop Line," is approaching completion. This loop line is not only of great local interest, but is also of general importance to the commercial interests of the United Kingdom, as it forms a through connection between Kingstown and Queenstown, where the mails are taken on board for the United States. The length of the line from Westland Row to Amiens Street Station is a little over a mile. It runs through the principal portions of the city, and the cost of construction was very materially increased by the purchase of buildings. It consists of eighteen iron bridges, with intervening brick arches having spans varying from 27ft. to 30ft. each. The iron bridges include the Liffey Viaduct, which is the principal one.

The best view of this viaduct is from Carlisle Bridge, and the illustration given on page 204 is taken from this point. At the north end of the Amiens Street Terminus are being erected new platforms for the convenience of passengers arriving by the trains coming over the Loop Line. These platforms will be made of concrete and covered, and on the arrival platform from Kingstown a lift is being constructed, upon which the mail bags will be raised or lowered. At this point there will be erected a signal box in which 70 levers will be worked. From here "No. 1" and "No. 2" lines commence. No. 1 line is that connecting the Loop Line with the Great Northern system to Belfast. No. 2 connects the Loop Line with the Liffey Junction Railway at Newcomen Bridge. This latter line was constructed jointly by the Great Southern and Western and Midland Great Western Railway Companies, and both systems have goods depôts at the North Wall. The viaduct and bridges have been designed by Mr. John Chaloner Smith, M.Inst.C.E., and Mr. William Hemingway Mills, M.Inst.C.E., and to the courtesy of the latter gentleman we are indebted for much of the information we now give.

SHIPBUILDING NOTES.

ON the 14th inst. Messrs. Laird Brothers launched from their works at Birkenhead an iron twin-screw steamer, the "Sir Richard Grenville," built to the order of the Great Western Railway Company, and intended for service as a mail and passenger tender at Plymouth. She has been built to Lloyd's highest class, and is about 132ft. long by 30ft. beam, with a tonnage of 545 tons O.M., and will be fitted with two sets of triple-compound engines driving twin screws. She will have a speed of about 12 knots.

ON the 16th inst. the fine steel screw passenger steamer "Fuping," built at Blyth by the Blyth Shipbuilding Company, Limited, for Mr. James Whittall, of London, per Mr. John White, also of London, for China trading, had a very satisfactory trial trip. The "Fuping" is a duplicate of the "Ching Ping," recently built for Mr. John White. She is 223ft. in length, and is fitted with Smith & Son's steam winches, Donkin & Nichols' steam steering gear, and Napier's patent windlass and capstan. The engines are by Mr. Middleton Pratt, of Huddersfield, and are of the triple-expansion type, and worked very satisfactorily.

Notices of Meetings.

THIS WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Friday, February 27th, at 7.30 p.m. Students' meeting. Paper to be read: "Disintegrators," by Mr. B. Chatterton.

PHYSICAL SOCIETY.—Friday, February 27th. Papers to be read: "Proof of the Generality of Certain Formulæ Published for a Special Case by Mr. J. H. Blakesley," by Professor W. E. Ayrton and Mr. J. F. Taylor; "Further Contributions to Dynamometry," by Mr. J. H. Blakesley; "Note on Electrostatic Wattmeters," by Mr. Swinburne; "Interference with Alternating Currents," by Professor Ayrton and Dr. Sumpner.

SOCIETY OF ARTS.—Friday, February 27th, at 4.30 p.m. Lecture on "The Science of Colour," by Captain Abney F.R.S.

ROYAL INSTITUTION.—Saturday, February 28th, at 3 p.m. Lecture III., on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

BALLOON SOCIETY.—Friday, February 27th, at 8 p.m. Paper to be read: "British Borneo (Past, Present, and Future)," by Mr. W. B. Pryer.

MANCHESTER ASSOCIATION OF ENGINEERS.—Saturday, February 28th, at 7 p.m. Paper to be read: "Dr. Joule: with Special Reference to His Discovery of the Mechanical Equivalent of Heat," by Mr. J. Angell, F.C.S.

NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, March 2nd, at 7.30 p.m. Paper to be read: "The Balancing of High-Speed Steam Engines," by Mr. A. Rigg.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, March 2nd, at 8 p.m. Papers to be read: "The Chemical Changes between Nitric Acid and Metals"; "Further Researches on the Butter of the Cow," by Mr. J. A. Wanklyn."

SOCIETY OF ARTS.—Monday, March 2nd, at 8 p.m. Cantor Lecture III., on "The Electric Transmission of Power," by Mr. Gisbert Kapp, M.Inst.C.E. Wednesday, March 4th, at 8 p.m. Paper to be read: "Modern Flour Milling," by Mr. J. H. Carter.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, March 2nd, at 8 p.m. Special general meeting.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 3rd, at 8 p.m. Ordinary meeting. Paper to be read, with a view to discussion: "On the Subterranean Water in the Chalk Formation of the Upper Thames, and its Relation to the Supply of London," by Mr. J. T. Harrison, M.Inst.C.E.

OWENS COLLEGE UNION ENGINEERING SOCIETY.—Tuesday, March 3rd, at 7 p.m. Paper to be read: "Hospital Buildings," by Mr. F. W. Maxwell.

PRICES CURRENT, 25TH FEBRUARY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Balley Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 17 6	.....	7 7 6	London.
„ Angles	7 0 0	.....	7 10 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 0 0	„
„ Ship and Girder			7 0 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	42/-	Cash.
Scotch Warrants, m/n	47/-	„
Hematite Warrants, m/n	50/9	„
Stocks in Stores. Scotch	549,644	Tons.
Middlesbro'	124,201	„
Hematite	207,650	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	...	.....	...	f.o.b.	Glasgow.
Gartsherrie	...	.....	...	„	„
Carnbrae ex Store	50/6	.....	50/-	„	„
Eglinton „	50/-	.....	49/6	„	„
G.M.B. „	47/6	.....	47/3	„	„

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£	s.	d.		£	s.	d.
Spelter: Ordinary		£25	0	0	to	25	5	0
Copper: British Cakes and Ingots		57	10	0	„	58	0	0
„ Chili Bars, G.O.B.'s		58	2	6	„	58	10	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)		53	2	6	„	53	10	0
„ Manufactured (strong)		65	0	0		.....		
Lead: Common Pig		13	10	0	„	13	15	0
„ English Sheet		14	5	0	„	14	10	0
Tin: Straits		90	0	0	„	90	10	0
„ Australian		90	5	0	„	90	15	0
„ English Ingots		94	0	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The market has continued steady during the week. No change of importance has taken place, and business continues of a limited nature. Stocks decreased about 1,000 tons during the first fortnight in February. Chili bars are about 2s. 6d. higher than last week, quotations to-day being £53 2s. 6d. to £53 10s. cash, with steady business. Manufactured, £65, "strong."

TIN: Firmer, with improving prices.

LEAD: Steady, prices unchanged.

SPELTER continues to advance, supplies being limited and most producers fully sold for some months ahead. Prices on the Continent are higher than in England, so that there is every likelihood of a further rise in price.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	5¼	to	0	0	6¼
„ „ Liquid	gal.	0	1	0	—	.....		
„ Citric	lb.	0	1	8½	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	15	0	—	.....		
„ Tartaric	lb.	0	1	3½	—	.....		
Alum: Lump (powder 10/- ex.)	ton	5	12	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	25	0	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	10	0	0	—	.....		
„ Liquor	lb.	0	0	3	—	.....		
Antimony	ton	75	0	0	—	.....		
Bleaching Powder	„	6	12	6	—	.....		
Bisulphide of Carbon	„	13	0	0	—	.....		
Borax	„	28	10	0	—	.....		
Benzole (90 %)	gal.	0	4	9	—	.....		
„ (50/90 %)	„	0	3	7	—	.....		
Copper Sulphate	ton	17	10	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	21	10	0	—	.....		
„ White Sugar	„	25	10	0	—	.....		
„ Brown „	„	19	10	0	—	.....		
Potash: Bichromate	lb.	0	0	3¾	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	20	10	0	—	.....		
„ Chlorate	lb.	0	0	5½	—	.....		
„ Prussiate (Yellow)	„	0	0	10	—	.....		
„ Sulphate (Basis 90 %)	ton	4	0	0	—	.....		
Precipitate: Red	lb.	0	8	6	—	.....		
„ White	„	0	8	6	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Epsom { Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	10	0	—	.....		
„ Recovered	„	7	5	0	—	.....		
Soda: Ash	deg.	0	0	1¾	—	.....		
„ Caustic (White 70%)	ton	11	2	6	—	.....		
„ „ { „ 60%)	„	9	17	6	—	.....		
„ „ (Cream 60%)	„	9	10	0	—	.....		
„ Crystals	„	3	8	0	—	.....		
„ Bicarbonate	„	7	10	0	—	.....		
„ Hyposulphite	„	6	10	0	—	.....		
Solvent Naphtha	gal.	0	1	8	—	.....		
Tartar, Cream of	cwt.	5	7	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Prices of all "Union" articles are firmly maintained, and bleaching powder is more active. In sulphate of copper some heavy sales have been made, and the article is now firmly held at an advance of 15s. to 20s. per ton. Sulphate of ammonia is easier, and little business is being done at present. Carbolic acids are unchanged, but there is less pressure to sell crude, the production being now considerably reduced. Benzoles are easier. All qualities of sulphur are in active demand.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	36	0	0
„ Ceylon	„	29	0	0
Cottonseed	„	19	0	0
Cod	„	23	0	0
Lard	„	32	0	0
Linseed	„	21	10	0
Olive, Spanish	„	43	0	0
Palm, Lagos	„	25	10	0
Rapeseed: English	„	28	15	0
Seal: Pale	„	25	0	0
„ Brown	„	.....		
Sperm	„	48	0	0
Whale	„	21	0	0
Turpentine	per cwt.	1	8	9
Coal	per gal.	.....		
Petroleum (Refined)	„	0	0	5¾
Spirit	„	0	0	8

DIRECTORY OF PAPER MAKERS OF THE UNITED KINGDOM. London: MARCHANT, SINGER, & Co.—This useful directory contains an alphabetical list of the names of paper manufacturers, with a list of the different sorts of paper made at each mill. There is also an alphabetical list of mills, a classified list of different makes of paper, and a list of the water-marks used by paper makers and wholesale stationers.

THE INSURANCE YEAR BOOK, 1891. London: SIMPKIN, MARSHALL, & Co.—This book, which contains a complete list of the life assurance companies carrying on business in Great Britain, has a preface, in which the history of life insurance, the nature of a policy, the calculation of the premium, the conditions of the contract, the division of profits, and surrender values are all fully explained. There is also a note which gives an explanation of the summary of valuation returns, and other tables. Under the head of each company there will be found tabulated returns giving the total income and total outgo during the past five years.

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HOME INDUSTRIES.

LONDON, 26th February, 1891.

The Money Market.—The money market remains firm, but without any distinguishing feature. The efforts of the Bank to strengthen the general monetary position of the market have proved fairly effective, and the drain of gold for abroad has greatly diminished. Business in the stock markets is still on a very small scale, and there are no indications as yet of a revival. Colonial Government stocks have been firm in the expectation of legislation to add them to the list of securities in which trust funds may be invested, and investment stocks generally have been in request. Home railways are idle and irregular, and American rails are by no means brisk. The market for foreign bonds keeps fairly good, and there has been a recovery in Argentine values after a fresh decline. Silver securities are drooping, although the low price of the metal has stimulated purchases of it. A fair business is transacted in mining shares, but industrial and miscellaneous securities present no features, unless it be the constant fluctuations in Bell's asbestos shares.

The Junior Engineering Society.—At a meeting of this Society on the 20th inst. papers were read by Mr. J. B. Ball, on "Carriage Way Pavements in Large Cities," and by Mr. Albert Wollheim, on "The Design and Construction of Sewage Precipitation Works." Mr. Ball briefly described the essential features of a good carriage way pavement, pointing out the absolute necessity of a proper foundation. The present systems of paving were described, and it was stated that the Improved Wood Pavement Company had laid nearly 3,000,000 square yards of their paving. In Berlin the use of asphalte had increased between 1880 and 1887 from 127,000 to 655,000 square yards, and in London between 1883 and 1889, over 60,000 square yards of wood had been relaid with asphalte. Mr. Wollheim, in his paper, dealt with the design of sewage precipitation works and pumping machinery, and various apparatuses for adding the chemicals, and pointed out the necessity of each apparatus being automatic in its action. Some recent important experiments by Mr. Lindley, M.Inst.C.E., of Frankfort, on the displacement of water in tanks were referred to, and the principles of the design of settling tanks were considered.

New Screw Steamer for the Congo.—A new screw steamer, of a type suitable for work on the Congo, is to be built by Messrs. J. I. Thornycroft & Co., of Chiswick, for the Baptist Missionary Society. The vessel will be similar in construction to the "Peace," which had a draught of only 1ft., and will be placed at Stanley Pool, where it is to be used for mission work. The method of screw propulsion has been chosen in preference to that of paddle wheels, as the machinery is lighter and more readily transported overland to its destination. This type is perhaps better than the stern-wheel steamer, which necessitates the boiler and engines being placed at the extremity of the vessel, and thus causes an increased strain. The management of the vessel can be carried on from the upper deck, the steam valve and reversing levers being under the control of the missionary who has charge of the vessel. The dimensions of the vessel are 84ft. in length by 13ft. in breadth, and when loaded she will have a draught of 2ft. 2in. The vessel is to be provided with the Thornycroft water tube boiler, which can be easily transported overland, and quickly put together again when the parts are brought to their destination.

The West End Safe Deposit.—On the 21st inst. we had an opportunity of inspecting a safe deposit which has been opened by the Security Company, Limited, at 63, St. James's Street, S.W., and constructed by Messrs. Chubb & Sons, of 128, Queen Victoria Street, E.C. This firm are also erecting for the same company safe deposits in Birmingham and Glasgow. The West End Deposit, though not as yet so large as others in London, is exceedingly strong, being constructed of "compo" steel, 1¼in. thick, which is said to be absolutely undrillable. The principal compartments are a large safe deposit chamber, containing small safes or "pigeon-holes," a strong room for chests, fireproof throughout, and three small strong rooms, which will be let singly. The main entrance door to the large chamber, of which we hope to give an illustration in a later issue, is of massive proportions, weighing about two tons, and is built up of "compo" steel. It is secured by sixteen massive bolts, weighing nearly a quarter of a ton. Three locks are provided—viz., a patent detent lock, a change key lock, and a triple "time" lock, the latter of which will run any length of time up to seventy-two hours. These locks are fitted upon an internal spring plate, so that in case of an explosion from the outside, the concussion will be reduced to a minimum.

Institution of Mechanical Engineers.—The summer meeting of this Institution in the present year will be held at Liverpool in response to a cordial invitation received from the Mayor, Mr. Joseph B. Morgan, Assoc.Inst.C.E. and Assoc.Inst.Mech.E., on behalf of the local members of the Institution, the leading engineers, shipowners, and merchants, and other influential residents in the city and neighbourhood. The meeting will commence on the 28th of July, and will last four days.

MANCHESTER, 26th February, 1891.

A New Steam Trap.—Mr. J. J. Royle is introducing a new form of steam trap which is simple and effective. It consists of two hemispherical shells of cast iron, each of which is provided at its crown with an orifice. Within the sphere formed when the two pieces are bolted together, a copper ball is placed, and a spindle is carried up from it and passed through the upper orifice. The steam is admitted at the side and the water escapes by the lower orifice, fitted with a valve which is closed by the downward pressure of the ball. By an ingenious arrangement or proportioning of the upper orifice, the ball is put in equilibrium, and readily rises as soon as water accumulates. In this way the valve is opened, being speedily closed when the water is cleared. The new trap is very simple and compact, and is notable for the novelty of its construction.

The Prospects of the Ship Canal.—In the course of an address delivered in Salford, on the 24th inst., Mr. Marshall Stevens gave a number of interesting figures of the trade prospects of the above undertaking. After pointing out that there was practically quay space along the whole length of the canal, and that at the Manchester end alone there was dock accommodation greater than in the whole port of Cardiff, he went on to deal with the statistics of the subject. The whole of the foreign and colonial trade of the United Kingdom amounted in value to £742,343,336, of which £299,679,804 was shipped or received *vid* Liverpool and the Humber ports. The imports of food stuffs into the country amounted to 1,186,072 tons, and of raw material to 8,516,713 tons, while the exports of such materials as are manufactured or obtained in this district amounted to 28,674,392 tons. Considering that 7,000,000 persons would be served by the canal, it was certain that a large proportion of the above quantities would be carried by it, and it was further worth noticing that the magnificent navigation on the Clyde only served a nation with 3,734,700 people. About 1,000 tons of bale and case goods left Manchester daily, much of which would undoubtedly be shipped direct. Practically the whole of the salt trade would pass over the canal, and the coal trade of both Lancashire and South Yorkshire would be benefited, Manchester being the nearest shipping port for many of them.

The Engineering Trades.—Although there is still a large amount of business, there is a very perceptible decrease in the number of new orders. Many signs are to be noted of a diminished trade, and it is quite apparent that the extension of the cotton spinning industry has practically reached its limit, although it is true that many new mills are being erected. In the machine tool trade extensions are numerous. Messrs. Smith & Coventry, Limited, are carrying out a very important enlargement of their works, and Messrs. Hulse & Co. are about to commence work in a new shop, which, despite the recent large extension of their premises, has become necessary. This erecting shop is 120ft. long and 35ft. wide, and is fitted with a 25-ton overhead power travelling crane of special design, which is so arranged that the crab can be brought close up to the pillars carrying the gantry. A clear lift of 26ft. is given, this being necessary to take in the large standards of the combined vertical and horizontal planing machines made by the firm. The firm are just completing some very heavy tools, among which is a large massive planing machine for armour-plate work, and a punching and shearing machine for 1¼in. steel plates. In textile machine works much activity still prevails. Messrs. Ashworth Bros., of Manchester, are about to commence a large branch establishment in the United States for the manufacture of their well-known specialties. The land has been acquired by them near Fall River, and the project is to be pushed forward.

New Type of Oil Engine.—Messrs. Crossley Brothers, Limited, Openshaw, Manchester, delivered their first oil engine last week, a 4-horse power nominal indicating about 9½ h.p.

The Linen and Jute Trades.—The home trade still suffers from the various adverse influences which have been mentioned from time to time, and there appears to be little, if any, prospect of an immediate change for the better. As regards the shipping department, the aspect of trade is unfavourable. A private cablegram to a Portland Street shipper from Valparaiso, says: "Stop all goods, pending further news." Exchange is at 16¾d. for 90 days' bills. For the Chilian importer there is an extra burden on that account of over 100 per cent., owing to the fluctuations in the price of silver. The Eastern markets are very dull at the present time, while here also the rate of exchange has a deterrent effect. Prices of linens generally are fairly steady. Hessians are unchanged, but the position of buyers is strengthened owing to the determination of the Calcutta Jute Manufacturers' Association to resume running full time.

GLASGOW, 26th February, 1891.

Pig Iron.—The total number of furnaces in blast last week was fourteen. There are altogether 140 furnaces in Scotland, and in ordinary times from 80 to 100 of these are in blast. During the past four months only six have been in blast. In spite of the increased production yielded by the eight additional furnaces, and the prospect of a general resumption of production, the price has stiffened, and that not in consequence of speculation, but of a legitimate trade demand. This is in many ways an encouraging sign. The recent history of the Scottish iron trade affords a remarkable instance of the astuteness with which the iron manufacture is carried on. The furnaces were blown out and production stopped just at the time when demand had definitely slackened, and when prices began to show a downward tendency, and the obvious meaning of the movement was cleverly disguised by seizing the occasion of dissatisfaction among the furnacemen to effect what was in reality a lock-out. A week or two ago, before the increased demand was visible to those outside, the makers began to resume production, and before the furnaces are fully in blast find themselves making for a rising market. The series of events shows the shrewdness of those who administer the huge concerns connected with the iron trade of Scotland. It remains to be seen, however, whether the demand which has already influenced the trade to a small extent will be maintained.

Labour Troubles.—The most important labour dispute pending is the strike of blast furnacemen, which has already lasted about five months, and is now going on without any sign of a settlement. The demands of the men involve practically the assimilation of the Scotch to the English system of working. They demanded originally an eight-hour shift, with extra pay for Sunday duty. They seem, however, to have narrowed their demand to the latter point, and are now understood to be holding out for time and a half wages for Sunday. The ironmasters have met this with the announcement that they refuse to give extra pay for Sunday, and that they intend reducing the rate of wages by 20 per cent. The men have offered to submit the question of wages to arbitration, and have intimated that, should the state of the market show a reduction in wages to be necessary, they will accept it, but that they cannot forego the claim for extra pay as regards Sunday duty. Meanwhile, Messrs. Dixon & Co. have relighted a portion of their furnaces, and have secured a number of men to take the places of those on strike.—On the 24th inst. the boilermakers employed by Messrs. Scott & Co., Greenock, numbering about one hundred, struck work on the ground that one of their number had been dismissed owing to his having refused to work during the night. It seems that there is a union rule against night work, excepting under special conditions, and the case named is alleged to have been in contravention of this rule.

Engineering and Shipbuilding.—There is still a lack of orders in local engineering and shipbuilding circles. Some of the larger establishments have, however, still large contracts which are keeping them employed, though there is a dearth of new orders to replace these as they are worked off. The smaller concerns are fairly busy, though with work of no great magnitude. There are, nevertheless one or two heavy contracts for engineering material, for which Glasgow firms are at present quoting. Messrs. Wm. Arrol & Co. are making rapid progress with the material for the superstructure of the Tower Bridge. The columns, girders, and ties are built and drilled in position in the yard before being despatched to London for erection. The drilling is being done partly by rope-geared multiple drills as used on the Forth Bridge contract, and partly by electrical drills. These are worked by a "Manchester" dynamo and motor, and have been applied most successfully to this particular work. The riveting will, of course, be done by Messrs. Arrol & Co.'s well-known hydraulic riveter. As an instance of the fluctuating character of the earnings of shipbuilding firms, it is to be noted that Messrs. W. B. Thomson & Co., Limited, engineers and shipbuilders Dundee, have last year earned a profit of under £90, exclusive of a payment for interest, which causes the year's working to show a loss of about £1,000. There remained, however, a balance of undivided profits at the beginning of the year's work of £3,700, and to this sum Mr. Thomson has added sufficient to pay a dividend of 6 per cent. on the capital, according to the terms of his agreement with the company. The prospectus of Messrs. Merry & Cunninghame (Limited), to which reference was made last week, has now been issued. The capital is £250,000 in shares of £10 each, one half of the capital in preference and the remaining half in ordinary shares.

(From our own Correspondents.)

LIVERPOOL, 25th February, 1891.

The Mersey Bar.—The dredging operations which have been conducted for many months, with the object of removing the bar at the mouth of the Mersey, have so far been quite unsuccessful. Although 117,000 tons have been removed by the suction dredgers, recent surveys have shown that this amount has made no appreciable difference in the depth of the water over the bar. This result verifies the opinion of experts, who were of opinion that dredging operations, to be effective in this particular case, should only be adopted as an auxiliary to permanent works. If these operations are continued it is probable that the £20,000 voted by the Dock Board will be expended in vain.

The Atlantic Cattle Trade.—With regard to the investigation now being made as to the accommodation for cattle upon board the steamers, and the methods of embarking and discharging the cargoes of live stock, it may be noted that the steamer "Alexander Elder" has just arrived, after a stormy voyage, with 790 head of cattle on board without losing a single head, and that during the last few months she landed over 7,000 head of cattle with the loss of only eight animals.

SHEFFIELD, 25th February, 1891.

Iron and Steel.—A steady amount of work continues to be turned out here, but there is not so much overtime worked as was the case six months ago. The demand for railway material is still active, and a fairly large order for

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rails has been placed. Sheffield is able to produce the best steel rails at a low price, and, with a free entry into Continental ports, would do a good business. Rolling stock builders expect some large orders for coal waggons from the home railways, most of whom, it is said, will be compelled to adopt the Midland Railway's policy of owning their freight trucks. The trade in steel castings is very quiet, but the cause of this is not apparent, as the shipbuilding and other heavy trades are fairly brisk, and these are usually the best customers for castings. Leeds engineers continue to draw their material in great part from Sheffield, but they sometimes give a large order to Germany, especially when they want it very cheap and the testing is not too severe. Some very heavy machine tools, as well as cranes and hydraulic plant for special work, have been supplied by the leading makers in Leeds. Local engineers continue busy mainly on work given out last year, and the small firms employed in making drilling machines, ratchet braces, spanners, taps, and dies are doing a brisk trade.

ELECTRIC LIGHTING AT BARNSLEY.—The Corporation have applied to the Board of Trade for sanction to borrow £23,000, to be applied for electric lighting purposes. With regard to overhead wires, the Board of Trade say that, while they are very unwilling, in the case of a permanent installation, to approve of a system in which overhead lines are used, in deference to the wishes expressed by the Corporation, they will not decline to approve of the proposed system in the present case. It is estimated that an additional £20,000 would be required to place the wires underground.

GENERAL.—The general trades of the town are fairly good, but a few of the cutlery hands are idle owing to the closing of some markets abroad, mainly in the United States. Silversmiths and electro-platers are busy, and Messrs. Mappin & Webb, one of the leading firms, are extending their plant considerably. Taken as a whole the Sheffield trades may be said to be good.

DREDGING MACHINERY.—A large consignment of dredging machinery has recently been shipped for the Spanish Government from the works of Messrs. Rose, Downs, & Thompson, of the Old Foundry, Hull, comprising five of their largest D-size "Kingston" dredgers, for fixing to the decks of ordinary wood floats, for use in the Philippine Islands, and a large hopper barge, fitted with a "Kingston" dredger and compound surface-condensing engines and marine boiler, for use at the Spanish Arsenal at Carraca, Cadiz. The whole of this order has been shipped in pieces for re-erection abroad. The work is of the highest class, and has been completed under the personal inspection of Captain J. Alvarez, S.R.N., the naval architect to the Spanish Royal Naval Commission in London. We understand that these orders were obtained by Messrs. Rose, Downs, & Thompson in direct competition, and it is expected that further orders will follow as a result of the satisfactory tests.

BIRMINGHAM, 25th February, 1891.

GENERAL.—Business generally continues quiet. In the iron trade inquiries are few, and there are not many orders. Eastern buyers are pressing for delivery of orders already placed. "Marked" bars are still at £8 per ton at works, with £1 10s. extra for "Best," and £2 10s. extra for "Best Best." Some few specifications are being taken for common iron bars at £6, and cable bars at £6 7s. 6d. per ton. Cinder pig is being sold at 40s. per ton, hot blast at 70s., and cold blast at 95s. to 100s.

CHAINS.—Chain and cable makers are still fairly well employed, but report that fresh orders are very scarce. The Lloyd's Proving Houses at Tipton and Netherton are full of work. All cables for ships are tested at these houses according to Act of Parliament, and the users of short link crane and incline chains seem disposed to insist on having certificates from the same authorities. It would, perhaps, be wise for Parliament to pass an Act to control the inspection and testing of all crane and other chains.

LEICESTER, 25th February, 1891.

COAL MINING.—There has been some decrease in the number of orders. The collieries are working less time than they have done for a considerable period. The stocks on hand are very low, and prices are in consequence well maintained. Coal owners are very firm in resisting concessions in view of large contracts. The pottery and tile works are all well employed.

WOOL SPINNING AND YARN TRADES.—The local wool market is feeling the effects of the late London sales, and prices are fully maintained. There has not been a large amount of business in the past few days. Indeed, it is somewhat inactive, though there is a steady consumption. The business done is for present needs, and speculative operations are quite absent. Average deep-stapled fleeces make 22s. 6d. to 23s. 6d. per tod; superior lots, 24s. to 25s. per tod; choice lots, majority Shropshires, 26s. to 27s. per tod. Spinners are not very busy, and orders taken are at barely remunerative prices.

BOOT AND SHOE TRADE.—There has been a further accession of business, and generally this industry is in better condition, but the amount of trade does not yet reach the average of last year. Though there is an absence of great pressure, workpeople are fairly well employed. Leather merchants are doing more business, but buyers are cautious, anticipating a fall in the market. There are, however, no indications of there being any decrease in current quotations.

SWANSEA, 25th February, 1891.

PUBLIC WORKS.—The Swansea County Borough Council are seeking to borrow £88,000 for works of sewerage and water supply.—The London and North-Western Railway Company have offered to spend £20,000 in replacing their present tips at the Swansea South Dock by the most recent appliances, but they stipulate that the Trust shall deepen the entrance to the dock. A scheme to render the River Tawe navigable might contribute to this end. The idea was considered impracticable fifty years ago owing to the freshets in the river, but it is contended that the scheme is not beyond modern engineering skill. If carried out it would give Swansea a floating harbour all the way up to the weir at Morriston, and although it would probably cost £200,000, the improvements would result in a permanent saving to the Trust.

CLOSING OF IRON AND STEEL WORKS.—In a few days the Rhymney Iron Works will be closed, and the directors of some of the other large iron and steel works in the district are talking of blowing out their furnaces owing to the high price of fuel and labour, which makes profits impossible.

CARDIFF, 25th February, 1891.

IRON AND STEEL.—The pig iron market is still depressed, and prices show no improvement. The inquiry for steel rails is very poor, and at the Rhymney Works it has been decided to suspend operations at the rail mill. In the iron ore trade, Rubio of good quality is quoted at 14s. c.i.f. Cardiff or Newport, 14s. 3d. Swansea, 15s. Port Talbot, 14s. 9d. Porthcawl, 15s. 6d. Glasgow, 15s. Tyne, 15s. 3d. Tees.

COAL AND COKE.—The condition of the steam coal market this week is not so satisfactory as in recent weeks, a natural result of the possible development of labour disputes. Steam coal is weaker, although a number of colliery owners are so well supplied with orders that they have not been forced to follow the downward tendency. Current quotations are:—No. 1 quality, 14s. 9d. to 15s. 3d. f.o.b.; No. 2 quality, 13s. 9d. to 14s. 6d. f.o.b.; No. 3 quality, 13s. 3d. to 13s. 6d. f.o.b.; No. 4 quality, 12s. 6d. to 13s. f.o.b. Small steam coal, 5s. 6d. to 5s. 9d. For house coal there is a brisk demand at rather lower figures, 13s. 9d. to 14s. being the ruling figure for No. 3 Rhondda, and 12s. 6d. for No. 2. Patent fuel realises 13s. 6d. to 13s. 9d. In the coke trade one or two export orders have come to hand for furnace coke, which is quoted at 19s. 6d. to 20s. 6d. f.o.b.; foundry, 21s. 6d. to 22s.; best foundry, 24s. to 27s.

INSTITUTE OF MARINE ENGINEERS.—The Senatus of the University College of South Wales and Monmouthshire has granted to the members of the Bristol Channel Section of the Institute of Marine Engineers the free use of certain rooms, for the purpose of meetings, in the University College, Cardiff. A resolution was passed at a meeting of the local members of the Institute in Cardiff to the effect "that the best thanks of the Institute of Marine Engineers be given to the Registrar and Council of the University College of South Wales and Monmouthshire, for granting us the free use of rooms in the college for the purpose of holding local meetings." Professor Elliot has been elected chairman.

THE BRITISH ASSOCIATION MEETING.—The following list of nominations has been made for the Sectional Presidencies for the Cardiff meeting, which will commence on the 19th of August next:—A (mathematics and physics), Professor O. J. Lodge; B (chemistry), Professor Roberts-Austen; C (geology), Professor T. Rupert Jones; D (biology), Mr. F. Darwin; E (geography), Mr. E. G. Ravenstein; F (economic science), Rev. Dr. Cunningham; G (mechanics), Mr. T. Forster Brown; H (anthropology), Professor Max Müller.

BARROW-IN-FURNESS, 25th February, 1891.

HEMATITE.—There is but a small business doing in hematite pig iron. Prices have improved, owing to the clearance of stocks of hematite warrants for consumptive purposes to the extent of 3,726 tons, leaving the stocks still in hand at 209,482 tons. Hematite warrants have changed hands at 50s. 10d. net cash, but makers are still asking 53s. per ton for Bessemer mixed numbers net f.o.b., and complain that they cannot make a profit with raw material at its present cost. Iron ore is in less request, being at 10s. 6d. to 11s. 6d. per ton net at mines, and East Coast coke is still firm at 21s. to 22s. per ton delivered at the furnaces. Another furnace has been blown out at the West Cumberland Works, where only one out of six furnaces are in blast. Forty-one furnaces are blowing in the North-West district, and 35 are idle, 8 being idle in Furness, and 27 in West Cumberland, although 48 furnaces are built in the latter district, and only 28 in the former. The reason for this curious position is the fact that makers are much better employed in Furness than in Cumberland, at Barrow alone 12 of the 14 furnaces being in blast.

STEEL.—There is less activity in the steel trade, and although a few orders for rails have been placed during the week, the outlook is not cheerful, nor is it at all likely that the mills will be busily employed throughout the season; in fact, in West Cumberland the mills are only on short time, and at Barrow this week, for the first time over a long period, the mills did not start till Tuesday morning. Prices are unchanged, with rails at £4 15s. for heavy sections.

MIDDLESBROUGH, 25th February, 1891.

PIG IRON.—There was a large attendance at the weekly market held on 'Change, and a more cheerful feeling prevailed. The improved shipments indicate a better demand, and have had a favourable effect upon prices. Merchants ask 42s. 3d. for No. 3 G.M.B., buyers offering from 42s. to to 42s. 1½d. Cleveland warrants are 42s. cash buyers. In hematite, East Coast brands are 54s. per ton f.o.b. mixed numbers, sellers; West Coast brands are 50s. 9d. cash buyers, sellers 1½d. more. The stock in Connal's store on the 23rd inst. amounted to 123,373 tons, being an increase this month of 367 tons.

SHIPMENTS OF PIG IRON.—These are very favourable this month, amounting till the 23rd inst. to 60,094 tons, as against 31,338 tons to the 23rd of last month, and 32,921 tons to the 23rd of February, 1890. Scotland took 32,220 tons; other parts of England and Wales, 6,775 tons; and foreign countries, 21,099 tons. The main improvement is to Scotland, but the increase is general, and there is a very hopeful prospect.

MANUFACTURED IRON AND STEEL.—Prices are unchanged, but inquiries are fewer and the prospect rather duller. Some large orders have been placed lately for railway material, but they are said to have been taken at very low prices. Iron ship plates, £5 15s.; angles, £5 12s. 6d.; bars, £5 15s.; steel ship plates, £6; angles, £6 5s.; rails, £4 17s. 6d. per ton, all less the usual discount and on the usual terms.

NEWCASTLE, 25th February, 1891.

THE COAL TRADE.—In connection with the Northumberland coal trade a hopeful feeling exists, but it appears to have no better foundation than the possible development of labour complications elsewhere. The output at the pits is being increased, and the tendency to firmness in prices is somewhat strengthened. The shipments of coals and coke at Tyne Dock during the week ending the 21st inst. amounted to 104,673 tons, being a decrease as compared with the corresponding week last year of 3,012 tons.

SHIPBUILDING.—Though the pressure of work in most of the yards is diminishing, and the feeling in commercial circles is somewhat despondent, it is a hopeful sign that, in addition to some foreign orders for tonnage that have been secured in this district lately, one or two important contracts have also been obtained from English shipowners. Among these may be mentioned an order for a vessel of superior type, which is to have a carrying capacity of 7,000 tons. This order has been obtained by Messrs. C. S. Swan & Hunter from a leading Hartlepool shipowning firm. The engines and boilers for this vessel have been ordered from the Wallsend Slipway and Engineering Company, Limited, and they will be constructed on the latest principles, with a view to the attainment of high speed combined with economical consumption of fuel.

NEW COMPANY.—The old-established firm of Messrs. T. & W. Smith & Co., shipbuilders and repairers, North Shields, has been converted into a limited liability company, under the style of the Smith's Dock Company, Limited. Under the newly constituted company it is proposed to further develop the business by adding a pontoon dock and suitable premises for the carrying on of engine repairing. Some time ago the probability of a pontoon dock being provided at these works was mentioned in this column, and it is satisfactory to find that the prediction then made, on the strength of information received at the time, is likely to be fulfilled.

THE TIMBER TRADE.—Just now there is but little timber being imported, and at the docks nothing is being done, except the forwarding of numerous lots of mining timber to the various collieries. At the sawmills business is fairly active; the brisk state of the local building trade is causing a large demand for sawn timber and mouldings.

DUNDEE, 25th February, 1891.

JUTE AND FLAX TRADES.—Neither branch of the local industry presents any new feature of interest. Last week prices of jute were low, in consequence of a low exchange, but buyers did not operate freely. Little further reduction is looked for, and a rise of prices yesterday is attributed to the increased disposition to buy shown by spinners. Cable advices from Calcutta report that prices of loose jute are firm, and that the market for baled jute shows an upward tendency. In the local market yesterday there was more business done both for distant and in spot parcels, and the market was firmer. Jute yarns are firmly held, and there is considerable inquiry. There is a fair demand for jute goods from the United States and Canada. Cablegrams from New York report a firm market there, burlaps 40in. 10½oz. being quoted at 5 1/16c. per yard, and light weights at 4¾c. per yard. The political disturbances in Chili and Argentina exercise a disturbing influence on the South American trade The market for flax and tows has been quiet, but there are some indications of improvement. In Fife yarns transactions are reported to be fairly numerous, but other sorts are quiet. There is a pretty good home demand for linens, but there is room for improvement in the foreign inquiry. Sailcloth is dull, and some curtailment of production is expected.

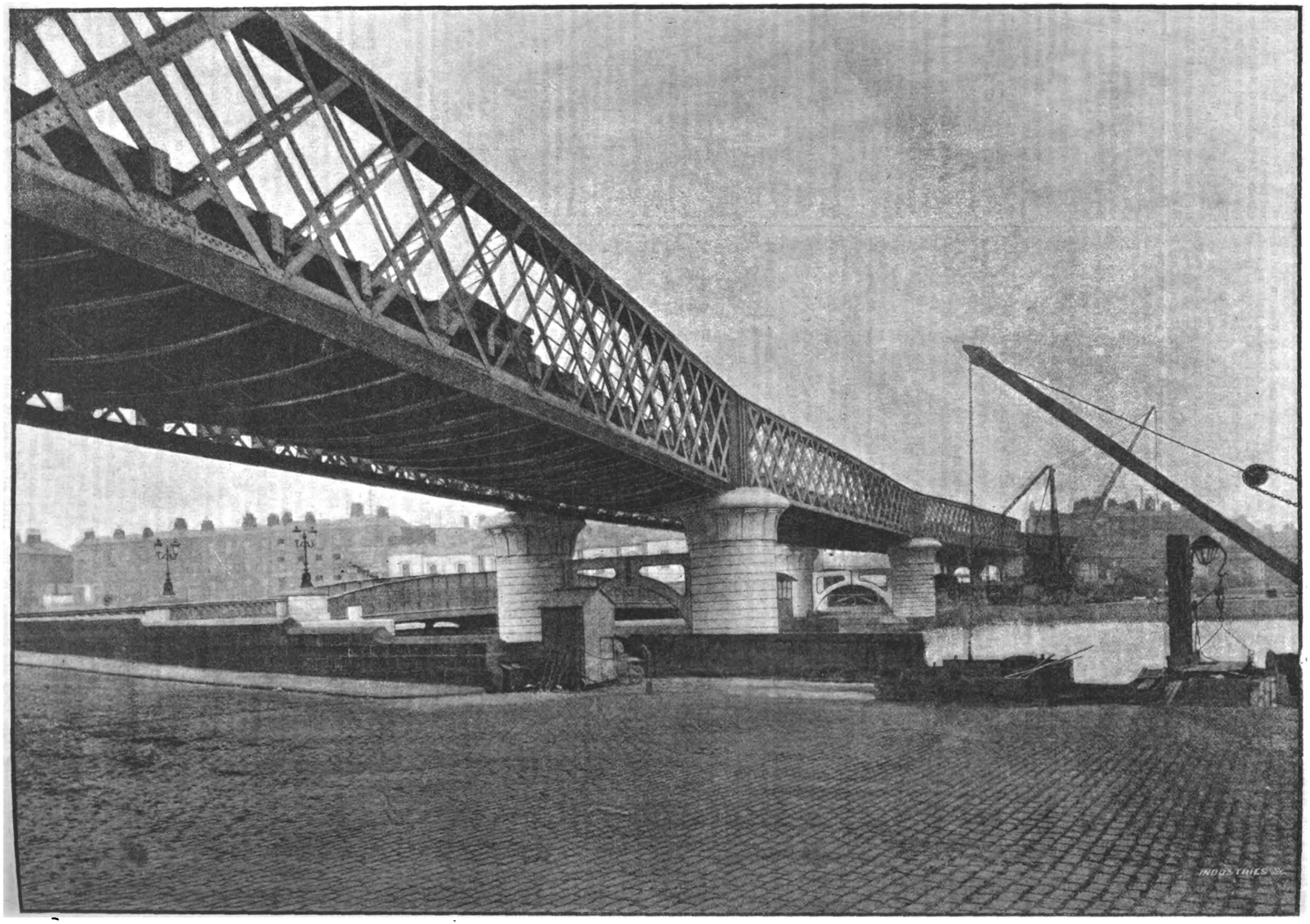
NEW RAILWAY.—The first sod of a new railway, which is to run from Crieff to Comrie, was cut last week. The contracts amount to £30,000, and the total cost of the undertaking is expected to be about £40,000. The distance of Comrie from Crieff is between six and seven miles.

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DESIGNED BY MR. JOHN CHALONER SMITH, M.INST.C.E., AND MR. WILLIAM H. MILLS, M.INST.C.E.

(*For description see page* 201.)



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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 27TH FEBRUARY, 1891.

THE BOARD OF TRADE AND RAILWAY RATES.

THE Board of Trade have this week introduced into Parliament their Bill to confirm the provisional order recently made by them under the Railway and Canal Traffic Act of 1888. It is not too much to say that no more important measure, as affecting trade and industry, has ever been presented for the consideration of the House of Commons. The Railway and Canal Traffic Act of 1888 mainly dealt with general principles, which were enunciated in the various enactments that the Act called into operation; but this is a matter that deals essentially with details, and it is detail that mostly concerns both the railways and the traders in their everyday relations. The new Bill does not go quite so far as the traders generally would desire, but it goes much farther than the deposited schedules of maximum rates and charges, and the proposed classification of goods and mineral traffic submitted by the companies themselves, in accordance with Section 25 of the Act of 1888. It even goes farther than the proposals contained in the Report of the Commissioners of the Board of Trade, made in July last, for it has been found expedient to make essential modifications of both station and service terminals, as specified in that Report. What, however, is still the main blemish of the Bill, in the view of traders generally, is the recognition of station and service terminals, against which traders as a body have urgently fought. The maximum station terminal is defined in the Bill to be "the maximum charge which the company may make to a trader for the use of the accommodation (exclusive of coal drops) provided, and for the duties undertaken for which no other provision is made in this schedule by the company, at the terminal station for, or in dealing with merchandise, as carriers thereof, before or after conveyance." This clause is, of course, a distinct acknowledgment of the right of a railway company to make charges other than those authorised in their schedules for conveyance, without reference to services actually rendered. In other words, the Board of Trade authorises separate charges for the use of premises that the traders have always regarded as, and maintained to be, an integral part of the railway. But when we come down from the recognition of the principle of station terminals to the consideration of their details, we find that the traders have not quite so much cause for dissatisfaction. The station terminal proposed by the London and North-Western Railway Company, in their deposited schedule, was 1s. 4d. for Class A, 2s. for Class B, and 2s. 6d. for Class C traffic, including both ends. The Board of Trade originally proposed that these terminals should be reduced to 1s., 1s. 6d., and 2s., including both ends, but this proposal having been resisted by the traders, the Bill now before Parliament has been so far modified in respect to terminals that the station terminals proposed are only about one-half of those originally proposed, being 6d. per ton for Class A traffic, 1s. per ton for Class B traffic, and 2s. for Class C traffic, including each end. The station terminals proposed for the other classes—that is, from Class 1 to Class 5 inclusive—are 1s. 6d. at each end, or 3s. in all, whereas, in the original schedules of the London and North-Western Railway Company, they were set down as 4s. between two large towns, 3s. 6d. between a large and a small town, and 3s. between two small towns. The terminal proposed for Class A, or mineral traffic, is as low as it could well be, if a terminal is to be allowed at all, and from this point of view, therefore, traders have not much reason to complain. The companies are entitled in this class to make a charge for the use of trucks, where these are provided by them and not by the traders, in addition to the maximum rates, which, in the Bill now submitted to Parliament, are the same as those proposed in the Report of the Board of Trade issued in July last. The comparative maximum rates in each class, under each set of schedules, are shown in the following statement:—

Class.	Ten Miles. L. & N.W. Ry.	Ten Miles. Board of Trade.	For Thirty Miles. L. & N. W. Ry.	For Thirty Miles. Board of Trade.	For Fifty Miles. L. & N. W. Ry.	For Fifty Miles. Board of Trade.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
A ...	0 10	0 9	2 6	2 2	4 2	3 7
B ..	1 8	1 1	4 7	2 11	6 11	4 10
C ...	2 1	1 5	5 10	4 0	9 0	6 8
1 ...	2 6	1 10	7 1	5 2	10 10	8 7
2 ...	2 9	2 3	7 9	6 3	12 1	10 6
3 ...	2 11	2 6	8 7	7 2	3 9	11 11
4 ...	3 4	3 0	9 10	8 8	15 10	14 5
5 ...	4 2	3 7	12 1	10 2	19 2	16 11

Here there is a considerable reduction in class rates all round, which cannot fail to be satisfactory to a large body of traders. But what is equally important is the fact that the traders have succeeded in getting the classification to a large extent recast. The iron and steel trades, for example, have had the bulk of their productions transferred from Classes 1 and C to Class B, and, although they did not succeed in getting pig iron placed in Class A, for which some of the principal traders contended, they have had a more than compensating gain in the transference of the bulk of their manufactures to a lower class than those in which they were originally placed. It has been much the same with other manufacturers. The Board of Trade has shown its readiness to listen to all reasonable representations affecting classification, and the general result has been a schedule which is certainly a great improvement upon that originally submitted by the companies. So far as service terminals are concerned, it has been a difficult thing for the Board of Trade to fix the amount to which the companies are fairly entitled in respect of operations beyond the mere conveyance of traffic. Those operations or services generally consist in loading and unloading, covering and uncovering. The following statement shows the amounts asked for in the companies' schedules, and the amounts proposed to be allowed in the Bill of the Board of Trade, the latter distinguishing the sum due in respect of each specific service, while the former simply lumped the whole amount claimed in one item:—

MAXIMUM SERVICE TERMINALS INCLUDING BOTH ENDS PROPOSED BY THE LONDON AND NORTH-WESTERN RAILWAY COMPANY.

Class.	Between Two Large Towns.	Between Two Small Towns.
	s. d.	s. d.
A } B }	A reasonable sum, subject to determination by the Railway Commissioners.	
C	1 6	1 0
1	3 0	2 0
2	3 6	2 6
3	4 0	3 0
4	5 6	4 0
5	7 0	5 0

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MAXIMUM SERVICE TERMINALS INCLUDING BOTH ENDS PROPOSED BY THE BOARD OF TRADE.

Class.

A, B { Such reasonable sum as, in case of difference, shall be determined by an arbitrator appointed by the Board of Trade.

	Loading.		Unloading. At Each End.		Covering.		Uncovering.		Total.	
	s.	d.	s.	d.	d.		d.		s.	d.
C	0	3	0	3	1		1		0	8
1	0	5	0	5	1·5		1·5		1	1
2	0	8	0	8	2		2		1	8
3	1	0	1	0	2		2		2	4
4	1	4	1	4	3		3		3	2
5	1	8	1	8	4		4		4	0

There is not so much difference between the service terminals proposed by the companies and those appointed by the Board of Trade as is found in the station terminals, and in the terminals sought for in Classes A and B by some of the companies. The Board of Trade, however, proposes to allow the traders to perform such services for themselves if they desire to do so, and thereby gives them the opportunity of avoiding making any payment if they think the amounts excessive. To these terms the traders can hardly offer any reasonable objection, and it is more than probable that in practice, except with very large traders, who are concerned in having their work done in a particular way and within short limits of time, the railway companies will get the business that comes under the head of service terminals to do as hitherto.

It is probable that there will be a great fight in the future over the whole question of railway rates and charges. The railway companies are far from satisfied with the Board of Trade proposals. They speak of them as confiscatory, and have apparently determined to resist them to the utmost. The Bill will, therefore, when referred to a Select Committee—as it is practically certain it will be—have its provisions and proposals as hotly contested as the original schedules were when under the consideration of the Board of Trade Commissioners. But it would be a matter for regret if the whole ground had to be gone over again, and it is to be hoped that the Government will be able to devise some method of dealing with the Bill whereby this expensive and inconvenient course may be avoided.

PROPOSED LABOUR COMMISSION.

EXCEPT for the amount of information which such an inquiry must elicit, it is difficult to see what purpose the appointment of a labour commission can serve. We have had a plethora of commissions upon labour, and each of them have published voluminous reports, useful certainly to the economist, useless almost altogether for practical purposes, excepting so far as the researches of the economist after filtering through many minds effects these. Factory Commissions, Trade Union Commissions, Depression of Trade Commissions, Sweating Commissions, Poor Law Commissions have all been more or less labour commissions, each after its kind. All authoritative information upon questions of this sort is no doubt valuable, or at all events contains some modicum of valuable matter; but much might be ascertained without the machinery of a Royal Commission which has not yet been ascertained. For example, there are no adequate statistics of the rates of wages available either for the present time or for any period. Nor are there any adequate statistics of the cost of living now or at any other period. The same applies to the rate of profits. Thus one of the elements essential to a thorough understanding of the problem of the relations of capital and labour is wanting. Either the question must be dismissed as incapable of solution by the study of materials of this sort—and there is some justification for this view—or these must be made the basis of some fruitful inquiry on the subject. But such an inquiry does not lie within the possible province of a Royal Commission. It is an inquiry which might be appropriately undertaken by the Labour Correspondent of the Board of Trade, or, better, by a competent statistician. There is indeed nothing that the Commission is at all likely to discover which would not in all probability be discovered and expounded more speedily and more accurately by some such competent and experienced hand as Mr. Charles Booth, or one of the other experts of the Statistical Society.

If the intention is to follow up the report of the Commission by a series of labour laws, whose all-embracing provisions would enclose us in a mighty legislative machine, then indeed the Commission ought to be opposed. It is possible, however, that, like many another Commission, its Final Report may be the end of it, and its ponderous blue-books remain only as a kind of photograph of our social state for the benefit of future generations. While this criticism may be urged against confidence in the outcome of the Commission, there is one subject connected with labour already dealt with by the legislature which ought decidedly to be investigated with a view at least to make the provisions of the law plain to the judges who have to administer it. The recent contradictory judgments—*e.g.*, by Mr. Justice Cave and by Mr. Bompas, Q.C.—besides many others, and the uncertainty of jury trials under the Conspiracy Act of 1875 show conclusively that the Act requires revision. Conduct regarded in one court as criminal, in another court is innocent. This ought not to be. Whatever the law is, it ought to be clear and distinct. A man ought to know the limits of his freedom, or to have the opportunity of knowing them. A proper codification of the law of master and servant, and a healthily critical and, so far as may be, unbiassed tone of public opinion during labour disputes is far more likely to be effectual than any number of Royal Commissions or labour laws. This involves, however, a greater amount of public enlightenment than we have at present. It is a long method, but it seems the best. Legislation has always the appearance of being a short and easy method; but here, as in many other departments, the longest way round may be the shortest way home.

THE RETIREMENT OF SIR RICHARD MOON.

THE half-yearly meeting of the proprietors of the London and North-Western Railway Company, which took place last week, although held in the ordinary course of business, marked an event which was not only of importance to the railway chiefly concerned, but also noteworthy in the history of railways generally. The event to which we refer is the retirement of Sir Richard Moon from the chairmanship. Sir Richard has been so long connected with the London and North-Western Railway, and has so impressed his personality on its management, that all who know anything about railway work immediately call him to mind when that railway is mentioned. His great business qualities, his attention to details, and his entire devotion to his work have given him a unique position among railway directors, and will make his place exceedingly difficult to fill. No doubt he had surrounded himself with an exceedingly able body of men, and we hope that Lord Stalbridge, who has been elected to his position, will, not only by his own energy and ability, but also by securing the goodwill and hearty co-operation of his staff, be able to carry on the business of the company with success, a condition which requires due attention to the interests of the shareholders, to the welfare of the workers in all departments, and to the convenience and safety of the public.

Mr. W. H. Smith, M.P., expressed in a graceful manner the feelings of the shareholders regarding the retirement of the Chairman. He reminded them that Sir Richard Moon had joined the company as director forty years ago, and that he was elected chairman over thirty years ago. In that position he was fortunate in finding the chief work of his life, and he devoted himself entirely to it, seeking neither honour in other directions nor profit in other employments. No doubt his highest reward was in the confidence which the shareholders continued to express in the direction of the company, and in the assurance that its affairs were being conducted with honesty, with integrity, with a perfect regard to the claims and interests of the shareholders, and at the same time with due regard to the duties the company had to discharge to the public and to its servants. He also found part of his reward in the success which attended the operations of the company, which was in great part due to him in co-operation with the able staff with which he surrounded himself. Success is measured not merely by size of dividends, but also by goodwill between the servants of such an immense company and its officers and directors and freedom from labour disputes. The London and North-Western Company has been exceedingly free from such disputes, and its servants have shown during periods of excitement and agitation that they can adhere to the interests of the company, a state of affairs which is due largely to the influence and spirit of the man having the leading control. The consequence has been that the company, notwithstanding vigilant competition, has made great and rapid progress. It has consequently been able to get along without much of that fighting which has disfigured some of our commercial undertakings, and which has lessened the confidence that the public had in them. It has retained the confidence of its workmen by the care it has taken of their interests. As an example of this, it may be noted that it contributes about £24,000 a year to their sick and benefit funds in various ways, and a payment is thus produced, due partly to the contributions of the company, but more largely to those of the men themselves, of £60,000 a year, which comes to about £1 per head for all employed by the company. The servants of every grade are thus made to feel, and they show that they feel, that their interests are cared for by the company, that the company's interests are theirs, and that, in point of fact, it is one large co-operative concern for the benefit of all who are interested in it.

Sir Richard Moon, in replying to the kind things said of him at the meeting last week, indicated the secret of his success. He devoted himself, in the first place, to the interests of the company, and took care that its honour and integrity were maintained, and that its promises were fulfilled. He surrounded himself with good officers and servants, and treated them fairly. He was thus able to make everyone in the service loyal to the company, and he expressed the opinion that there was not any society in this country, or in the world, as loyal to its employers as the staff of the London and North-Western Company. He had always tried to show that it was only by treating servants well and loyally—in fact, by being one of them—that we could expect faithful work, and he impressed this upon his officers. At his farewell meeting with them, he gave this advice: "Remember, first of all, you are gentlemen; next, you are North-Western officers. Whatever you promise you must perform, and, therefore, be careful what you promise, but take care you perform it." If the same spirit existed generally between employers and employed there would be less difficulty between capital and labour. We have, therefore, dwelt on the work of Sir Richard Moon, as having a most important bearing on the trade and industry of the country. Such men do far more good in their day and generation by liberal-minded example than specialists in any department of science, however distinguished, for they not only provide the means of living, but also show us how to live and enjoy life in the highest and best sense. We are sure that our readers will unite with the shareholders of the London and North-Western Railway Company in expressing the hope that Sir Richard Moon may long enjoy a well-earned rest in his retirement.

THE "JUBILEE" OF THE CHEMICAL SOCIETY.

OUR readers have been made aware (see *Industries*, Vol. X., page 116) that the Chemical Society had made arrangements to celebrate their "jubilee" this week. On the afternoon of the 24th inst. a meeting was held in the theatre of the University of London, at which the President (Dr. Russell) made an introductory speech, tracing the position of chemical science before the year 1841, and the steps which led to the formation of the Society in the February of that year. Early in this century, Dalton, Davy, Cavendish, and Wollaston upheld the position of chemistry in this country, but a period of apparent inactivity followed, which induced Mr. Robert Warington to issue a circular inviting persons to become members of the proposed Chemical Society. Mr. Robert Warington's contribution to the proceedings of the meeting this week was of especial interest, as he is the son of the Mr. Warington who was so instrumental in bringing about the formation of the Society. He had fortunately kept the letters which his father had received, and these he had arranged and tabulated in an album which he presented to the Society.

Professor Odling, of Oxford, followed with a short sketch of the development of chemical theory during the last fifty years, and the proceedings terminated with the presentation of addresses from the Royal Society, by Dr. John Evans and Lord Rayleigh; from the Pharmaceutical Society, by the President; from the Société Chimique de Paris, by M. Gautier; from the Deutsche Chemische Gesellschaft, by Dr. Will; from the German Society of Chemical Industry, by Dr. J. F. Holtz; and the reading of an address from the Russian Physico-Chemical Society and congratulatory telegrams from many distinguished foreign chemists.

In the evening a *soirée* was held at the Goldsmiths' Hall, at which was exhibited an unique collection of apparatus and specimens illustrative of the work of Gilbert, Hauckwitz, Sir Isaac Newton, Scheele, Cavendish, Sir Humphrey Davy, Thomas Young, Dalton, Sir John Herschel, Berzelius, and Faraday; together with that of past presidents of the Society, amongst whom were represented Thomas Graham, Brodie, Gladstone, Warren de la Rue, Frankland, Sir Frederick Abel, Sir Henry Roscoe, Gilbert, Perkin, Hugo, Müller, and Crookes.

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On Wednesday evening the Fellows entertained the foreign delegates and guests from kindred societies at a dinner at the Hôtel Métropole, when the Marquis of Salisbury made an excellent speech on the scope and practical use of chemical science.

Letters to the Editor.

IS THE STUDY OF THERMODYNAMICS OF USE TO ENGINEERS?

To the Editor of "Industries."

Sir,—When I first read the question, "Is the study of thermodynamics of use to engineers?" asked by the letter of "Student" in your issue of the 9th ult., I found myself inwardly replying, "It depends upon the engineer!" for I have not yet forgotten the story of the legal witness who, posing as an engineer, turned out to be a maker of iron bedsteads; and one would scarcely hesitate to answer the question with a negative for him!

Probably what "Student" really wants to know is if the study of thermodynamics is of any use to *him*, since this is a very natural and certainly a more wisely definite inquiry than the more general one he puts forth. I am frequently being asked by puzzled students and beginners in the profession whether such and such branches of engineering study are of any use, and I have long ago given up answering such questions without knowing something of the training and knowledge of the questioner, and of his probable future work. Since one could not honestly and unreservedly give an affirmative reply to the inquirer with "Student's" question who was quite certain to limit his engineering work to some branch of hydraulics, such as the manufacture and working of turbines, any more than I am now able to fully assure a student friend, who, with a veritable passion for locomotives, and with a fixed resolve to work at nothing else, is puzzled just now to see how he is most usefully employing his time in the construction of dock walls and the design of turbines, on which his college course now necessitates his working.

Then, again, it is very desirable to recognise something of what is mutually meant by "thermodynamics," and what is to be the criterion by which to measure the use of its study. Some of your correspondents, notably those connected with education, have not failed to acknowledge that the advantage of a certain study is often found only in the mental exercise and power it affords, and your own article has pointed out the fitness of thermodynamics for such a purpose, but I imagine it is not this to which "Student" refers. If, then, we measure the use of an engineering study by its useful application in practical life, and hence, by the greater power and capability of the possessor, it is not easy to see wherein a knowledge of thermodynamics will increase the efficiency of an engineer who is never called upon to work on any operations where heat is a connected agent. On the other hand, to ask if an engineer engaged in the manufacture or superintendence of mechanisms depending for their utility upon the application of heat, either in air, or gas, or steam, is the better for a knowledge of the science of heat, because many men have made good engines without that knowledge, seems to me as wise as to doubt that an artist is the better for the study of perspective, because, forsooth, there are some artists who, without this study, can paint pictures which sell.

Since "Student's" letter was caused by a recent issue of Professor Cotterill's book, and by the varying opinions of its reviewers, one imagines he includes by "thermodynamics" the whole of the subjects considered in that work; but surely neither the writer himself nor the most ardent enthusiast for a liberal engineering education would assert that so extended a study should be a *sine quâ non* in the training of every engineer. That it is so included with very many is beyond doubt, and one has not much trouble to find, and in the front ranks of present day engine construction, some notable examples of the use of Professor Cotterill's teaching. But while the so-called necessary subjects in engineering training continue to increase in number and extent as they have done during the past few years, it will, I think, be a much-contested question as to how much time should be devoted to the more purely theoretical side of the subjects, as compared with the more practical side.

No engineering educational course can be made to exactly suit the needs of each student, and since time is limited, and the subjects many, one hears of considerable difference in the methods of teaching. Not long since a student from a well-known Midland Technical College, in singing the praises of his Professor, said to me "He gives us a formula for *everything*." This would mean, I suppose, that to get on to something useful, meaning thereby something practical, certain primary statements are taken for granted; and in the case of thermodynamics the student would not himself perform any experiments on the theoretical parts of heat, such as on specific and latent heat, absolute temperature, expansion of gases, mechanical equivalent, but would, after a few hurried formulæ lectures, proceed at once to practical experiments with the laboratory engine and make himself familiar with the efficiency of that engine at least. On the other hand, he may devote so much of his time to becoming master of principles that his course may be ended without their practical application ever being reached. Speaking generally, I am inclined to say that an engineer engaged chiefly in engine work cannot know too much thermodynamics, but as to how much he should endeavour to acquire consistent with a right proportion of other equally important subjects must, I think, be left to individual decision. Nor am I able to imagine any eminent engineer, whatever branch he may be engaged in, who can be ignorant of such fundamental principles of thermodynamics as (shall I say) the mutual conversion of work and heat, which covers so wide a ground.

I have thought it worth while to examine the examination papers set in "Steam" at the Science and Art Department examinations for the past ten years, in order to see what guide they would afford to the position of thermodynamics in the opinion of that learned body. I find that it would at all times have been possible to pass well in either stage without working a single question relating to thermodynamics; in some years the elementary stage contained no heat questions, while in no year did the heat questions in the advanced stage exceed 20 per cent. of those set. In the honours stage the proportion varies from 20 per cent. to 40 per cent., there being usually two or three questions in a total of seven or eight, six being the maximum number to be attempted. Nor have the City and Guilds papers a higher ratio, as in the honours steam section of mechancial engineering for one year no heat question was set, and for another year only one in five. This is surely a startingly low proportion for so essentially a thermodynamical subject as steam!

Your correspondent Mr. Bodmer mentions for the encouragement of "Student" that the discussions on steam engine performances at our Institutions is not alone confined to the "professors"; it is perhaps worth while my adding that in the most noteworthy of these discussions of recent years, that on Mr. Willans' well-known experiments, the participants in the discussion and correspondence numbered twenty-six, of whom nine were Professors, the remainder including such all-round men as Dr. Anderson, Mr. Bodmer, and Mr. MacFarlane Gray. But how very small a proportion of practical men, considering that the professors were there almost *en masse!* I remember being much struck some time ago at the earnest attention given by the very practical audience of a Naval Architects' meeting to Professor Cotterill when speaking, and not very popularly, on some thermodynamic question. Shall I be pardoned if I say I think this sort of thing is due to the fact that practical men look to reap where they have not sown! "Student" will, I hope, see even in this another affirmative answer to his question.

Yours, &c.,
Sidney H. Wells.

Engineering Laboratory, Dulwich College, S.E.,
19th February, 1891.

MR. KAPP'S CANTOR LECTURES.

To the Editor of "Industries."

Sir,—Herewith I beg to hand you copies of correspondence between Mr. Gisbert Kapp and myself relative to particulars given by him concerning our Barking installation.

As the report of this lecture appeared in your last week's issue, I should be greatly obliged if you will kindly find space in your columns for the publication of the enclosed in your issue of this week.

Yours, &c.,
The General Electric Power and Traction Company, Limited.
W. G. M. Mackenzie,
Secretary.

New Broad Street House, 35, New Broad Street,
London, E.C., 25th February, 1891.

[Copies of Correspondence].

Gisbert Kapp, Esq.

Re Cantor Lecture on Monday, 16th inst.

Dear Sir,—I am requested by the managing director to draw your attention to the enclosed printed matter with reference to date relating to the Barking Road Electric Installation, which is the property of the General Electric Power and Traction Company, Limited. The figures thus given are entirely misleading, and the publication of them is calculated to seriously injure our interests, as well as those of the North Metropolitan Tramways Company, and we must request you accordingly to withdraw the Tables IV. and V., and the statements made by you based thereon at the next Cantor lecture, in such a public manner as will be likely to reach all persons before whom the original tables and statements have come.

If the statements have been based upon information obtained from Mr. Frazer, we may call attention to the fact that he left the company's employ in July last, and has since had no opportunity of acquiring any knowledge as to the improvements that have taken place since then, which renders the data published by you still further misleading.

In the event of your failing to comply with our request, we shall, in the interests of our shareholders, be compelled to consult our solicitors on the subject.

Yours faithfully,
(Signed) W. G. M. Mackenzie,
Secretary.

31, Parliament Street, S.W.,
February 21st, 1891.

The General Electric Power and Traction Company, Limited,
35, New Broad Street, E.C.

Dear Sirs,—In reply to your letter of yesterday, the statements to which you object were based on figures obtained from Mr. Frazer, and were given at the Society of Arts distinctly on his authority, and not on mine. After your explanation, which puts a totally new complexion upon the matter, I am of course myself desirous to withdraw from my lecture any statement or table the accuracy of which is questioned, and I shall on Monday withdraw the two Tables IV. and V., and statements connected with them. At the same time, allow me to point out that in your interests, as well as in mine, withdrawal alone would not be so effective as withdrawal combined with the substitution of the correct figures, and I should feel obliged if on Monday you would send me a telegram authorising me to state that when the lectures appear in print the obsolete figures of Mr. Frazer will be replaced by figures corrected up to date and supplied by you.

Yours faithfully,
(Signed) Gisbert Kapp.

THE PRESENT POSITION OF THE ALKALI TRADE.

To the Editor of "Industries."

Sir,—In your fairly moderate article on "The Present Position of the Alkali Trade" in your issue of the 13th inst. (which has only to-day come under my notice) you say, "In our recent review we pointed out that the Union could only succeed in one way, and that was by completely revolutionising its means of production—in fact, by gradually transforming its old plant, and remodelling its manufactures on lines of modern progress."

I cannot at the moment put my hand on the review you refer to, but as one indirectly interested in the newly-formed United Alkali Company, will you kindly allow me to ask just what is meant by "transforming its old plant and remodelling its manufactures on lines of modern progress"? If I understand matters aright, the *raison d'être* of the United Alkali Company, and of the Leblanc group of processes which they work, is principally the manufacture of caustic soda, bleaching powder, chlorate of potash, and (to a less extent) sulphur. If the plant and processes employed for the production of these by the above company are "old," will you kindly indicate which is the new plant and process that has superseded them? Where, and by whom, has this plant and process been worked on a manufacturing scale, and for how many years? What is the present annual production of the four chemicals named by the new process which has superseded the old plant of the United Alkali Company?

I do not speak of *proposed* processes, nor of processes that have not been commercially developed, for if capitalists shrink from every venture excepting such as cannot possibly be prejudicially affected by possible new inventions or future developments, where shall they turn? Not to iron or steel, for we all know that these are soon to be superseded by "the metal of the future," aluminium, the raw material for which is to be found in every clay hole. Not in gas, for the advent of electric lighting sounded its doom a dozen years ago (yet somehow the companies continue to pay their old-fashioned dividends). Not in brewing, for the reformation in the drinking habits of the people (Mr. Goschen's last Budget speech to the contrary notwithstanding) is soon to convert this into a "lost art." Not even in railways or shipping, because both modes of locomotion will ere long be as antiquated as the stage coach or last week's newspaper, consequent on the development of flying machines driven by electricity, generated by thermopiles; said machines necessitating no expenditure for construction or maintenance of permanent way. Who shall say that all these are merely dreams? Who shall say whether any—and if so which—of the 20,000 new inventions every year patented in this country alone will prove more than a dream?

But to return to the question of new inventions in connection with the alkali trade, may we not look at the matter in this light: The chemical elements and compounds have each been endowed with a number of properties most of which are known. But some few may be unknown. Now, unless the unknown properties of certain elements and compounds differ considerably from the known ones (and no amount of experimenting will give them the necessary properties if they do not already possess them), what ground is there for believing that the principal products of the United Alkali Company will not continue to be made by the present processes or by some simple modification of them? To say that these elements and compounds are *not* endowed with the necessary properties would, perhaps, be rash; would it not be equally rash to assert that they *are* so endowed?

To sum up: Are we not justified in drawing the moral: That if the Leblanc alkali maker has anything to fear from the progress of new invention, has he not, at least, equal cause for hope?

Yours, &c.,
Newcastle, 25th February, 1891. M.

[The several interrogatories proposed to us by our correspondent at the commencement of his letter are, we think, answered in a general way by the quotation in our article from the Alkali Inspector's Report. This gentleman states that "the struggle between the older and newer processes is no longer doubtful." The words "newer processes" will, we take it, be quite clear to the mind of our correspondent. The review referred to in our article is one relating to the chemical progress of the past year, and will be found on page 43 of our issue of the 9th ult.—Ed. *Industries.*]

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—Your correspondent "D. H. N." mentions one of the strongest arguments that could be advanced in support of the pipe line gas scheme. Although the Weights and Measures Act of 1889 gave discretionary powers for the London County Council to take action against coal merchants for giving under measure, nevertheless, the poorer classes are robbed in a wholesale and shameless manner, and, as evidence of the extent of this fraudulent dealing, the officers who have the work of detection brought up sufficient evidence during some seven or eight months of last year to secure nearly 400 convictions. If the London County Council would boldly take in hand the scheme of heating-gas supply suggested, they would confer more real benefit on London and its citizens than has been effected by all the legislative enactments since the middle of the sixteenth century.

Yours, &c.,
George M. Collins.

154, Canning Street, Liverpool,
23rd February, 1891.

To the Editor of "Industries."

Sir,—While it is impossible to be wanting in sympathy with the object of Mr. Thwaite's scheme, it seems to me that most people will regard his proposal to gasify fuel far away—one hundred and fifty miles or so in the provinces—and pipe it to London as too heroic, involving as it does, upon Mr. Thwaite's own showing, an outlay of at least ten millions sterling; attacking one of the most powerful gas corporations in the world; and taking from railway companies, carters, and middlemen, such an important source of income that their opposition is certain. Mr. Thwaite has not told us what is to be the price of the gas per 1,000ft. to the consumer, and what he considers a fairly probable dividend to the syndicate at that price. Moreover, it would be some satisfaction to many, who, like myself, have read with interest Mr. Thwaite's very admirable exposition of his scheme, to know whether he purposes putting all his eggs in one basket—*i.e.*, depending on one pipe from each coal or gasification centre—and what would be the result of a hitch or breakdown. As far as I can see, the pipe lines must be, if single, 9ft. in diameter.

Much of the public support will depend upon the selling price of the gas. Here, in Manchester, a memorial has been presented to the Corporation Gas Committee to induce them to reduce the price of gas to 2s. per 1,000 cubic feet, with a view to encouraging its use for heating purposes. My own impression is that gas

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must be supplied at even less than this before the public will take kindly to its use as fuel. To be successful there are two other points to be attended to. I believe I have seen the most modern forms of gas-heating stoves, and I have taken great interest in the use of gas as a heating agent for twenty years, watching each development, but to-day I do not know of a gas-heating stove whose radiating power is comparable to a very small coal fire; secondly, I do not know of any gas stove which does not discharge its products of combustion into the air of the room but what has the objectionable feature that it parts with those products by discharging them at far too high a temperature into the chimney, this being a great loss of heat. Your correspondent, "B. B." (page 136), seems to know of a stove which by an arrangement of flues is free from this objection. I, for one, should be glad to know what the arrangement is like.

Mr. Thwaite has displayed characteristic boldness by proposing to pipe the gas to London, but Dr. Bailey has shown what I think is the best way to begin—namely, to try the experiment on Manchester (and Liverpool). The Lancashire coalfield is close at home, and from a successful experiment of this magnitude the public confidence in the larger London project would be assured. *Manchester has fogs at least as bad as any London fog.*

The suggestion of your correspondent, James Armer (page 136), that the coal should be gasified at London would overcome many difficulties. Of course, it is a distinct departure from Mr. Thwaite's scheme, as it eliminates the prominent feature of piping gas a hundred and fifty miles, but the railway interests and the carting interests would be met. Wherever the gasification of the fuel is effected, one point must be insisted upon, that the purification plant for recovering sulphur, ammonia, and hydrocarbons shall be in duplicate, and each of such a size as to efficiently remove all these impurities from the gas; and by duplication the breakdowns which we often hear of at ordinary gas works would not—as now—be followed by the admission of impure gas into the mains, a most important consideration.

After all, in these days when a chemical union of eight millions or so of capital can be financed, it does not seem outside the range of probability that, by the co-operation of existing gas concerns with practical reformers like Mr. Thwaite, a scheme involving ten or even twenty millions of capital could be successfully launched and steered.

Yours, &c.,
W. Jesse Lovett.

154, Eccles New Road, Salford, 24th February, 1891.

THE SKILLED LABOUR MARKET.

The reports sent in to the Board of Trade by twenty-one societies, representing 239,080 members, show that of this number 8,063 men were unemployed during January as compared with 7,253 men in December, an increase of 810. The proportion of men unemployed has thus increased from 3·05 per cent. to 3·37 per cent. This increase may be attributed to the prevalence of recent strikes, of which the number increased from 60 in the previous month to 73. There were 25 strikes in the cotton trade, 10 strikes in the coal trade, and 7 strikes among dock labourers. The effects of the Scottish railway strike have severely affected the men engaged in the iron trade, and the proportion of unemployed increased from 5 to 16·25 per cent. The deficiency of raw material was the cause of this increase, and it seems probable that trade will now return to its normal condition. The severe weather seriously affected the building trades, and its effects were still felt at the end of last month. In the engineering branch of the iron trade the proportion of unemployed in the chief society, which numbers about 70,000 men, had decreased from 2·7 to 1·9 per cent. The shipbuilding trade also is in a very fair condition.

THE CLEVELAND INSTITUTION OF ENGINEERS.

At a meeting of this Institution, held on the 23rd inst., at Middlesbrough, the President (Mr. Charles J. Bagley) being in the chair, Mr. Wm. Hawdon read a paper entitled "Notes on American Blast-furnace Practice, and a Comparison with the Work Done in the Cleveland District." Mr. Hawdon said that in the Northern States they had in the best works a splendid plant, with all the latest improvements that European practice and their own experience of some years' working had given them, together with rich ores containing about 63 per cent. of iron and good fuel. In the Southern States the furnace plant was of a cheaper and less substantial construction. In manufacturing pig iron they endeavoured to keep before them two chief points—viz., economy of fuel and output of production. The American practice was to build a separate blast-main for each furnace, with two or more blowing engines coupled to it, and, by an arrangement of valves, each engine could be blown into any particular main. There was then fixed a certain "make" to be arrived at which required a certain pressure of blast and a certain number of revolutions of the engines per minute. They ran their engines at this speed, having an indicator on each engine, showing at a glance the number of revolutions per minute. Each engine had a governor attached, and this was necessary to maintain the equal speed required, for when the furnace began to "hang" a little, or not drive so freely, the resistance to the blast was greater. The Americans attached very great importance to this arrangement, and it seemed almost incredible how Cleveland engineers could have allowed this valuable arrangement to escape their notice. Several furnaces in America were making from 2,300 to 2,400 tons per week, but the general make was about 1,700 tons. The author claimed that the practice in Cleveland was, on the whole, the best, and much superior in some respects to the American. In fact, large makes in America were at the expense of a lack of economy in fuel; stronger and more costly engines were required, with more strain on the men.

In the discussion which followed, the President thought there was room for improvement in the ironworks of the north of England, and that the great improvements which were going on at Jarrow and other places would become general.

THE CHAMBER OF SHIPPING.

On the 20th inst. the annual meeting of the Chamber of Shipping was held, Mr. T. L. Devitt, the President, being in the chair. There was a large attendance of those interested in shipping, including representatives from the affiliated societies. The report of the Council showed that two societies, the Britannia Insurance Association and the Sunderland Shipowners' Society, had been affiliated to the Chamber during the past year, the number of affiliated societies now being twenty-five. The President said that the Chamber had taken an important step in instituting the Federation of Shipowners. The societies throughout the kingdom had rendered every assistance, and on the previous day the Chamber had been strengthened by the addition of 750,000 tons from Liverpool. Although the manifesto of the Federated Trades Council had been withdrawn, the men were still prevented from working on the boycotted ships. He hoped that the members of the Shipping Federation and the Council would always work together to resist the onslaught which was being made against them. Sir William Gray, the President for the ensuing year, said that the causes of the present depression in the shipping industry were the over-supply of tonnage and the high price of fuel and labour. A discussion afterwards took place as to the advisability of forming labour conciliation boards, and Sir A. Rollit, M.P., referred to the successful working of the London Conciliation Board. The resolution in support of the proposal was eventually withdrawn. At a dinner in the evening, Sir D. Currie, M.P., referred to the competition of Germany, France, and the United States, which was favoured by the subsidy laws of those countries. It was necessary that there should be a strong mercantile marine, in order that the food supplies of the country might not be interfered with in the event of war.

TRIAL OF H.M.S. "PALLAS."

A welcome reaction appears to have set in as regards the trials of Her Majesty's ships, as, in addition to the very successful results obtained in the "Gossamer," "Latona," and, still more recently, in the "Pearl," at Pembroke, we have to add an equally good result obtained at Portsmouth on the 20th inst. with the "Pallas."

The "Pallas" is a third-class cruiser of what was known as the "Pandora" class, taking the "Pandora," now "Katoomba," as the typical ship, and she is thus exactly similar to the six Australian cruisers. These were, when laid down, called second-class, but since the increased dimensions given to such second-class cruisers as the "Latona," &c., they have been relegated to the third class. The indicated horse-power with forced draught is 7,500, and speed 19 knots. With natural draught 4,500 indicated horse-power for eight hours consecutively are required, which should give a speed of about 17 knots. The trial on Friday last was by natural draught so called—more strictly draught assisted by not more than ·5in. air pressure due to the fans—and the required results were most easily obtained. To all intents the trial was one of natural draught, for, though the stokeholds were closed and the fans working, yet the air-pressure rarely rose above ·1in., and directly it began to do so the steam pressure rose rapidly and the fans had to be checked. With the very feeble assistance thus obtained from the fans the indicated horse-power was for the consecutive hours—4,867, 5,017, 5,199, 5,141, 4,974, 5,068, 5,062, and 5,115, or a mean of 5,055 for the eight hours, being 555 in excess of that stipulated for. The mean speed of four runs on the measured mile was 17·566 knots, so that we may safely say that with open stokeholds the "Pallas" will be a 17 knot boat.

The machinery worked very easily, and very little water was required on the bearings, but this, of course, might be expected. The crucial test will come in on the full power trial, which is fixed for to-day. With regard to this question of bearings, there are few things which strike the eye more, in connection with modern marine machinery, than the completeness of the lubricating arrangements, as compared with those of a few years back. Now we have one oil tank, from which runs a main service pipe, supplying the branches to every part, each of which has its regulating valve and its rate of supply almost invariably visible to the eye, so that the engineer officer on watch has the control of the whole arrangement right under his hand.

As already stated, the boilers did easily all that was expected of them, and, as it has been in nearly every case of failure the boilers which have given out, some instruction may be gained by a consideration of the differences, if any, between the boilers of the "Pallas" and, say, the "Katoomba," which has not been quite such a success, although almost identical in design, and built and engined by the same makers, Messrs. Hawthorn, Leslie, & Co. Forced draught was introduced in the Royal Navy so as to obtain a large horse-power from a small weight of boiler, by increasing the quantity of coal burnt per square foot of grate; but the proportions of the boiler, as regards ratio of tube surface and heating surface to grate surface, remained about as they were for natural draught. But one alteration in design was proposed and carried out in, among others, the "Galatea" and "Undaunted," with the same idea in view of saving weight—viz., the use of double-ended boilers having only one combustion chamber common to the whole of the furnaces. Comparing a double-ended boiler of this class with two single-ended ones put back to back, the weight of the two backs of the boilers and of the backs of the combustion chambers is saved. This answered very well in the two ships named, the "Galatea," with 496 square feet of grate surface, developing 9,000 i.h.p., or about 18·5 per square foot of grate. This success led to the more extensive use of this class of boiler, and it was expected with increased air pressure to obtain 20 i.h.p. per square foot. Then, however, began to come a series of unfavourable results, and among them the accident to the "Barracouta," in which the back draught—how caused has not yet, and probably never will be, satisfactorily explained—burnt the unfortunate occupants of the stokehold. It was thought that the common combustion chamber may have had some connection with the accident, and so it was divided off by brick partitions into separate chambers, and the boilers of other ships, including the "Katoomba," were divided in the same way, so that with four furnaces she has four combustion chambers, not separated, however, by steel plates and water spaces, but by brick walls. The "Pallas," on the other hand, although originally intended to have the one common chamber, now has four distinct combustion chambers, separated by water spaces, thus being similar to the "Latona" class, except that, the total length of boiler not having been altered, her combustion chambers are necessarily very shallow.

In spite of the brick partitions, an accident occurred on the trial of the "Katoomba" exactly similar to that on the "Barracouta," flames issuing into the stokeholds and burning the stokers. To complete the similarity, no satisfactory explanation has been given; the tubes showed signs of leaking, but whether the leaks caused the back draught or *vice versâ*, or whether some other cause produced both, is not clear. Apart, however, from the accident, it is clear that, as between the common combustion chamber in the state it has now arrived at with its brick partitions, and the separate combustion chamber to each furnace, there can be little doubt as to which is in every way the best. The gain in weight is gone, because the bricks are at least as heavy as the steel sides, and with that goes all the advantage, because in all other respects the separate system is the best. Of course, the weight of the backs was saved, but then nearly the most efficient part of the chamber was taken away, for the hot gases coming direct from the furnace strike the back and meet it under the most favourable conditions for giving up their heat, and this heat has then only to travel through a thin plate to reach the water; on the other hand, the tube plate is thicker, the gases do not strike it so directly, and it is cut up by the tubes. Theoretically we should expect the "Pallas" to do better than the "Katoomba," and practically this is confirmed, for what the "Pallas" did with ·1in. of air it was necessary to use ·75in. for in the "Katoomba." This means that more heat was generated in the furnace of the latter, but, instead of passing into the water, the excess simply went up the funnel. Taking all things together, it appears probable that we have seen the last of the combustion chamber common to all the furnaces.

The "Pallas" vibrated considerably during the trial, the revolutions, which averaged 144·5, nearly agreeing with her natural period; it is probable that there will thus be less vibration at the higher power.

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TRANSFORMER DISTRIBUTION.*

(*Continued from page* 177.)

Let us now assume the self-induction to be 0·05. The resulting diagram is shown in Fig. 2. The double-load current is almost exactly 40 amperes. Various other examples may be taken

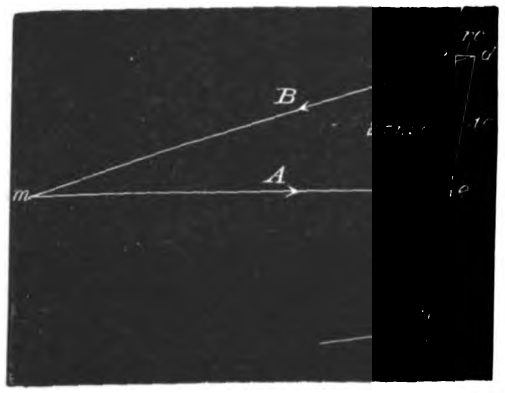


Fig. 2.

in the same way. We thus find that according to the self-induction hypothesis the difficulty does not lie, as commonly supposed, in getting enough self-induction in the armature; the trouble is that there is generally too much. But in machines from 25,000 to 50,000 watts it is exceedingly difficult to make dynamos that will not run perfectly in parallel, so great is the permissible margin of self-induction.

The orthodox hypothesis thus tells us that with ordinary sizes of machines it is exceedingly difficult to design them so that they will not run in parallel. Either, therefore, all ordinary machines run perfectly in parallel, or the orthodox hypothesis is wrong.

Parallel Running according to the Armature Reaction Theory.

Take the case of a machine like the Siemens, with coils passing between poles. If there is a continuous current in the armature, in some positions it will assist the field magnets, and in others it will to some extent weaken them, while in intermediate positions it has no effect on the magnets as a whole. In an alternate-current machine, though the armature current is alternating, relatively to the field magnets it is direct. If a series of

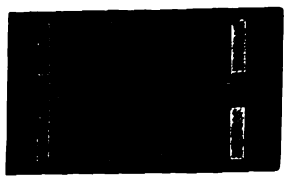


Fig. 3.

instantaneous photographs of the armature current could be taken, each part of the air space would have its direct current.

If the pressure curve of a machine were traced, and placed in the diagram of the poles, it would be as shown in Fig. 4. The positive direction of the current or pressure in the armature and field-magnet coils is shown by shading, the negative by dotting. If electricity flows in the armature when the sides of the coils are in the active fields, one side of the field between the poles is

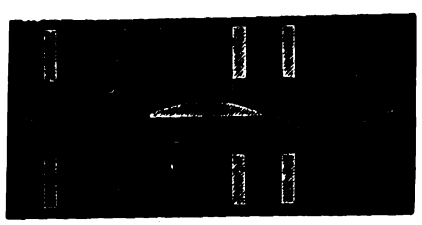


Fig. 4.

strengthened and the other weakened, as shown in Fig. 3. The field thus becomes stronger on one side. The curve of pressure thus gets displaced, as shown in Fig. 5.

It will be seen that each magnet is now exposed to the back induction due to the armature current. A circuit *a* taken round

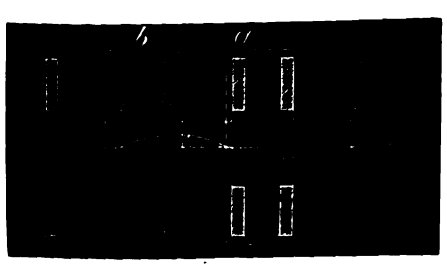


Fig. 5.

the field-magnet circuit is interlinked with the whole wave. The line integral is not changed if it is taken round any other circuit, so that the sides are the same distance apart as they are in *a*. A circuit taken as shown at *b*, however, includes only half a wave,

* Abstract of a paper read by Mr. J. Swinburne before the Institution of Electrical Engineers on the 19th inst.

so that from Fig. 5 both the cross and the back induction could be completely worked out.

The effect of the armature current, then, is first to make the current lag relatively to the position of the field magnets, and then to lessen the pressure as a whole. It thus resembles the effect of the insertion of artificial self-induction.

A machine without friction may be imagined, and when its field magnets are separately excited, so as to give an electromotive force exactly equal to that of the mains when it is connected so as to be in step, it runs as a motor taking no current. At each instant the electromotive force of the machine is exactly equal to the electromotive force of the mains, so no current passes. On putting on some load the machine begins to lag. As soon as the machine lags, a current passes through the armature. The current due to the difference of two equal alternating electromotive forces is not in step with either of them. This is shown in Fig. 6, where two pressure curves are

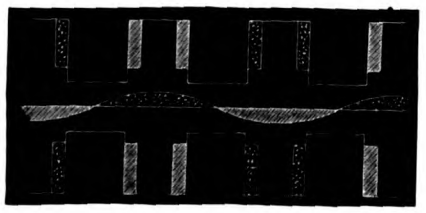


Fig. 6.

drawn a little out of step. The current through resistance is proportional to the shaded parts. If the electromotive force of the machine were still the same as that of the mains, it would still develop no power as a motor, because at some parts of the period it would be supplying power to the mains, and at other parts the mains would be supplying power to the armature; for at any instant the armature current would be equal to the difference of the two electromotive forces divided by the resistance of the armature. The average current curve is shown in Fig. 7. The electromotive force of the machine does not, however, remain equal to the main electromotive force, merely differing from it in phase, but is decreased by the reaction of the armature current on the field magnets. The average current

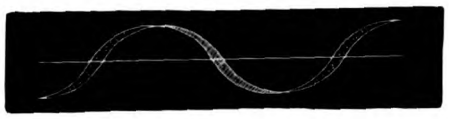


Fig. 7.

curve shows that there would be considerable back induction, or many ampere-turns tending to weaken the field. This weakening of the field by the armature reaction allows the main also to supply a current against the electromotive force of the machine, so that it acts as a motor, and power can be taken from it.

If the machine is to be worked as a generator in parallel with the main circuit—that is to say, if it is to supply power to the mains instead of to take it from them—the same reasoning holds good. If the engine supplies just a little too much power, the machine will begin to lead, and an armature current will pass, which will strengthen the fields by reaction, and the machine will at some instants act as a generator, because its electromotive force is now a little higher, as the armature current has strengthened its field. Similarly, if the steam of the engine were completely shut off, the machine would lag until it worked as a motor.

According to the armature reaction theory, then, whether a machine will run in parallel with others depends on its armature resistance and armature reactions. It must be borne in mind that most machines have cast-iron fields, which may not respond to the armature reactions quickly, so it may be difficult or impossible to run them in parallel.

Another important consideration is the government of the engines. The whole question of the government of central stations requires the most careful consideration. I have dealt with the matter at some length elsewhere (*Industries*, September, 1890), but the subject should be very fully thought out in designing stations.

Arrangement of Station.

If the machines are employed in parallel, they may feed into common bars, as in the case of direct currents. If each district must have its own circuit—which seems to be generally assumed necessary—each circuit may be led away from the common bars with a transformer regulator in it. It is a great advantage to transform up, and to have all the switches, connections, and measuring instruments on the low-pressure side. The high-pressure circuits may then be arranged to have no metal exposed anywhere. If each district must have its separate circuit, it has its own step-up transformer, with its regulator.

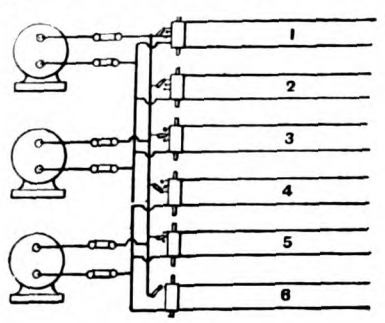


Fig. 8.

One arrangement is shown in Fig. 8. The dynamos are all in parallel, and wound for 100 volts, the immediate neighbourhood of the station being fed direct. Each feeder circuit has a transformer with a variable number of primary turns. A compensated voltmeter is placed on each, and all the attendant has to do is to alter the switches a little occasionally, so as to keep all the instruments' pointers vertical.

(*To be continued.*)

THE ELECTRIC TRANSMISSION OF POWER.*

The lecturer, in commencing his second lecture, said he wished to withdraw Tables II. and VI. (given in our last issue) for the present, while some alterations were being made in them. Oersted's and Faraday's electromagnetic discoveries were described, and it was experimentally shown how electrical energy may be transmitted between two dynamo machines. The fields of both machines were separately excited, and the two armatures coupled in series with one another; and on turning one armature by hand, the second armature was seen to rotate also. An electromotor will run at such a speed that the counter e.m.f.—that is, the e.m.f. induced in its armature by the rotation—is almost, but not quite, equal to the e.m.f. supplied to its brushes, the difference between the two e.m.f.'s being such as to allow the current required by the motor to pass through the armature resistance. The electrical power which a motor converts into mechanical power is equal to the product of the counter e.m.f. set up in its armature multiplied by the current passing through the armature.

In the electric transmission of large powers over considerable distances, it is always advisable to use high voltages, since the higher the voltage the less is the weight of copper required in the supply mains for a given percentage loss over their resistance. In each case that arises, there is a particular voltage at which it is most economical to work. For the transmission of large powers, multipolar generators and motors are generally used, as they have several advantages over the two-pole machines, the chief being that, for a given large output, a multipolar is cheaper and weighs less than a two-pole, and also its armature reaction is less. There is a limit to the output of a two-pole machine, and this limit is about 100 horse-power. Beyond this the armature reaction is too great for satisfactory working, and a multipolar should be used. The armature conductors of a multipolar machine may be connected in parallel, in series, or in combinations of parallel and series. Table III. gives the connections for an eight-pole series wound-drum armature. The reader is supposed to be looking at one end of the armature, and the letters D and U indicate "down" conductors and "up" conductors, and the letters F and B front cross-connection and back cross-connection respectively. Thus the winding at the beginning is down bar 202, across back connection; up bar 25, across front connection; down bar 50, across back connection, and so on.

The regulation of the speed and power of a motor is a very important subject. Experiments were made with a shunt motor to show that if the field magnetisation of the motor was weakened by inserting resistance in the shunt the speed increased, and if the field magnetisation was increased the speed decreased, the voltage at the motor brushes being kept constant; also to show that the speed varied directly with the e.m.f. supplied to the brushes if the field magnetisation was kept constant. The same shunt motor was connected by a belt to a dynamo, and this dynamo was arranged to feed an arc lamp, and it was experimentally shown that the motor actually ran faster when the lamp was burning than when it was switched off, the motor being supplied at constant potential. When the current through its armature was increased the increase of loss in the field magnetisation due to the armature reaction was greater than the increase of loss of potential over the armature resistance, and therefore, to get up the proper counter e.m.f., the motor ran faster. Is is evident that if the armature reaction had exactly counterbalanced the loss over the armature the speed would have remained absolutely constant. In machines which have not sufficient armature reaction a demagnetising series coil should be wound on the magnets.

A shunt motor having wrought-iron magnets will run at a constant speed if it is worked much below its normal voltage and current, and supplied with a varying voltage. This is because the machine is worked on the straight part of its magnetisation curve, where the lines of force through the armature are proportional to the exciting ampere turns. The chief disadvantage of a shunt motor is that in order to prevent the armature being burnt up a resistance is required in the armature circuit on starting; this resistance may be short circuited as soon as the motor has started, and its insertion

* Abstract of Cantor Lecture delivered at the Society of Arts by Mr. Gisbert Kapp, M.Inst.C.E., on the 23rd inst.

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THE ELECTRIC TRANSMISSION OF POWER.

TABLE I.

$$\text{Volts} \ldots\ldots = Hvl\,10^{-8}$$
$$\text{Kilogrammes} \ldots\ldots = \frac{Hcl}{9{,}810{,}000}$$

C Total current through armature; c, current through single armature conductor.
e_a E.M.F. in armature in volts.
τ Number of active conductors counted all round armature.
p Number of pairs of poles ($p = 1$ in a two-pole machine).
n Speed in revolutions per minute.
F Total induction in C.G.S. lines.
Z ,, English lines.

Electromotive force:
$e_a = F\tau\frac{n}{60}10^{-8}$, $e_a = Z\tau n\,10^{-6}$ — for two-pole machines.
$e_a = pF\tau\frac{n}{60}10^{-8}$, $e_a = pZ\tau n\,10^{-6}$ — for multipolar machines with series wound armature.

Torque.....
Kilogramme-metres $= 1{\cdot}615\,F\tau C\,10^{-10}$; Foot-pounds $= 7{\cdot}05\,Z\tau C\,10^{-6}$ — for two-pole machines.
Kilogramme-metres $= 3{\cdot}23\,F\tau cp\,10^{-10}$; Foot-pounds $= 14{\cdot}10\,Z\tau cp\,10^{-6}$ — for multipolar machines.

TABLE II.

MOST ECONOMICAL CURRENT FOR ELECTRIC POWER TRANSMISSION.

D	Distance in miles.
a	Section of conductor in square inches.
E	Terminal volts at generator.
e	Terminal volts at motor.
HP_g	Brake horse-power required to drive generator.
HP_m	Brake horse-power obtained from motor.
c	Current in amperes.
	Efficiency of generator, 90 per cent.; efficiency of motor, 90 per cent.
g	Cost in £ per electrical horse-power output of generator.
m	Cost in £ per brake horse-power output of motor, including regulating gear.
$G = 9g\,HP_g$ ...	Cost in £ of generator.
$M = m\,HP_m$ ...	Cost in £ of motor and regulating gear.
$t = 18{\cdot}2\,Da$ ...	Weight in tons of copper in line.
K	Cost in £ per ton of copper, including labour in erection.
s	Cost in £ of supports of line per mile run.
p	Cost in £ of one annual brake horse-power absorbed by generator.
q	Percentage for interest and depreciation on the whole plant.

$$\text{Capital outlay} = g\frac{Ec}{746} + m\,HP_m + Ds + \frac{1{\cdot}6\,K\,D^2c^2}{Ec - 880\,HP_m} = A.$$

$$\text{Annual cost per brake horse-power delivered} = q\frac{A}{HP_m} + p\frac{HP_g}{HP_m}.$$

Put $B = \frac{Ep}{670} + q\frac{Eg}{746}$.

$j = \frac{880}{E}HP_m$, the current which would be required if the line had no resistance,

and $\beta = j^2\frac{EB}{1{\cdot}6\,q\,K\,D^2 + EB}$; then the most economical current at the given voltage E is—

$$c = j\left\{1 + \sqrt{1 - \frac{\beta}{j^2}}\right\}$$
$$c = j\left\{1 + \sqrt{\frac{1{\cdot}6\,q\,K\,D^2}{1{\cdot}6\,q\,K\,D^2 + BE}}\right\}$$

For very long distances the term under the square root approaches unity and the most economical current the value $2j$; from which it follows that under no circumstances will it be economical to lose more than half the total power in the line.

TABLE III.

TABLE OF WINDING FOR 8-POLE DRUM ARMATURE; 202 CONDUCTORS; SERIES WINDING; BRUSHES (±) 135° APART.

F	B	F	B	F	B	F	B	F
D	U	D	U	D	U	D	U	
202	25	50	75	100	125	150	175	
200	23	48	73	98	123	148	173	
198	21	46	71	96	121	146	171	
196	19	44	69	94	119	144	169	
194	17	42	67	92	117	142	167	
192	15	40	65	90	115	140	165	
190	13	38	63	88	113	138	163	
188	11	36	61	86	111	136	161	
186	9	34	59	84	109	134	159	
184	7	32	57	82	107	132	157	
182	5	30	55	80	105	130	155	
180	3	28	53	78	103	128	153	
178	1	26	51	76	101	126	151	
176	201	24	49	74	99	124	149	
174	199	22	47	72	97	122	147	
172	197	20	45	70	95	120	145	
170	195	18	43	68	93	118	143	
168	193	16	41	66	91	116	141	
166	191	14	39	64	89	114	139	
164	189	12	37	62	87	112	137	
162	187	10	35	60	85	110	135	
160	185	8	33	58	83	108	133	
158	183	6	31	56	81	106	131	
156	181	4	29	54	79	104	129	
154	179	2	27	52	77	102	127	
152	177	202						

TABLE IV.

COST OF TRANSMISSION OF POWER PLANT.

Distance in Miles.	H.P. Delivered.	Speed of Machines.	Cost in £. Gen.	Mot.	Line.	Total Cost.*	Cost per H.P.
						£	£
1·870	85	450	640	560	440	1,880	22·2
·280	195	500	760	680	132	1,800	9·7
·280	51	600	320	280	60	720	14·1
·375	90	550	520	480	80	1,240	13·8
·560	71	600	440	400	60	1,040	14·6
·280	40	700	260	240	20	640	16
·375	75	600	480	440	68	1,120	15
·500	87	500	520	480	100	1,260	14·5
1·560	150	600	760	720	330	2,050	13·7
·220	98	450	440	420	232	1,270	13·7
6·250	11	900	132	110	480	960	87
2·200	51	600	360	320	300	1,140	22·4
·187	60	900	240	220	18	600	10
5·000	41	750	240	200	344	1,020	24·8
3·750	220	600	1,040	960	640	2,960	13·5
·002	15	600	112	104	8	252	16·8
·250	19	700	160	160	20	390	20·5

* This includes regulating apparatus, instruments, posts, insulators, lightning arresters, erection, and supervision.

and removal may be automatically effected by a switch moved by a centrifugal governor on the motor shaft.

For large isolated electrical transmissions, where the generator is run at constant speed, and the motor is required to keep constant speed, both generator and motor are usually series wound, and so designed that the difference between their characteristics (curve connecting internal e.m.f. and current for constant speed) for any current is equal to the loss of volts over the complete electrical circuit when that current flows through it. When this is done the generator and motor automatically vary the e.m.f. and current, and the motor runs at constant speed. In electrical tramcars, where a large torque is required at starting, series motors are generally used; the field coil connections are led to switches on the conductor's platform, so that the coils may be connected in series or parallel as required.

On account of the lateness of the hour Tables II. and IV. were not dealt with at length.

THE ELMORE COPPER PROCESS.

As promised in our issue of the 30th ult., we now give some particulars of the works of the Elmore's Patent Copper Depositing Company, Limited, which are situated at Haigh Park, Hunslet, near Leeds. The works are close to the Midland Railway, with which a siding communicates, and also within easy reach of the local canal.

Strickly speaking, there will be two distinct companies, with their buildings on adjacent sites—one for making tubes, and the other wire. At present the wire company's works consist of a brick building in course of construction, and our recent visit was confined to the more nearly completed works of the company engaged in the manufacture of tubes. An idea of the general aspect of the place will be gathered from the accompanying illustrations, Figs. 1 and 2.

Starting with the raw material, in the form of Chili bars, containing on an average 97 per cent. of copper and 3oz. of silver and ½oz. of gold per ton, the first operation is to reduce the metal to a form suitable for use in the subsequent process. To this end it is melted in ordinary furnaces, run into a ladle, the slag skimmed off, and the copper granulated by pouring it into a tank of water. During this operation the sharp difference in properties of the metal and its oxide (of which the slag mainly consists) is well brought out by their behaviour on sudden cooling: the metal is at once quenched by reason of its high conductivity, and causes little commotion during its solidification; the drops of slag, however, are solidified on the outside while retaining a hot core, and, in consequence, spit vigorously. The granulated copper is of even size and irregular shape, exposing a considerable surface, which properties fit it well for its office as anode in the depositing tanks. This is the only fusion to which the metal has to be subjected.

From the melting shed the granulated copper is conveyed to the tank room, but before tracing its career further we must devote a little space to a description of the boilers, engines, and dynamos. There are two boilers, each of 250 h.p., supplying steam to three Willans & Robinson engines, two driving dynamos by Mather & Platt and one driving a dynamo direct. An Elwell-Parker dynamo stands idle at present, and a horizontal Fowler engine is about to be put in. When the installation is complete, the power available will be capable of depositing 25 tons of copper per week. At present one Willans engine and its dynamo are running, supplying current for such tanks as are in use, but a new shed is just completed, and is only waiting for the tanks; it will then represent 10 out of the 25 tons output.

Passing to the tank room that is in actual use, the process of depositing is seen. The granulated copper, of which the preparation has been described above, is laid on a copper tray at the bottom of the tank which serves as the anode. In most, if not all, of the other processes of copper deposition, the anodes have been, or are, composed of plates cast to the size of the tank, and usually hung vertically. Very material disadvantages result from such an arrangement. In the first place, owing to the different densities of the electrolyte and the products of its electrolysis (in this case the difference between the densities of a strong solution of sulphate of copper and of dilute sulphuric acid), the liquid in the neighbourhood of the anode is unlikely to be uniform in composition in successive horizontal strata. In consequence, corrosion of the anode will occur irregularly, according to the greater or less degree of saturation of the liquid in contact with it. This same irregularity will be accentuated by the want of uniformity of the composition of the anode itself; even in refined copper there is a tendency to the localisation of the comparatively small quantities of impurities it contains, and it is inconceivable that a similar but more marked divergence does not obtain in crude copper. The result of these causes is the local attack of the anode leading to portions being detached by the failure of adjacent parts, necessitating renewal long before the whole of the metal is dissolved, and consequent reworking of the scrap. The particular arrangement of granulated copper on a horizontal tray, adopted in the Elmore process, avoids these difficulties. Above the tray serving as the anode is a cast-iron cylinder, revolving on a horizontal axis and constituting the cathode; a solution of sulphate of copper is the electrolyte. The revolving cylinder is completely immersed, and contact is made with it by a copper brush pressing upon its surface near one end. An agate burnisher, applied to the cylinder much as a tool is to work in the lathe, only

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that it is disposed nearly vertically instead of horizontally, is given a traversing motion by means of a horizontal shaft at the back of the tank which extends the whole length of a set of tanks. This shaft for a length at one of its ends equal to that of a single tank is provided with a screw thread, which, working in a stationary nut, causes the burnisher in each tank to travel from end to end of the revolving cylinder to which it is applied; at the end of the traverse its motion is automatically reversed, and it returns in precisely the same manner. It thus, as it were, cuts a shallow screw upon the newly deposited copper. The rate of traverse is in such relation with the speed of revolution and the width of the burnisher that each "cut" of the burnisher overlaps that which precedes it, leaving no intermediate unburnished spaces. It must not be supposed that there is an actual abrasion of the copper, the motion is that of a screw cutting lathe, and screw-like markings result, but that is all. It is this burnishing process that is claimed to be the cause of the remarkable properties that the deposited metal appears to possess. There is no room for doubt but that it has a very definite effect on the structure of the copper film. We saw at the end of each cylinder which was not exposed to the action of the burnisher, but which was only pressed on by the copper brush making electrical connection with it, a rough pimply deposit of crystalline copper, presenting a sharp contrast to the even surface of the burnished portion.

It is well known that copper of this description is so weak a material that it may be said to be scarcely coherent. This was strikingly shown during our visit by an interesting little experiment. The end of one of the finished cylinders presenting this rough and pimply appearance was struck a very moderate blow with a small hammer, and practically began to break up, the nodules or excrescences of crystalline copper being jerked off quite freely. Of course, it might be urged that this crystalline and incoherent condition might be avoided by reducing the current density, and, where other means are wanting, this method is certainly practicable, and, indeed, moderately efficient; but this argument would leave out of sight the main merit of the Elmore process, which is that a high current density may be used (with the aid of the burnisher) without producing incoherent crystalline copper.

As the rate of deposition is, even with a high current density, slow, the commercial difficulties of a process which voluntarily neglected to avail itself of the utmost attainable would be enormously enhanced, as the capital locked up in the copper while in the act of being deposited would be correspondingly increased. It is stated that the appearance of the surface of the burnished copper is a criterion of the condition of the inner layers, as a roughness or pimple once formed is not eliminated by subsequent deposition and burnishing.

With regard to details of the process carried out in the depositing room, it may be mentioned that the pressure on the burnisher is obtained and regulated by means of an indiarubber band, that the tanks are lined with a special composition of fairly elastic nature to prevent chipping and cracking, and the cast-iron cylinders on which the tubes are made, of course, require special care in manufacture in order that their surface may be sufficiently smooth. The whole execution of the depositing is so nearly automatic that the process goes on day and night with scarcely any attention. A thickness of ⅛in. is generally obtained in about six complete days.

The tube thus formed on its mandrel is taken to the machine shop, where it is rolled off. The method appears curious, but is really very simple and effective. The copper encasing the cast-iron mandrel is pressed upon by three rollers while the whole revolves; the rollers are given a traversing motion from end to end of the mandrel, and produce a dilatation of the copper casing. After undergoing this process the tube slips readily from the mandrel, the waste end where the burnisher has not been is cut off, and it is ready for use.

The production of copper tubes direct from granulated crude copper having thus been demonstrated, the quality of the deposited metal remained to be ascertained. The company state that they are in the habit of controlling the quality of the output by testing a portion cut from every tube made. A register is kept of the results thus obtained, and the history of any piece can be traced at any time.

For breaking the specimens the firm have a 30-ton testing machine by Herriot, of Glasgow, a vertical pattern much resembling the well-known Wicksteed machine, which is sufficient for their ordinary needs. A test was made in our presence of a strip cut from a cylinder in the condition in which it comes from the rolling-off machine—that is to say, unannealed. Its dimensions were 1·564in. by 0·191in., giving an area of 0·299 square inch. It broke at 6·15 tons, corresponding to a tensile strength of 20·6 tons per square inch, and had an elongation of 21 per cent. Seeing that ordinary copper of anything like this strength is so hard that its extension is extremely small, this must be considered a remarkable result. The company are prepared to guarantee the metal they supply to have a tensile strength of 20 tons per square inch, and an extension of at least 15 per cent. It is not found that cutting the strip for testing from the cylinder parallel with its axis instead of circumferentially makes any appreciable difference in the test.

Besides the above numerical instance of the quality of Elmore copper, its behaviour in the workshop calls for some remarks. Ordinary copper when worked is hardened so considerably that repeated annealing is necessary to prevent cracking. It is stated that Elmore copper can be bent or flanged without annealing. Seeing what injury may result from the exposure of copper to the complicated products of the combustion of gaseous or solid fuel, the advantage accruing from this special property goes without saying. But the mechanical properties of

THE ELMORE COMPANY'S TUBE WORKS.

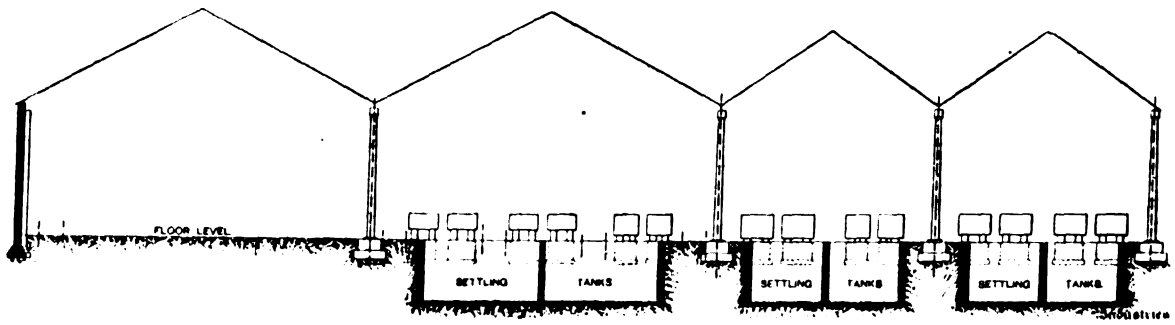


FIG. 1.—SECTIONAL ELEVATION.

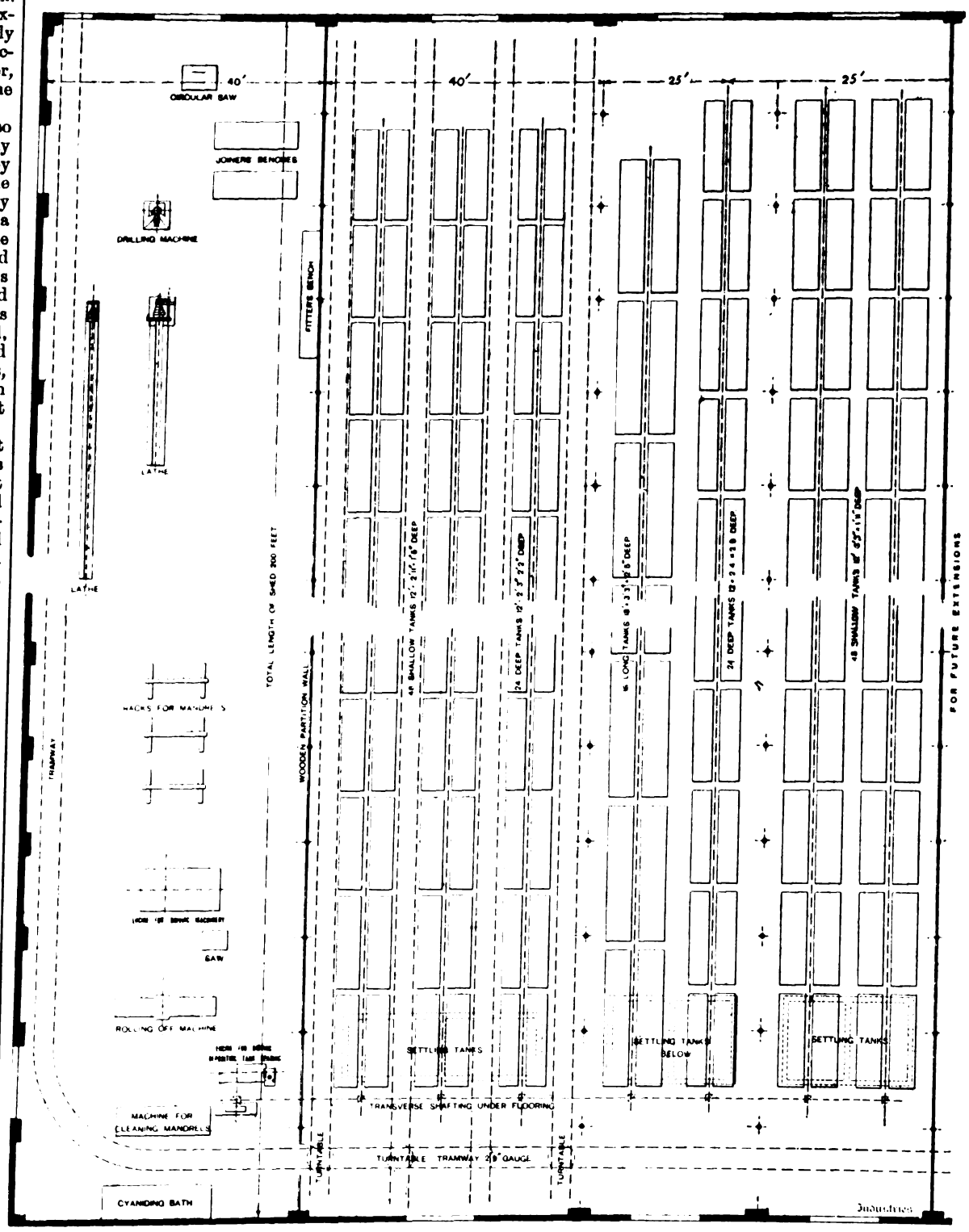


FIG. 2.—GENERAL PLAN.

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Elmore copper are not more remarkable than its chemical qualities are said to be. Of this no actual demonstration was given, but statements were publicly made which are deserving of the closest consideration. The high tensile strength accompanying the great extension given above would tend to show that a material with such properties could scarcely be copper as we ordinarily know it. Much may be ascribed to the absence of impurities; indeed, Professor Roberts-Austen maintained recently, at a meeting of the London Section of the Society of Chemical Industry (see *Industries*, Vol. X., page 42), that copper probably exists in an α and β condition, similar to those states proved to exist in the case of iron, and that the known influence of impurities may be due to their determining which of these states the copper may be in; thus we may, for the first time, have in Elmore copper to do with one or other of these allotropic modifications. But instead of the difference in quality being due to absolute purity, it may rather be ascribed to the presence of one particular impurity—viz., hydrogen. Indeed, this suggestion has been made by Mr. Bertram Blount, who has quoted the known case of the modification of iron which is deposited in the aciertype process, which is generally considered due to combined hydrogen. It is well known that copper has an extraordinary affinity for hydrogen; G. S. Johnson has shown that copper reduced from its oxide by hydrogen retains traces of that element with extraordinary tenacity, far more strongly than can be accounted for by supposing it due to occlusion. Against this idea may be set the statement of Mr. Frank Elmore, that he has not detected hydrogen in the copper produced by this process, and, further, that the e.m.f. used is not high enough to decompose water. This last is a serious objection, but not insuperable, as the e.m.f. necessary to deposit an alloy of copper and hydrogen may be less than that required for the elimination of hydrogen alone. An instance in point of the affinity of one element for another markedly modifying the total energy required for its reduction is the comparative ease with which aluminium may be reduced in presence of copper on account of its strong affinity for that metal.

To whatever cause we may ascribe this difference it seems pretty certain that the difference is real. Mr. F. Elmore has experimented with copper vessels for containing crude ozokerit and similar materials. Usually sufficient corrosive impurities are present in such substances to cause candle-makers to have recourse to silvered or platinised basins and other receptacles, but Mr. Elmore's experiments go far to show that copper will shortly take their place. He has compared the powers of withstanding corrosion of vessels of Elmore copper and of copper produced by the usual methods, and finds the former scarcely attacked by influences that seriously affect the latter. The company is so impressed by the value of this observation that it proposes to set up plant for the production of dishes of copper, or coated with copper, forthwith. Of course some modification of the apparatus will be necessary; instead of the ordinary motion of the burnisher, one must be devised to deal with concave shapes, or, if not that, at least with discs which may afterwards be spun into the required form.

A careful examination of what is at present to be seen at the Elmore Company's works leads to the conclusion that the process has been carefully thought out, and difficulties that would not at once be obvious have been foreseen and provided for. The fundamental idea of the process—continuous burnishing during deposition—may be said to have proved its value, and the one other thing needed to ensure commercial success is a low cost of production. Many factors here come into play. It may at first seem obvious that any process in which electrical energy obtained from fuel through those wasteful intermediaries—the boiler, engine, and dynamo—must be unable to compete with one in which heat from the same fuel is used directly. But the consumption of fuel in the ordinary refining process is altogether in excess of that actually necessary to fuse, and maintain in a state of fusion for the requisite time, the copper to be refined. Further, it must not be overlooked that the energy required to deposit the copper on the cathode is only that needed to *transfer* copper from anode to cathode. None is needed for reducing the copper from oxide or other compound to metal; that has already been done by the producer of Chili bars. A more serious objection is the slowness of the process. This may be minimised by increasing the current density to the extreme limit of safety; possibly the use of more than one burnisher traversing the same cylinder might raise this limit. The company, whose immediate business such commercial considerations primarily are, feel convinced that the cost of production will be much lower than by older methods. Should this claim be made good, it appears to us that, where copper goods of high quality and of such shapes that a burnisher can be caused to traverse their surfaces by any simple mechanical motion are required, the Elmore process will prove a formidable competitor to the methods at present in vogue.

Notes.

COAL IN BRAZIL.

ALTHOUGH the deposits of coal in Brazil are by no means as important as those of iron ore, still there are many provinces where coal exists and is worked, while a search would probably lead to the discovery of other beds. Graphite is also found, and saltpetre has for a considerable time been worked. The Government grant liberal terms to those looking for and developing mineral fields.

THE ELECTRIC LIGHTING OF TRAINS.

PROFESSOR KOHLRAUSCH has reported on the experiments which have been in the electric lighting of railway trains between Cannstadt and Stuttgart, and his conclusions are that such lighting must be independent of the locomotive, and that it must be on the accumulator system. He disapproves of carrying a dynamo, owing to the consequent increase in the number of couplings in the train, and advocates charging the accumulators by means of fixed engines at various stations, and changing the batteries when approaching exhaustion. This system is stated to have been successfully carried on by the Oërlikon Company on Swiss railways.

THE TRADE OF DENMARK IN 1889.

THE trade of Denmark in 1889 with foreign countries amounted to 3,375,000 tons, of which 2,792,500 tons belonged to imports and 583,090 tons to exports. The estimated value of the whole trade with foreign countries amounted to £28,534,000, in which imports figured for £16,906,000 and exports for £11,628,000. Of this last amount £9,056,000 were native produce, and £2,000,000 foreign goods re-exported. Taking the volume of trade, it is seen that there are 200,000 tons more than in 1888, and 350,000 tons more than the average for the last five years. The increase is shared both by imports and exports. As regards values, there is an advance of £3,000,000 over the previous year, which is noticeable both in imports and exports.

SHIPBUILDING YARD AT DANTZIG.

A REPORT to the Foreign Office from Dantzig states that the only recent public work of importance there is an extensive shipbuilding yard which is being built by Mr. Schichau, the well-known torpedo-boat builder, of Elbing. The site is on the south side of the river, just outside the fortifications. It adjoins the line of railway to Stettin, so that Mr. Schichau will have every convenience for the carriage of all he requires to carry on his business, which, although only said to be a branch of the Elbing works, must in time become the most important of the two places, on account of the greater depth of water at Dantzig as compared with Elbing. The making-up of the ground alone, in order to obtain a secure foundation for the requisite buildings, has given employment to a large number of people. For this purpose Mr. Schichau has purchased a sand hill about half a mile from his site, and he is at present engaged in transporting the sand to its destination by means of an aërial line which passes some 40ft. above the high road, railway, and adjoining properties. Mr. Schichau is said to have already received numerous orders, which only await the construction of the slipways to be put in hand.

EUROPEAN COMPETITION IN SHIPPING.

OUR large shipping companies are beginning to feel rather keenly the competition from German and French lines of steamers, sailing not only from Continental ports but also from British ports. A few days ago the new North German Lloyd steamer "Havel," which was built by the Vulcan Company, at Stettin, sailed from Southampton, and is intended to form one of the regular German liners from that port, and great things are expected of her in the way of speed. She is the sister ship of the "Spree," which ran nearly 20 knots an hour with an indicated horse-power of 13,000. Two other vessels to be added to the Atlantic fleet will also be of Continental build. The Hamburg-American Company, the owners of the "Normania," which was built at Fairfield, Glasgow, will, in a few months, place another German-built steamer, with a 20 knot speed, on the Southampton route, so that that port will be well supplied from German sources alone. The French Compagnie Générale Transatlantique is having a large fast steamer built at the Forges et Chantiers de la Méditerranée at Havre. This competition is evidently stirring up the Cunard Company, who, we understand, are about placing orders for four new steamers, which are intended to beat everything afloat as regards speed. The Atlantic race is thus evidently far from ended, and it will be interesting to note the developments in marine engineering and shipbuilding resulting from this contest.

SMOKE ABATEMENT IN THE WEST OF SCOTLAND.

ABOUT three months ago we referred to a meeting which was held in Glasgow for the purpose of promoting a movement for the abatement of the smoke nuisance in the West of Scotland, and, judging from the speeches made and the representative nature of the Committee appointed, we expected that very rapid progress would be made in the solution of the problem. The first thing wanted was, of course, money to carry on the necessary experiments, and the Committee thought that from £2,000 to £3,000 might be profitably spent in the investigation, but we are sorry to observe that the appeal for funds has met with a very small response. It was sent to upwards of 3,000 persons, and only 161 responded with subscriptions amounting to a total sum of £485, which is, of course, quite inadequate for the purpose. The Committee stated at a recent meeting that as the appeal was made at the end of the year it may have been overlooked, and they decided to postpone any definite decision for another month, in the hope that the public might see their way to give the necessary assistance to enable them to carry out the proposed investigations.

MODERN PHYSICS.

So many people regard the atomic theory as a solid statement of fact, and the ether as existing "stuff," that engineers are now probably open to assimilate more scientific notions. Modern science declares that energy is much the same kind of thing as matter. Though it has no inertia, and is not acted on by gravity, it is indestructible and can always be localised like matter, and presumably occupies space as matter does, but independently of it. If energy disappears in one place it appears somewhere else, and in the meantime it moves from one place to the other. Professor Poynting, in his papers, which have formed the basis of some of these theories, carefully pointed out that he made use of assumptions; but that has been forgotten. Modern science also declares that action at a distance does not exist. The argument is that we cannot conceive it. Many people say they can conceive action at a distance quite as well as atomic lumps rattling together, but that is by the way. Modern science says, "what is inconceivable does not exist." As conceivability depends on experience, this is another way of stating that modern science has experience of the whole universe. Being told that a "pull" does not exist in Nature, and Professor Poynting having shown how energy moves about, we gather from the teachings of modern science that when a portable engine drives a thrashing machine, the energy goes from the engine to the thrasher, through every part of the universe except the belt. The belt is the only thing made or created that does not help to drive the thrasher. There are many other interesting cases of a similar kind, but perhaps one is enough to assimilate at a time.

THE COTTON INDUSTRY.

THE cotton spinning section of the staple industry is in a much worse position than at the beginning of the year; in fact, the tone is now somewhat depressed. Owing to the great decline in raw American cotton, coptwist and weft have been very difficult of sale, and values of yarn have declined at a greater rate than raw cotton. At the present time the margin between cotton and yarn shows little more than change for a shilling. The position is such that already there is a discussion going on privately as to the desirability of organising general short time. If this were attempted it is not at all certain that spinners as a body would adopt half hours, as many are better situated than others. Be that as it may, the position is discouraging to spinners, and at the moment there are no favourable prospects. Weaving, too, as distinct from spinning, is in a poor way. It is said that in Blackburn alone there are 15,000 looms standing idle, whilst in Burnley there are numerous loom sheds working short time. Altogether the cotton industry is going through a critical time. The supply of cotton will be large for all users. The current American cotton crop estimates are now 8,250,000 bales.

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Patent Record.

APPLICATIONS FOR PATENTS.

The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

9th February, 1891.

2299. Burnside, G. ..... Mining machines.
2300. Sutcliffe, R. ..... Tunnelling machines.
2302. Priestman & Priestman Dredging and similar machinery.
2329. Tout, J. R. ..... Cock or valve.
2337. Evers, M. ..... Gas engines.
2338. Brain, C. H. ..... Fluid pressure engines, applicable also as pumps.
2345. Cook, H. ..... Amalgamator.
2349. Juel & Ryan ..... Apparatus for purifying wood pulp.
2352. Wells, C. ..... Steam engines.
2353. Payton, W. ..... Apparatus for operating throttle and similar valves from a distance.
2354. Payton, W. ..... Engine governors.
2355. Payton, W. ..... Tool holder for drills, taps, and similar tools.
2356. Morris, H. B. ..... Machines for making wire netting. (5th September, 1890.)
2364. Ghosh, A. S. ..... Air pumps.

10th February, 1891.

2372. Bell, H. ..... Chucks.
2374. Barrott, L. ..... "Gin rollers" used in cotton gins.
2376. Morton, G. ..... Jacquard machines.
2377. Morton, C. H. ..... Gas reversing valves for open-hearth furnaces.
2384. Cartwright, G. A. ..... Knitting machines.
2387. Fricke, Turner, & Dunn Ordnance.
2398. Fraser, P. ..... Forging machines.
2401. Grew, F. W. ..... Machinery for washing grain.
2402. Douglas & Nicholls ... Metallic packing for shafts and spindles.
2408. Hanson, R. ..... Rocking bars of marine boilers.
2410. Wyman, H. ..... Looms for the manufacture of tufted fabrics.
2415. Barker, R. W. ..... Rotary engines (*Meyer*).
2422. Jones, E. C. ..... Gas-fired furnaces for boilers.
2439. Lake, H. H. ..... Apparatus for dyeing straw goods (*Searer*).
2443. Westinghouse, Jun., & Schreuder ..... Railway switch and signal apparatus.
2452. André, U. ..... Hydraulic mains for gas-making apparatus.
2459. Edwards, E. ..... Chuck for lathes (*Rambaud*).

11th February, 1891.

2465. Balfour, J. ..... Seed rolling and crushing machine.
2467. Murawski, H. ..... Furnaces.
2487. Terrot, C. ..... Circular knitting machines.
2512. Longridge, Cawley, & Austin ..... Shearing machinery.

12th February, 1891.

2525. Schippers, F. G. ..... Apparatus for operating Corliss valves of steam engines.
2527. Hodgson, Leeming, & Tetley ..... Appliances for operating the healds of looms.
2530. Boyd, A. ..... Mechanism for operating the steam valves of rotary engines.
2537. Houlden, H. W. ..... Steam engine.
2543. Redford, P. ..... Automatic vacuum brakes.
2553. Crawford, M. ..... Manufacture of balls for use in ball mills for grinding ores.
2569. Griffiths, James, & Hunt Rotary engines.
2572. Norton, J. A. ..... Feed apparatus of machine guns.
2573. Hammesfahr, E. ..... Crank plate mechanisms.

13th February, 1891.

2583. Wilson & Burrell ..... Steam engines.
2593. Binns & Snowden ..... Jacquard machines.
2595. The Pratt and Whitney Company ..... Machines for drilling gun barrels.
2596. The Pratt and Whitney Company ..... Machines for rifling gun barrels.
2601. Bodmer, G. R. ..... Hydraulic motors.
2605. Musgrave, W. M. ..... Governing apparatus of steam engines.
2623. Musgrave, J. V. ..... "Square motion" combing machines.
2624. Higginson, J., Jun. ..... Centrifugal governors.
2630. Hardwick & Robinson ... Punching mechanism for serrating the cutting edges of masons' tools.
2633. Hewitt & Morgan ..... Fog signalling apparatus.
2634. Edwards, E. ..... Water tube boilers (*Willmann*).
2649. Smith, W. ..... Motive power engines.
2662. Lange & Chauvin ..... Apparatus for the manufacture of looped and pile fabrics.
2670. Tenner, A. ..... Platen printing machines adapted to print from a continuous web.

14th February, 1891.

2676. Haythorn & Stuart ... Frictional clutches and couplings.
2680. Horsfall, J. T. ..... Temples for looms.
2681. Stelling, F. H. L. ..... Looms.
2684. Heald, Walmsley, & Walmsley ..... Shuttle guard for looms.
2685. Kaye & Crowther ..... Warp sizing machines.
2687. Hengst, C. F. ..... Rotary steam engine.
2692. Dunlop, J. ..... Steam engines.
2721. Thompson, W. P. ..... Apparatus for turning oval or other shaped objects (*Hansen & Schmidt*).
2730-1. Moore, F. ..... Compound pumping engines. (6th August, 1890.)
2737. Lock, C. ..... Gear wheels.
2741. Horn, W. W. ..... Automatic car coupler (*Reid & Scott*).
2744. Varchavki, M. ..... Sewing machines.

ELECTRICITY.

9th February, 1891.

2334. Eyre & Graham ..... Electrical communicators for use on public vehicles.
2360. Cheswright, H. T. ..... Accumulator plates.

10th February, 1891.

2417. Matthews & Cruickshank ..... Voltmeter and ammeter.
2418. Matthews & Cruickshank ..... Accumulators.
2433. Perry, J. ..... Continuous current transformer.

13th February, 1891.

2642. Mercadier, E. J. P. ..... Telephone receiving instruments.
2654. Forbes, Sir C. S. ..... Primary batteries.
2664. Atkinson & Atkinson ... Mining machinery.

14th February, 1891.

2677. Parsons, C. A. ..... Electricity measuring and recording instruments.

CHEMISTRY.

9th February, 1891.

2326. Smith, A. P. ..... Separation of iron and nickel from solution of their sulphates.
2343. Webb, T. G. ..... Apparatus for concentrating sulphuric acid.
2361. Alzugaray, J. B. ..... Metal alloys.
2362. Wilcox, Butterfield, & Batchelor ..... Manufacture of whitelead and other pigments.

11th February, 1891.

2499. Heraens, W. C. ..... Apparatus for concentrating acids.

13th February, 1891.

2611. Graham, Davis, & Davis Apparatus for the concentration of sulphuric acid.
2673. Darby, J. H. ..... Manufacture of steel.

14th February, 1891.

2682. Levinstein, I. ..... Colouring matters.

MISCELLANEOUS.

9th February, 1891.

2309. Marsden, S. ..... Lock nut.

10th February, 1891.

2378. Allcard, A. A. ..... Adjustable spanners.
2421. Lownes, P. W. ..... Wrenches.
2450. Carpenter, D. H. ..... Combined nut and pipe wrenches.

11th February, 1891.

2468. Beech, H. ..... Automatic fire-extinguishing sprinklers.

12th February, 1891.

2552. Tresidder, T. J. ..... Compound armour plates.
2576. Fuller, F. C. ..... Taps.
2578. Redfern, G. F. ..... Packing for steam engines, &c. (*Armengaud*).

13th February, 1891.

2592. Tweedale & Tweedale Prevention of smoke in steam boilers or furnaces.
2639. Blackburn, W. ..... Composition for removing scales from boilers. (5th September, 1890.)

14th February, 1891.

2719. Dugdale & Pogson ..... Rail joints.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

475. Sack, Von Maltitz, & Ziegel.
2150. Rowley.
2242. Hlawaty & Friedmann.
2387. Pollock.
2504. Wynne.
2544. Chenhall.
2632. Thompson (*Stehlik*).
2766. Lock.
2850. Stott.
2892. Horn (*Dean*).
3001. Gohmann.
3159. Cresswell & Heslop.
3240. Brehier & Talbot.
3312. Adeney & Parry.
3387. Bacon & Best.
3628. Bale & Sims.
3852. Lake (*Emmens*).
3956. Wolseley & Craven.
3962. Marchetti & Crossley.
4050. Tattersall.
4080. Archer.
4165. Wohlmuth.
4248. Jessett.
4473. Lake (*La Société Jph. Jay et Jalliffier*).
4586. Macaulay.
4647. Radotinsky.
4755. Edwards (*Wehmann*).
4765. Penman.
4901. Alexander.
4992. Gay & Hammond.
5072. Mond.
5102. Mols.
5142. Theisen.
5162. West, Sen., & West, Jun.
5194. Waller.
5216. MacMahon.
5259. Frith.
5283. Redfern (*Weinrich*).
5289. Adair.
5395. Vaughan (*Nilsson*).
5426. McGram.
5453. Ackroyd, Ackroyd, & Willoughby.
5491. Barrett.
5528. Gladstone.
5557. Gallaucher.
5570. Riley & Duff.
5584. Dubois.
5585. Longridge.
5598. Fleuss.
5641. Howard.
5684. Henderson.
5709. Longmore & Watson.
5836. Radcliffe.
5919. Hill, Sen., Hill, Jun., & Hill.
6206. Edwards.
6359. Peddie.
6609. Bamford.
6796. Bower.
7818. Bayly (*Hallock*).
8824. Richardson.
9118. Lake (*Krügener*).
9622. Pike.
10778. Ellis.
11442. Thompson (*Stowe*).
13044. Bardonnaut & Jupont. (20th February, 1890.)
14456. Moore. (17th February, 1890.)
16049. Haddan (*De Lambilly*).
16619. Waddle.
17240. Lake (*Moore*).
18184. Bonwill.
18205. Morgan.
18539. Mayer.
18589. Waddell.
19087. Erny & Subers.
19463. Clancy.
19572. Hopkins.
19960. Wild.
20185. Daudetreau.
20671. Lippacher, Reiner, & Dennerlohr.
20946. Bregha & Breza.
21010. Birch.
21089. Sorley.
21167. Y, Villar.
2057. Campion.
2108. Whitmore & Akester.
2165. Pullan.
2279. Goes.
2396. Blackband & Lunn.
2507. Cutlan.
2607. Fraser.
2762. Bancroft.
2767. Lock.
2875. Martin & Hendrickx.
2983. Collins.
3076. Gerbo.
3214. Wagner.
3276. Whalley.
3385. Tafel.
3585. Walford.
3832. Gray.
3882. Birtwistle & Bardsley.
4004. Barnett.
4079. Lowe.
4111. Scotter.
4228. Von Langer & Cooper
4372. Quine.
4519. Precht.
4582. Cole.
4599. Donne & Donne.
4743. Raikem.
4759. Precht.
4897. Reason.
4911. Topliss.
5033. Philburn.
5078. Hunt.
5134. Thompson (*Rostand*).
5150. Edwards (*Kneile*).
5163. Woodhouse.
5193. Dickinson.
5199. Electric Construction Corporation, Ld., Parker, & Robinson.
5309. Sharp.
5404. Grey.
5452. Parker.
5458. Hume & Parfitt.
5478. Crampin.
5498. Sims.
5548. Brindle, Reade, & Taylor.
5578. McGlashan & Rawlings.
5597. Woodruff.
5610. Billington.
5682. Hull.
5686. Cameron (*Lefarour, Johnson, & White*).
5848. Wardle.
6003. Potter.
6112. White.
6220. Lake (*Joeryensen & Bergh*).
6669. Greenwood.
6979. John Henry Lewis & John Skidmore.
8914. Crossley & Jones.
9180. Waddle.
10758. Gower.
10828. Burgon.
11643. Thurlow, Beeching, & Dier.
13134. Abel (the Firm of *Jacob Meuren*).
15652. Underdown & Beeston.
16553. Redfern (*Heller*).
16831. Ryland.
17413. Jarvis.
18185. Fiske.
18373. McCord. (16th April, 1890.)
18620. Wesson.
19329. Edwards (*Jaeger*).
19563. Cussen.
19578. Hardy.
20008. Watson.
20469. Wood.
20891. Edwards (*Cohn*).
20932. Körnig & Burgin.
20962. Thompson (*The Rochester Lasting Machine Company*).
21205. Peters.
21291. Carrington.

1891.

30. Downing (*The Morton Safety Heating Company*).
52. Gendron.
83. Thompson (*Striemer*).
263. Rutley.
268. Edwards (*Von Eulenfeld*).
274. Boult (*Grote*).
342. Hollingworth (*Webb*).
343. Hollingworth (*Webb*).
454. Brett.
495. Lamson.
583. Durand, Huguerien, & D'Andiran. (13th June, 1890.)
585. Calvert (*Ardern*).
590. Griffin.
616. Allison (*Ward*).
624. The American Elevator Company (*Otis Brothers & Co.*).
646. Lake (*King*).
647. Lake (*Weston*).
649. Lake (*Eickemeyer*).
651. Newton (*Worthington*).
656. Lake (*Stretch & Milne*).
986. Shrewsbury.
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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

MECHANICAL STOKERS.—*J. Proctor, Burnley, Lancashire.*—The stokers here referred to are for the purpose of automatically feeding the fuel to steam boiler furnaces, and are constructed in the following manner, reference being made to the annexed illustrations, in which Fig. 1 is a longitudinal vertical section and Fig. 2 a partial front elevation of such a mechanical stoker:—The furnace flue A has attached to its front end the coal hopper B, from

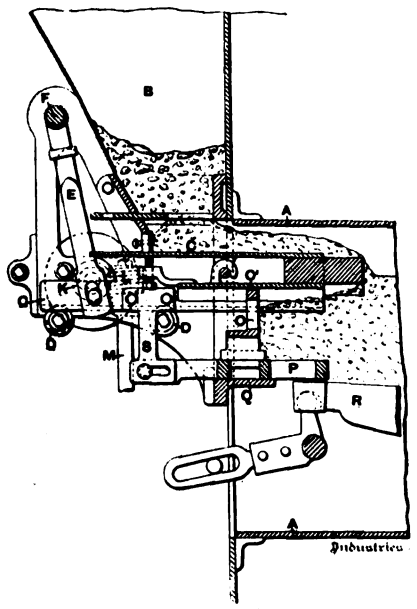


FIG. 1.

which the coal is fed on to a slide or carriage composed of two arched plates C C¹, fixed together and running on rollers D, and between the inner ends of which a tile or slab of fire-clay is fitted. The carrier is actuated by levers E E¹ fixed on or cast to a rocking shaft F carried by side plates. These levers E E¹ are actuated by means of slotted levers G caused to rock by crank pins H H¹ and plates I I¹ driven by a transverse shaft J, worm wheel K, and worm L on the vertical shaft M, which is driven by any convenient means. By keying the plates I I¹ by means of a feather on the shaft J either of the crank pins H or H¹ can be moved out of gear with its lever G or G¹ as desired. The fixed screws N hold the plates I I¹ in working position by being set in the grooves in the edges of the said plates (see Fig. 2). Below the fire door O is a plate P perforated or gridded, which moves in and out on the dead plate Q and over the gap between it and the front end of the fire-bars R. This plate is connected to C by an arm S and operated thereby, so helping to push forward the coal fed into the furnace by the slide. Claims: (1) In combination with the open mouth of the fuel hopper, an arched or stepped carrier or fire-clay slab moving to and fro beneath the said mouth and carrying the fuel forward into the furnace and depositing the same upon the moving fire-bars substantially as

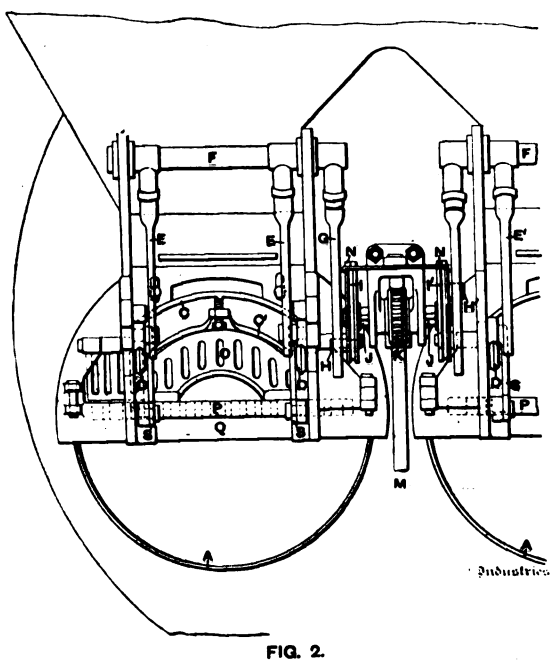
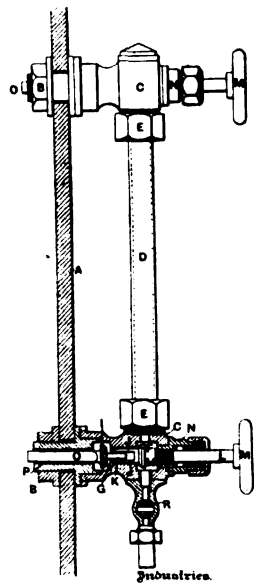


FIG. 2.

described and illustrated; (2) the combination with a feeding or distributing and coking apparatus, of a plate, preferably gridded, or equivalent device, moving to and fro beneath the said apparatus and over the dead plate and fire-bar ends, substantially as and for the purposes described.—No. 3186. February 28th, 1890. 8*d*.

VALVES FOR HOT GASES.—*J. van Langen & L. Cooper, both of Leeds.*—The valve proper is in the form of a hollow disc or plate provided with a hollow rim or flange adapted to dip into an annular cup containing a suitable liquid or solid packing material. This valve is mounted on a pair of hollow spindles, which receive cold water at the lower end by means of a flexible pipe, and discharge it, after circulating in the valve, at the top through another flexible pipe. The valve casing is of cast iron, containing the valve seating and gas inlets and outlets, situated above and below the valve seat respectively, and also a lower and upper stuffing-box for the lower and upper valve rods. Around the upper stuffing-box is formed a flange, between which and the stuffing-box water is circulated. The casing proper is provided with a closed jacket for cooling water, which surrounds the gas inlet and outlet, the valve chamber, and lower stuffing-box. The cooling water is admitted through a pipe connected to the lower lid connecting the lower ends of the inner and outer casing, and after circulating in the annular groove between these passes out through a pipe connected to the upper end of the outer casing. This pipe extends upwards above the annular receptacle surrounding the upper stuffing-box, and terminates in a double elbow connection, from which the water is led downwards through one pipe, and the steam generated escapes upwards through a second pipe. A small branch pipe from the exhaust pipe below the double elbow connection supplies water to the annular receptacle around the upper stuffing-box. Four claims are made, embracing the general construction of valves for governing the passage of heated gases, substantially as described.—No. 4225. March 18th, 1890. 6*d*.

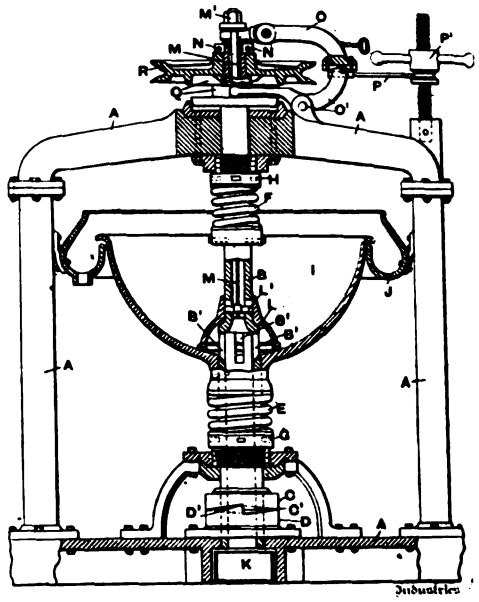
WATER GAUGE FOR BOILERS.—*J. McEwen, Liverpool.*—The invention refers to means whereby the passages from the boiler to the gauge are automatically closed should the gauge glass be broken. Referring to the annexed illustration, which is a part sectional elevation, A is the front plate of a steam boiler to which the water gauges are attached by the nuts B. C are the bodies or casings of the water gauges, D the gauge glass or tube, E the nuts for securing the gauge glass or tube in position, and R the usual blow-off tap. Each body or casing C is provided internally with the valve faces or seats F and G, against which the



valves H and I operate. The valves H and I are fitted with the interlocking fork ends J and K, by which the valve I is rotated when the valve H is operated by turning the hand-wheel M, thus maintaining a clear passage between the valve faces or seats F and G each time the hand-wheel M is rotated. The valve H is attached to the screwed spindle L provided with the hand-wheel M, the latter being for the purpose of operating the valves H and I when necessary. The spindles L pass through the stuffing boxes N in the usual manner. The valve I is fitted with the stem or guide O, which extends through the outlet P leading from the boiler, and is provided to prevent the outlet P becoming choked with deposit. From the above it will be seen that should the gauge glass be broken the valve I would be forced forward, so closing the passage from the boiler to the gauge glass. If the valve fails to close automatically the passage may be closed by valve H, as will be understood. After the gauge glass has been replaced I can be forced from its seat by means of the fork on the valve J. Claims: (1) In water gauges for steam boilers the use of the valves I for automatically closing the outlets for steam and water in case the gauge glass or tube breaks; (2) in water gauges for steam boilers the use of the valves H for closing the outlets for steam and water in case the automatic valves I fail to operate; (3) in combination with the valves H and I the use of the interlocking fork ends J and K, arranged to operate or rotate the stem or guide O in the passage P for the purpose specified; (4) the construction, combination, and arrangement of parts forming the improvements in water gauges for steam boilers, substantially as described and illustrated.—No. 4131. March 17th, 1890. 8*d*.

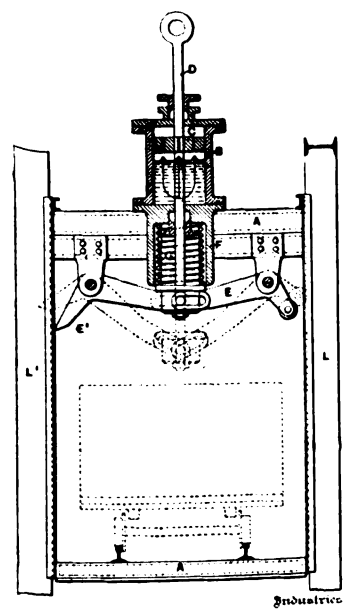
ADJUSTABLE SPANNER.—*W. Ash, Walsall, Staffordshire.*—The spanner constructed according to this invention consists of a suitable flat metal bar or handle, on the end of which is formed an arm projecting at right angles to the handle. Sliding on the bar is the sliding jaw, in one part of which a slot is made, and pivoted in the upper part of this slot is one end of a curved catch or pawl, adapted to engage notches formed on one side of the handle. A helical spring placed in the slot in the moving jaw presses against a short end of the catch, so holding the catch in engagement with the teeth on the handle until raised by means of a suitable handle formed on the said short arm. In other arrangements the catch is held in engagement by means of a flat spring, and also two catches or pawls are used instead of one, the catches in this case being pivoted on the opposite sides of the adjustable jaw, and engaging teeth formed on the wider sides of the handle. Claims: The improved moving spanner in which the moving jaw has one or more spring catches arranged substantially as and for the purpose described.—No. 4345. March 20th, 1890. 6*d*.

ORE CONCENTRATORS.—*W. P. Thompson, London.* (*C. E. Seymour & C. F. Staver, both of Hurley, Wisconsin, U.S.A.*).—The annexed illustration shows a part-sectional elevation of an ore concentrator embraced by this invention. Running in bearings



on a suitable frame-work A is a vertical hollow shaft B. This shaft receives a vertical reciprocating motion by means of the collar C thereon and a second collar D fixed to A, having respectively diametrical cams C¹ D¹, which so engage one another as to produce the said reciprocation. The shaft B is normally forced downwards by means of springs E and F, the tension of which may be adjusted by means of screwed sleeves G H. At about the middle of B is fixed the concave bowl I, into which the pulverised ore, &c., together with water, is fed. Around the upper edge of I is an annular chamber J, supported by A, into which the waste from I is caused, by centrifugal force, to escape. The shaft B is provided, at about the bottom of I, with four holes B¹, through which the contents of I may escape into a pan K. These holes B¹ are governed by means of a cone-shaped valve L fixed by means of a bolt L¹, working in slots in B, to a rod M. The upper end of M carries a nut M¹, between which and a collar N on B the forked end of a lever O, pivoted at O¹ and governed by a flexible rod P and nut P¹ as shown, may be forced, so raising M together with L. The other end of O, also forked, projects into a groove in a friction wheel Q capable of longitudinal movement on B, but revolving therewith. This wheel Q is for the purpose of engaging and disengaging the driving wheel R with B as required. Nine claims are made.—No. 15021. September 23rd, 1890. 8*d*.

LIFTS.—*A. Eichert, Hohenzollern Mine, near Beuthen, Silesia, Germany.*—The object of the inventor is to prevent the articles or persons in the cage of a lift being thrown out in case of the rupture of the cable. The accompanying illustration shows an



appliance for this purpose. Upon the cage A is arranged a cylinder B, in which is a piston C, through the medium of whose rod D both the junction of the ropes or chains at the top is ensured and the catch levers E E' are operated by the piece S. The piston C is provided with a number of parallel openings of sufficient size, and the cylinder is partly filled with a suitable liquid, such as glycerine. With the cylinder is connected a box F containing a spring G. Should the rope or chain break the operation of this safety device is as follows:—The spring G,

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which is compressed as the elevator moves up and down, expands in case of breakage, and forces the catch levers E E¹ against the guide ropes L L¹, but at the same time the piston encountering the resistance of the fluid in the cylinder prevents the too sudden action of the catch levers, and consequently the cage comes to a standstill gradually; the piston, in descending, also meets the liquid contained in the cylinder, and under the influence of the spring slowly forces the said liquid through the above-mentioned openings until the levers reach the position indicated in dotted lines, in which the cage is entirely under brake action. Claims: The arrangement as described and for the purpose set forth.—No. 19058. November 24th, 1890. 6*d*.

STEAM HAMMERS.—*E. S. Brett & J. Hazlewood, both of Coventry.*—The invention relates to steam drop hammers. Referring to the accompanying illustrations, Fig. 1 is a front elevation, Fig. 2 a

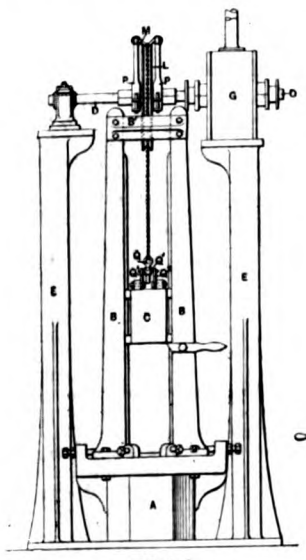


FIG. 1

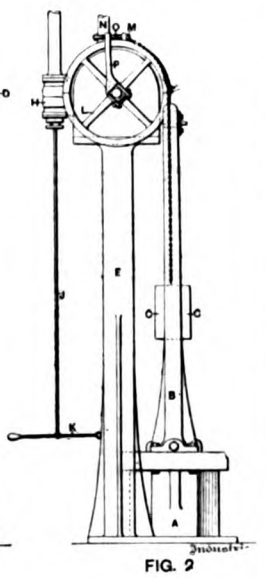


FIG. 2

side elevation, and Figs. 3 and 4 details, of a drop hammer constructed according to this invention. A is the fixed block, at each side of which is fixed a vertical guide B, in which the hammer C slides. Above the top of B B is placed the horizontal driving shaft D, running in suitable bearings on the pillars E E, the shaft D being operated by means of a plate piston F working in a cylinder G (Fig. 3). A suitable steam chest H and valve I is arranged in connection with the cylinder G, and also a rod J and lever K, by which the said valve is operated as desired. The driving shaft D has a loose pulley L, over which the chain connected to C runs. The upper end of this chain is connected to a cross-piece M connected by bolts N and springs O (Fig. 4) to arms P fixed on D. On the upper ends of B B is a cross-piece B¹, on which are fixed cushions, against which the bolts N strike when the hammer C is allowed to fall,

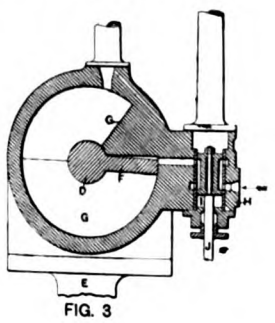


FIG. 3

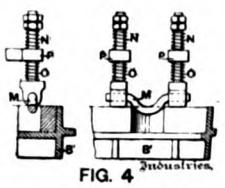


FIG. 4

so preventing piston F striking the interior projection G¹ of G. The length of the chain is made adjustable in order to accommodate the position of the piston F by means of an adjustable bolt Q screwing into a plate Q¹, carried by arms Q² pivoted to C. Five claims are made.—No. 2924. February 24th, 1890. 8*d*.

GAS ENGINES.—*Dr. N. A. Otto, Köln, Germany.*—The invention relates to engines working with a cycle of four strokes, and has for its object a method of maintaining the exhaust valve closed during the compression stroke. According to one method a double-ended lever, pivoted horizontally to the outer end of the cylinder, has one end connected to one side of the igniting slide, the other side of which is connected by a rod to an eccentric on the crank-shaft of the engine. The other end carries a pivoted rod, which ordinarily is held in a position so that it will strike the notched end of the spindle of the exhaust valve, by means of a spring holding it against the hooked end of the actuating lever. Connected to the second or valve-actuating lever is a link connected at its other end to a flexible diaphragm closing a cup-shaped vessel which is connected by a small pipe with either the gas supply pipe or the air inlet of the cylinder. The effect of this arrangement is that when the piston is performing its suction stroke, producing a certain rarefaction in the gas and air supply pipes, this reduction of pressure in being transmitted to the diaphragm cup will cause the diaphragm to be forced inwards by atmospheric pressure, thereby drawing down the rod which normally acts upon the notched end of the exhaust valve spindle, so that it slides under said spindle and allows the exhaust valve to remain closed during the compression stroke. The full pressure being meanwhile restored in the gas and air inlet pipes, and consequently in the diaphragm-cup, the diaphragm is forced outwards, so allowing the exhaust valve operating rod to regain its normal position and so open the exhaust valve as the piston commences its inward expelling stroke. In a modification the inventor connects the pipe of the diaphragm-cup with the interior of the working cylinder. Four claims are made, embracing the arrangement substantially as described, together with modifications as described and modified operating parts.—No. 4823. March 27th, 1890. 8*d*.

LOOMS.—*J. Lindsay & R. Allan, Dundee, N.B.*—The inventors' object is to provide an apparatus applied to the whip rail of a loom for weaving, to impart some elasticity in order to render the beating-up or other strains on the warp less severe than in ordinary looms. For this purpose one side or edge of a curved plate of thin steel of a suitable temper is fixed to the whip-rail in such a manner that it only touches the rail where fixed to it when free. The warps, in passing up from the warp beam to and over this spring whip-plate, bend it more or less according to the tension on them; and when the strain on them is suddenly increased by the beat-up, the spring whip-plate yields further, but immediately springs out to its normal position when relieved. One or more springs may be applied under this plate if required, or instead of the whip-plate being elastic, it may be of cast iron or otherwise rigid, and be pressed outwards by one or more springs, the rigid plate being hinged to the loom framing. Claims: The providing of a loom for weaving with a spring whip-rail or plate, or a spring-pressed whip-plate, substantially as and for the purpose described.—No. 4333. March 20th, 1890. 6*d*.

CRUSHING MACHINES.—*J. C. Cole, London.*—Crushing machines constructed upon the principle of this invention accomplish their object by means of a reciprocating motion imparted to one of a pair of jaws between which the material to be crushed is fed. Referring to the accompanying illustrations, Fig. 1 is a vertical section, and Fig. 2 a plan of such a machine having two pairs of jaws. On the frame A are the two adjustable crushing faces B, against which the movable crushing blocks C C¹ pivoted on rods D work. The head E is given a vertical reciprocating motion by means of the crank on the shaft F. The upper and lower ends of E are connected by means of toggle joints G G¹ G² G³,

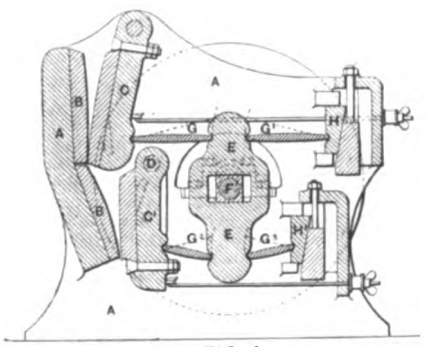


FIG. 1

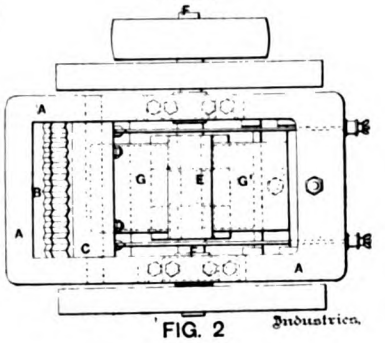


FIG. 2

to the blocks C C¹, the outer ends of G¹ and G³ resting in adjustable blocks H H¹. The disposition of the parts mentioned and the relative lengths of the upper and lower toggles give rise to two double reciprocations of the jaw C¹, while the upper jaw C makes but one double reciprocation to every revolution of the crank or eccentric shaft F. To effect this the parts are so arranged that the upper toggles are in a line, and so close the upper jaw when the crank has given its maximum motion in one direction to the piece E. The inventor also describes modifications in which three pairs of jaws are used, together with other improvements. Five claims are made.—No. 2281. February 12th, 1890. 8*d*.

VICES.—*J. Kenyon, J. Barnes, & R. W. Kenyon, all of Accrington, Lancashire.*—One jaw of the vice (preferably the front one) is, according to this patent, pivoted at or near its base to allow it to turn and adjust itself to the second or back jaw. In carrying this into effect as regards parallel vices the back jaw is constructed in the usual manner with a bracket or base plate, by which it is secured to the bench, and a sliding bar sliding in a slot between the jaw and its base to carry the front jaw. This arm is of L or a convenient shape, and is provided in its lower member with a socket to receive a pin or pivot on the bottom of the front jaw. In the upper part of this jaw a hole is provided, through which the spindle of the tightening screw passes, as well as through the vertical arm of the L slide. The lower end of the jaw is provided with a pivot, which fits into the socket in the sliding arm, and the back of the jaw is turned to the arc of a circle and fitted to rest against the L arm with a lug or tongue projecting into a groove, by means of which the greater part of the strain falls upon the sliding arm. The movable jaw is provided with a catch, which engages with a slot in the sliding arm to retain the jaw when required parallel to the fixed jaw. Claims: (1) A vice having one jaw pivoted at or near the bottom in a supporting slide-bar with an elongated or slotted hole, through which the tightening screw passes, the pivoted jaw being supported above its pivot by the tightening screw, or by a bracket, against which the screw bears as described; (2) a parallel vice having a fixed jaw, a base-plate, and a sliding bar, with or without the upright supporting member which carries the second jaw, and a jaw through which the tightening screw passes, pivoted thereto as described; (3) a vice having the several parts constructed and arranged substantially as described.—No. 4401. May 20th, 1890. 11*d*.

MECHANICAL STOKERS.—*J., T., & J. Vicars, all of Liverpool.*—The invention relates to those mechanical stokers in which the firebars are carried forward in a body from the front to the rear of the grate, and are moved back again in detachments or one at a time. The hopper for supplying the fuel to the stoker, instead of being fixed in the ordinary manner, is hinged at its bottom to the main frame of the stoker, so that it can be readily turned down to expose the front of the boiler for inspection, cleaning of the fire tubes, &c. A suitable hollow jacket in three pieces, secured between the fuel delivery orifice of the stoker and the roof of the furnace mouth, serves as a passage for air from the exterior to the interior of the furnace, the air entering and escaping through suitable perforations in each side of the casing. Claims: (1) A hopper and stoker jointed together in the manner and for the purpose set forth; (2) constructing furnaces with a mechanical stoker and hollow jacket disposed in the manner and for the purpose set forth.—No. 4203. March 18th, 1890. 6*d*.

GRINDING MILLS.—*F. Chapman, London.* (*G. Massey, Sydney, N.S.W.*)—In the annexed illustrations Fig. 1 is a sectional elevation, and Fig 2 a half plan and half horizontal section of a grind-

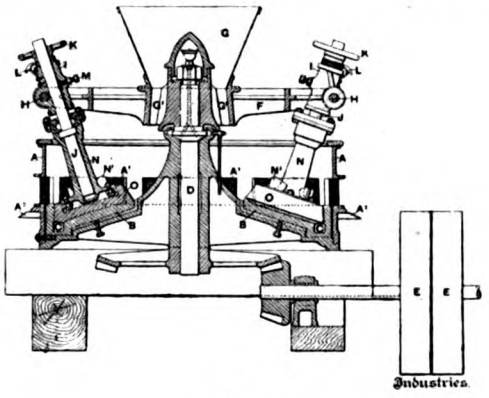


FIG. 1.

ing mill constructed according to this invention. Placed in the annular pan A is an annular grinding race B having a mercury groove C. Running in the centre of A and concentrically with B is a vertical shaft D driven by means of gearing from E and carrying upon its upper end a frame F having a hopper G in its centre for feeding the material to be crushed through holes G¹ into A. This frame F has pivoted on spindles H collars I embracing shafts J, the upper ends of which are screwed so that by means of hand-wheel K they may be raised or lowered, the distance being regulated by means of spring catch L working in a number of indentations in K, the shafts H being, after adjustment, fixed by set screws M. The lower ends of J carry by means of collars sleeves N, having vanes or splashers N¹, on the lower ends of which are bolted the muller heads O formed to suit the shape of the race B. Around A are fixed grates A¹ and a dis-

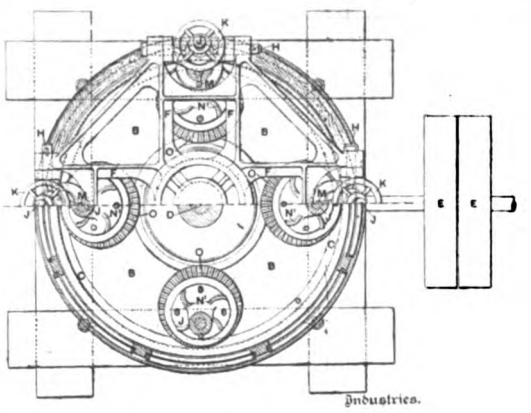


FIG. 2.

charge lip A². By pivoting the collars I carrying the spindles J as described, the muller heads, as the frame F is revolved, will, by centrifugal force, be pressed against the side of A. Six claims are made.—No. 18089. November 10th, 1890. 11*d*.

TUBULAR BOILERS.—*W. Hornsby & R. Edwards, both of Grantham, Lincolnshire.*—The invention relates to the construction of externally fired tubular boilers, constructed of two cylindrical shells of different diameters jointed together end to end but eccentrically, end plates being provided at the outer ends of the shells and at the other end of the larger shell not covered by the smaller one, and tubes are arranged between these plates. At the outer ends of the boilers are arranged fire-boxes forming continuations of the shells. Underneath the front or smaller part is arranged a fire-grate of the ordinary construction, the heated products of combustion from which first pass through the lower set of tubes connected to that part of the larger cylinder not covered by the smaller one, and to the outer end of the larger cylinder or back of the boiler, from thence they pass through the back fire-box, through the tubes running the entire length of the boiler and into the front fire-box, and then to the chimney. Claims: (1) Constructing tubular boilers with two cylindrical shells of different diameters attached together end to end eccentrically, and with tube plates and tubes arranged as described; (2) the manufacture and use of the improved longitudinal tubular steam boiler constructed and arranged substantially as described.—No. 4589. March 24th, 1890. 6*d*.

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SELF-ACTING MULES.—*G. Hartley, Brierfield, near Burnley, Lancashire.*—The invention consists of an arrangement of parts for automatically controlling or varying the speed of the tin roller shaft, or the spindles which it actuates, while the machine is in operation, so as to relieve the yarn of superfluous twist at the commencement of the draw. For this purpose two grooved driving pulleys of unequal diameter are employed, driven from the same rim-band, and capable of engaging alternately with frictional cones fixed to the tin roller shaft. At the commencement of the "draw" the larger driving pulley is thrown upon one of the cones, so as to drive the tin roller at a reduced speed and relieve the yarn of superfluous twist. After relieving the yarn the larger pulley is withdrawn and the smaller pulley thrown upon the other cone to increase the speed. The shifting movement of the pulleys is effected by means of a lever on the carriage coming, during its traverse, against suitable stationary guides. Claims: (1) The arrangement of mechanism for obtaining an increase or decrease of speed in spinning mules as described; (2) the combination of two speed pulleys of different diameters and friction cones, operating substantially as described.—No. 4110. March 17th, 1890. 6*d*.

SKIN SPLITTING MACHINERY.—*S. Bowron, London.*—In the accompanying illustrations Fig. 1 represents a front elevation, partly broken away, Fig. 2 being a transverse section on an enlarged scale of the principal parts of a skin splitting machine constructed according to the invention. A is the framework of the machine, similarly constructed at both ends, and B are bearings in which are supported shafts C, on which are mounted single flanged pulleys D carrying a broad endless band knife E, which travels across a table F, being kept perfectly level in its course by means of adjustable plates F^1 (Fig. 2). Beneath the knife E is mounted a roller G, the distance between the edge of the knife and the roller being regulated by adjusting screws G, one only of which is shown. On a shaft H are loosely mounted a series of rollers H^1. The skin to be split is placed upon the table J and one edge presented to the rollers G and H^1, which draw it forward, and present it to the edge of the splitting knife E. The roller G is supported rigidly throughout its length by bearings formed at intervals in the trough or casing G^1, and the rollers H^1 are pressed against the upper surface of the skin by means of a roller K, which is covered with indiarubber, and which, whilst imparting motion by surface friction to the rollers H^1, permits them to accommodate themselves to the slight inequalities in the thickness of the skin. As soon as the first portion of the skin has passed between the rollers G and H^1, the under layer is caught between rollers G and G^2, the upper portion being taken up as cut by the attendant. The roller K is enclosed within a metal cover K^1, which is open at the bottom to allow the rollers H^1 to project therethrough. This cover K^1 is mounted on arms K^2, shown broken, on the ends K^3 of which are counterbalance weights, by which means the whole

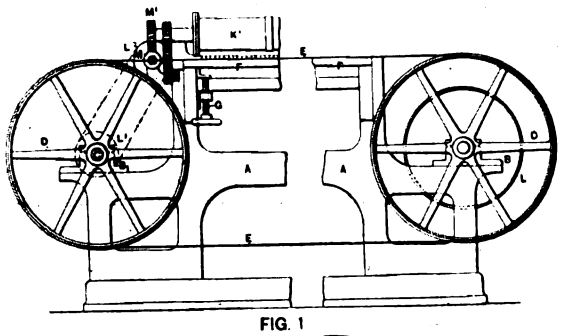


FIG. 1

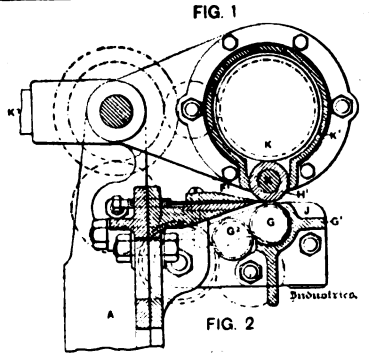
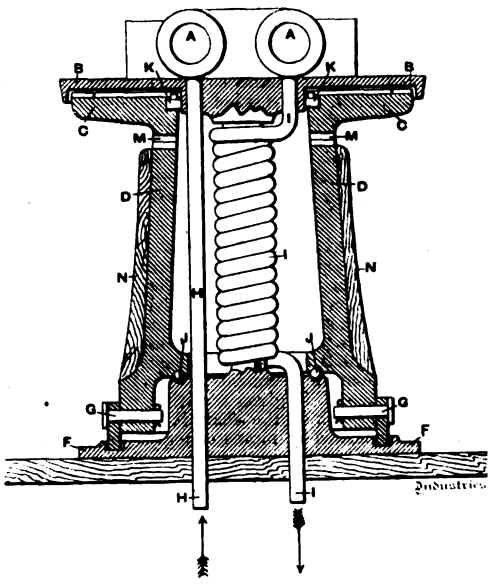


FIG. 2

of the parts H^1, K, and K^1 can be readily raised to afford access to the knife and adjusting parts in connection therewith. Claims: (1) In a machine for splitting sheep-skins the combination of an endless knife E with rollers G and H^1 in the manner described; (2) the combination with knife E and rollers G and H^1 of an indiarubber or other yielding roller K in manner and for the purpose as described; (3) the general construction and arrangement of a machine for splitting sheep-skins as described and illustrated.—No. 20093. December 9th, 1890. 6*d*.

THRASHING MACHINES.—*J. Marshall, Gainsborough, Lincolnshire.*—The aim of the inventor is to provide, in connection with thrashing machines, means whereby they are are fitted for use for thrashing clover or trefoil at one operation. For this purpose a clover shelling drum and "concave" is applied to the tail end of a thrashing machine, so that said drum receives the "cobs" from the upper dressing shoe, after the clover or trefoil has been passed through the ordinary thrashing drum, they being carried over the upper dressing shoe on to a caving riddle, provided for that purpose, and thence being delivered into the barrel of the clover sheller. The shaft of the clover sheller is, at the end situated at the outlet, provided with blades to throw back the seed and chaff, separated in shelling, on to the opposite side of the caving riddle, which separates the seed from the chaff and deposits the latter on the ground at the end of the machine under the barrel of the sheller, whilst the seed passes through the caving riddle and lower dressing apparatus to the elevators, and from thence is delivered into sacks at the other end of the machine. Claims: (1) In combination with a thrashing machine a clover or trefoil shelling drum as and for the purpose described; (2) the arrangement of parts so as to constitute a machine for thrashing or stripping and shelling clover or trefoil, substantially as described.—No. 4167. March 17th, 1890. 6*d*.

STEAM CAPSTANS.—*J. W. Brooke, Lowestoft.*—The annexed illustration shows a capstan constructed according to this invention. A A are the steam cylinders of the ordinary horizontal direct-acting type, having the steam and exhaust passages cast in one therewith. B is the capstan head, to which the cylinders are



bolted. C is the crown wheel. D is the iron revolving barrel of the capstan having holes M M for hand spikes; N N are the wooden whelps fixed round the barrel D. E is the wrought-iron spindle carried by the pawl-pan F. G are the pawls and bolts. H is the induction steam pipe, carrying steam to the cylinders A. I is the eduction coil, which coil is carried outside the spindle E, and forms a condenser for the eduction steam. Ball bearings J and rollers K are provided to reduce friction. The inventor claims in the construction of steam capstans, the utilisation of the annular space between the spindle E and the revolving barrel D for, and the combination therewith of, the steam pipe H and condenser coil I as described, and the general construction, combination, and arrangement of the several and respective parts together constituting the improvements in steam capstans as described.—No. 3724. March 8th, 1890. 6*d*.

ELECTRICITY.

DYNAMOS.—*A. C. Reignier, Paris, France.*—The invention relates to a method of coiling the armature (either of the drum, disc, ring, or other form), whereby more favourable utilisation of the mechanical or electrical energy expended may be obtained. In describing the method as applied to an armature of the drum type, the armature axis, which is fixed, carries the drum made to revolve on ball bearings at each end thereof, and between these bearings a magnetic core is fixed to the axis. The coiling of the armature consists of groups of laminæ, which are successively of insulating material, iron, copper, then iron insulating material again, iron, copper, and iron insulating material, and so on repeatedly. The copper laminæ are extended and serve as conductors which terminate in collecting conductors in the form of rings fixed at one end of the revolving drum, the driving pulley being fixed at the opposite end. The brushes are carried on an arm on a suitable rocker pivoted to the end of the stationary axis. Between the groups of laminæ are bolted wedge-shaped iron rods serving to secure together the several groups of laminæ in the form of a cylindrical armature. Claims: (1) A dynamo machine whereof the armature is built up of, first, a number of similar parts, each consisting of laminæ of iron, copper, and insulating material, each laminæ of copper pushed between two laminæ of iron outside of which are two insulating laminæ, and secondly, of wedge pieces fixing the groups of laminæ, the whole forming a hollow cylinder surrounding a soft iron core, and revolving on ball bearings, the armature being either a drum with Siemens coiling or a ring with Gramme coiling or of any equivalent kind; (2) the general construction of the drum machine described; (3) a modified construction wherein the junctions extend beyond the laminæ of the magnetic sides to parallel insulated rings situated at one end of the machine and of the same diameter as the drum, with brushes bearing on them; (4) a machine of the ring type, having its armature consisting of an annular laminated nave carrying externally iron, copper, and insulating laminæ, as in the drum machine, and internally copper and insulating laminæ connected to the external laminæ and to a collector with diametrically opposite brushes.—No. 3028. February 25th, 1890. 8*d*.

CONCENTRATION OF IRON ORES.—*R. Haddan, London.* (*G Conkling, Glens Falls, New York State, U.S.A.*)—The process of concentration of iron ores embraced by this invention consists in first crushing the ore to particles of about a quarter of an inch in size, and then exposing it in such a granular form to the action of powerful magnets, so that all the particles containing iron ore are separated from the gangue. These particles containing ore are again crushed to particles of about ¼in. or less in size, and exposed to the action of the magnets, so separating the remaining gangue from the iron ore. The separator used for the above purpose is constructed in the following manner:—Running in a suitable frame-work are two rollers, one placed at a suitable distance above the other, and at a suitable distance to one side of it, so that an endless band passing around the rollers will run in a slanting direction. This band runs in such a direction that the crushed ore fed by means of a suitable shoot on to its upper surface is carried upwards and over the higher roller. Situated between the endless band are three or more electromagnets, the poles of which are connected to an iron plate situated close to the underside of the upward travelling part of the band, the ends of said plate extending to near the surface of the two rollers, and being of a width equal to that of the band. Those particles of ore containing iron will be so held to the band by magnetic attraction until carried to the upper surface of the higher roller, where, as it passes away from the attracting magnets, it is released and so, as the band continues its course, is thrown from the band as it passes around the upper roller. The gangue separated from the iron containing ore rolls down the band and is collected in a suitable receptacle as it falls. Claims: The process as described —No. 18636. November 18th, 1890. 6*d*.

CHEMISTRY.

DYESTUFFS.—*S. Pitt, Sutton, Surrey.* (*L. Cassella & Co., Frankfort-on-the-Main, Germany*).—The invention relates to the production of new dyestuffs by the action of dimethylamine upon fluoresceine. The following is an example of the process embraced by the invention:—33 kilos of fluoresceine dissolved in 150 litres of alcohol, and 30 litres of an aqueous solution containing 40 per cent. of dimethylamine, are heated in a closed vessel (autoclave) for twelve hours to 175°–180° C. The contents of the vessel are diluted with 100 litres of water, and 8 kilos of caustic soda are added. That part of the dimethylamine which did not combine with the fluoresceine is separated by distillation, and by the adding to the remaining solution at a temperature of from 70°–80° C. of 50 kilos acetic acid of 50 per cent., the rhodaminol formed is caused to precipitate. This may be purified by repeatedly dissolving its sodic salt and precipitating it by means of common salt, filtering, and adding some muriatic acid, which causes the separation of crystals of the chlorhydrate of tetramethylrhodamin. Claims: (1) The process of preparing basic dyestuffs from fluoresceine or fluoresceine ethers by heating these substances with dimethylamine; (2) the new products which result from the process described.—No. 4904. March 28th, 1890. 4*d*.

MISCELLANEOUS.

SUPPORT FOR SHIPS' BOATS.—*C. J. van Sluijs, Ymuiden, & C. S. Jzn, Velsen, both of Holland.*—The support, constructed on the principle of the invention, is for the purpose of providing a secure resting place on the deck of the vessel for the boats, and also to provide means whereby the latter may be rapidly launched. In the accompanying illustrations Fig. 1 is an end elevation, Fig. 2 a side elevation of the rear support (the front support being of a similar construction), and Fig. 3 a plan of a deck support for ships' boats, constructed according to this invention. Two central supports A, supporting the main weight of the boat, are supported by means of hinged levers B, hinged at their lower ends to sliding blocks C, sliding on the plate E and actuated so as to be caused to recede from or approach one another, as desired, by means of a left and right-hand screwed shaft F running in bearings G. Hinged to the top of G are rods H hinged at their upper ends to the side supports I carried on the upper ends of the rods J. These rods J are hinged at J^1, the hinged part being embraced by a sleeve K (Fig. 4), capable

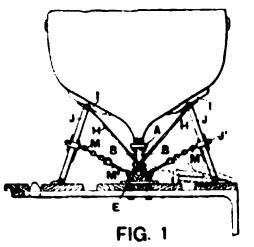


FIG. 1

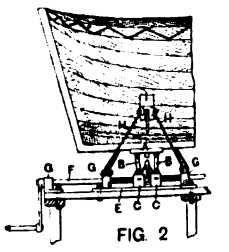


FIG. 2

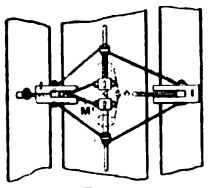


FIG. 3

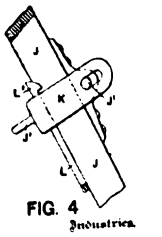


FIG. 4

of a slight transverse movement, and carrying a spring L, the end L^1 of which enters a notch in one part of the rods J, so holding them in the position shown. The sleeve K is connected by means of chain M and toggles M^1 to the blocks C. From the above it will thus be seen that as F is revolved the blocks C will recede from one another, so, at first, slightly raising the boat and then lowering it. At the same time, by means of the toggles M^1, the sleeve K will have been sufficiently moved to withdraw the end L^1 of L, so releasing the joint in the rods J, and allowing the side supports to fall as shown in dotted lines (Fig. 1). Six claims are made.—No. 16705. October 21st, 1890. 8*d*.

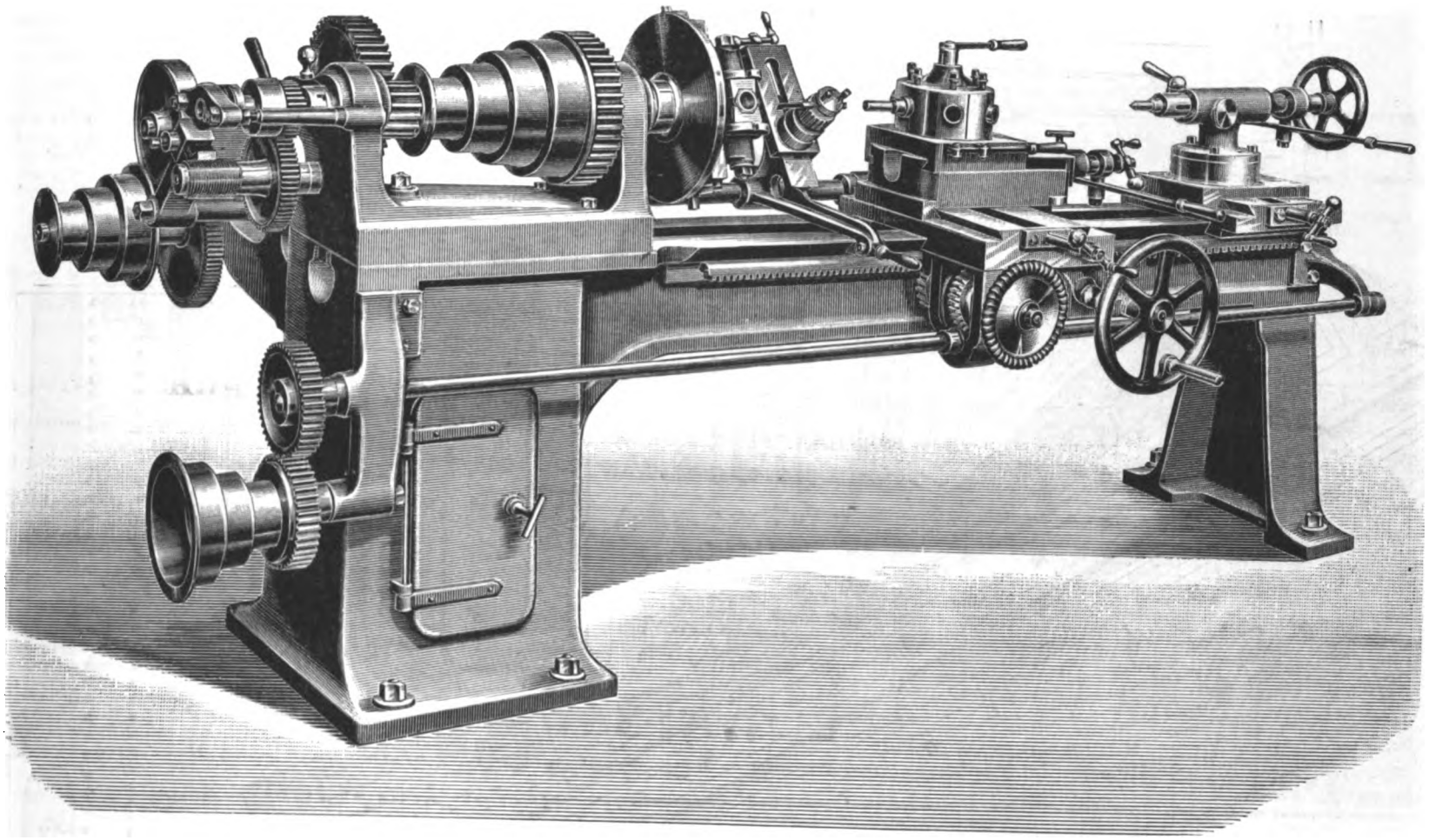
Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED BRASS FINISHERS' TURRET LATHE.

CONSTRUCTED BY THE NORTHERN ENGINEERING COMPANY, LIMITED, HALIFAX.

(*For description see page* 221.)



GENERAL VIEW.

THE ROYAL NAVAL EXHIBITION.

FOLLOWING the Military Exhibition of last year, the naval side of our defence is to have an Exhibition on the same grounds, adjoining the Royal Hospital, Chelsea. This Exhibition promises to be more successful than even the Military Exhibition.

What Chelsea Hospital is to the military service, Greenwich Hospital is to the naval service, and it was, therefore, proposed at one time that the present Exhibition should be held at Greenwich, amidst the associations of the service, the Naval School, and the fine museum of nautical models. But upon mature consideration it was considered that the difficulties of access were too great for a numerous collection of visitors to ensure the commercial success of the Exhibition. The limitation of space was another reason why it was not deemed prudent to hold the show there. As it is, in the present grounds, which comprise eight acres in addition to that covered by the late Military Exhibition, the committee have no difficulty in filling the whole area; the number of applications for space is so great that the difficulty is to make a judicious selection of the objects offered. As at present arranged, it is proposed to open the Exhibition on the 2nd May next.

The amended plan, given on page 218, gives an outline of the space covered, the additional eight acres being on the right from the arena to the boundary. On this new part an army of workmen is busily engaged in building the new erections and in making the alterations and additions required. Before describing these it will be well to advert to the objects of the Exhibition.

Although the Navy is recognised as our principal weapon of defence, yet from its very nature it is impossible for the great mass of the nation to form any idea from external evidence of the character of the service in which they are so deeply interested. It was considered, therefore, that an Exhibition which should convey to the general observer some conception of the rise and progress of the Navy, and the general character of our latest warlike productions, would be not only interesting, but productive of benefit, by creating additional popular interest in the service. Of course the Admiralty could not officially undertake the Exhibition, but a large number of volunteers from all branches of the service are entering with zeal into the duties on the various committees. Although it is anticipated that the receipts from the Exhibition will considerably exceed the outlay, it was considered prudent to procure a substantial guarantee fund, and thus relieve all connected with it from pecuniary liability, and at the same time to enlist the widest possible interest in the success of the undertaking. A large guarantee fund of £50,000 has therefore been raised from about 200 guarantors, many of our leading manufacturers giving their names for large sums. A great feature of the Exhibition will be its historical side. A collection of models and objects of interest will be brought together from Her Majesty's Dockyards, the Royal Naval College at Greenwich, and various other places, and these will admirably illustrate the naval history of the nation. The Arts Section will be represented by a most interesting collection of naval portraits, battle pieces, and relics. The buildings handed over by the Military Exhibition have been re-arranged and enlarged. Considerable additions have been made to the picture gallery; and the entrance, which is on the Thames Embankment, has been opened out and made more imposing.

About 300 applications for space have already been sent in, and from the list we find that all the leading builders of ships and manufacturers of marine appliances will be represented. Thus the Exhibition will be even more general in its character than its title indicates; it will be a veritable maritime exhibition. The collection of models will be probably the finest ever brought together. Not only will there be a complete series of historical models, but this will be supplemented by models contributed by all the most eminent shipbuilding and engineering firms in the country. Probably one of the most striking sets of models, and the highest in an educational sense to the tax-payers of the country, will be a complete series of models of the whole of Her Majesty's Navy at each particular station. Thus there will be the ships comprising the Channel Fleet, placed in position in the English Channel; another set will be the Mediterranean squadron, shown in the sea in question; other sections of the Navy will be given in conjunction with the particular parts of Greater Britain they are considered to protect.

A full-size model of Nelson's ship, "Victory," is now being built, as shown on the bottom right hand corner of the plan. The water line of the ship will be represented by the ground line, and the interior and lower deck will be made as realistic as possible to bring home to the minds of the visitors the appearance of the "Victory" on the day of the great battle of Trafalgar. Adjoining this model is being erected a panorama of the battle of Trafalgar. Contrasted with the model of the "Victory" will be the exhibit of Sir W. Armstrong & Co., in the St. Vincent Gallery. This will be a model, 270ft. long, of a modern armour-clad ship, with revolving turret guns and hydraulic loading gear complete, so as to show the latest improvements in the fitting and working of modern naval guns in a line-of-battle ship. Sir W. Armstrong's firm will also have a good display of ordnance and other material representing nineteenth century practice.

We may remark here that the collection of ordnance will be very complete. Service ordnance and gunnery and torpedo appliances have been supplied by the Admiralty, and these exhibits have been supplemented by all the famous gunmakers in the country. To illustrate the use of the Maxim, Nordenfeldt, and machine guns, a special gallery is being erected for exhibiting the firing of these guns. The section referring to navigation will be illustrated by a very complete and historical collection of objects connected with navigation. Amongst these we noticed in course of erection the model of the Eddystone Lighthouse. This model lighthouse is 155ft. high, and various types of electric lamps will be exhibited from the top.

In the new part of the grounds excavations are being made for a sheet of water 250ft. by 150ft., in which will be displayed nautical combats and other spectacles, the launching and firing of model torpedoes, and all that can be done on a miniature scale. This water basin will, no doubt, be a popular feature. The large new gallery, "The Camperdown," 450ft. by 50ft., already has the framework up, and is rapidly being covered in.

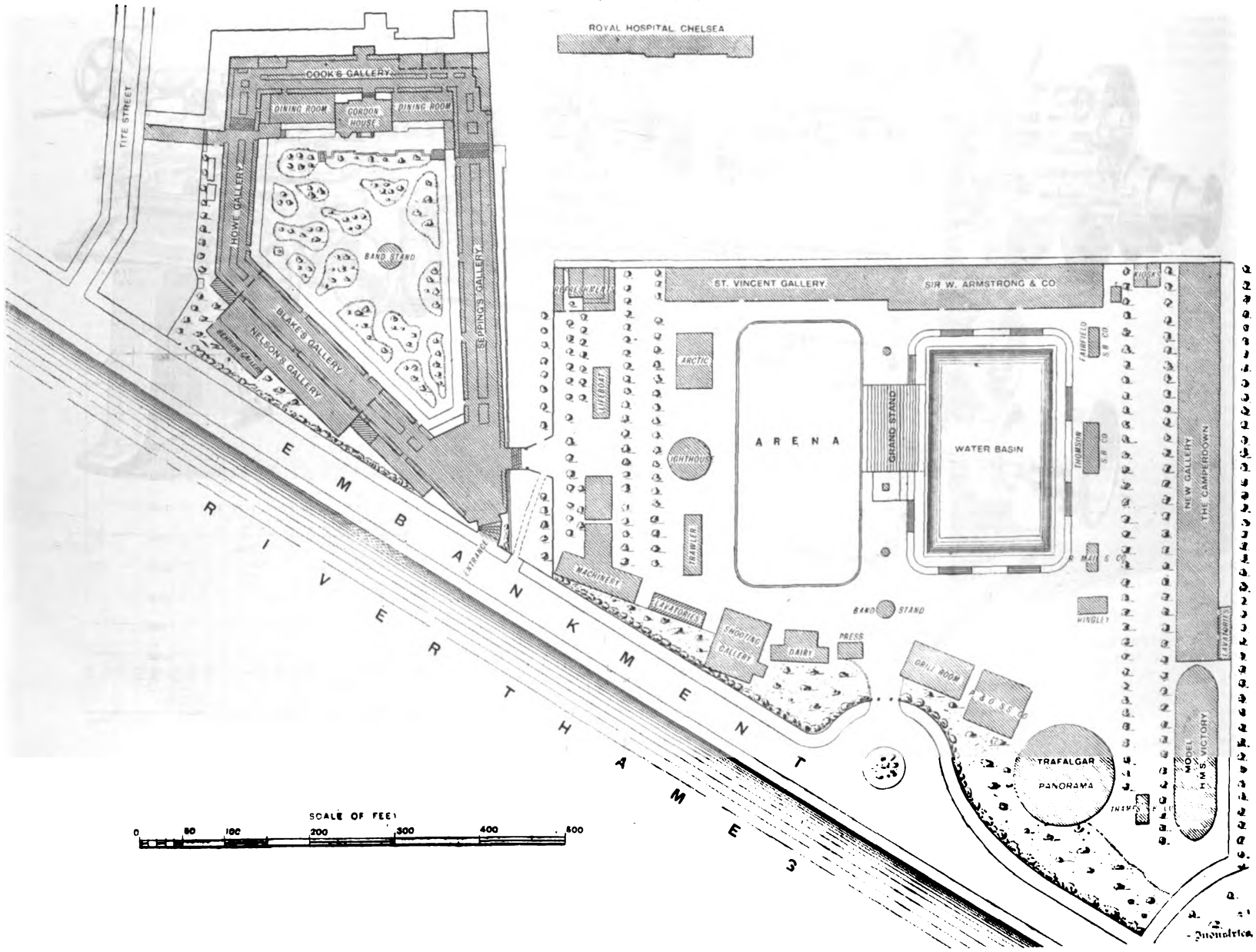
Amongst the miscellaneous sections are the Arctic section, the trawler and deep sea fishery, the lifeboat

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THE ROYAL NAVAL EXHIBITION.

Amended General Plan.

(*For description see page* 217.)



and life-saving apparatus, and the diving bell and other diving appliances. The first of these three is under the direction of a branch of the Navigation Committee, and contributes a very interesting exhibit, illustrating Polar exploration and the conditions of life under the Arctic Circle, the whole being brought vividly home by a realistic miniature Polar Sea. Diving operations will be illustrated in a large glass tank under the eyes of the spectators, and is expected to constitute as great an attraction as formerly at the Polytechnic.

The arrangements for lighting the Exhibition have been entrusted to Messrs. Siemens Brothers & Co., whilst Messrs. Willans & Robinson and Messrs. Davey, Paxman, & Co. will supply the electric fittings, dynamos, and engines respectively. Seventeen hundred incandescent lights and 400 arc lights have already been arranged for. The dynamos will be the same as those in use in the navy, and of the latest noiseless type.

Under legal advice, and for the purposes of convenient working, the Exhibition has been formed into a limited company. Besides the numerous metropolitan committees, local committees under the chairmanship of the naval commanders-in-chief have been formed at the several naval ports, to lessen the labours of the London committees and to collect and arrange the materials that will be exhibited from the great naval centres of Portsmouth, Devonport, and Sheerness.

The financial arrangements are under a finance committee, which maintains a careful watch upon all items of expenditure. Should a surplus result, as anticipated, it is proposed to devote it to naval charities.

The amusements are somewhat out of our province to discuss, but the financial success of the Exhibition will largely depend upon the popularity of the entertainments provided. Messrs. Pain & Sons will illuminate the grounds with 10,000 coloured lamps every evening. Once a week arrangements will be made for a grand "pyrotechnical display" of a nautical character. Balloon ascents will also be a feature in the programme. By the permission of the Board of Admiralty, parties of bluejackets will attend from the naval ports, and will give exhibitions of field gun, cutlass and small arm, and other drills.

THE SOCIETY OF ENGINEERS.

At a meeting of this Society, held on the 2nd inst., Mr. W. N. Colam (President) being in the chair, a paper was read by Mr. Arthur Rigg, on "The Balancing of High Speed Steam Engines." The author said that this paper formed the continuation and completion of one read by him before the Society of Engineers on the 5th April, 1886, entitled "Obscure Influences of Reciprocation in High Speed Engines." The earlier paper dealt with the internal strains caused by reciprocation, and the means by which their incidence on the engine itself could be rendered less violent, and the present paper was intended to take note of the external effect of these strains, and the modes by which their vibratory influence might be counteracted in a greater or less degree. The paper commenced with a memorandum on the origin and measurement of these strains, and this introduction was followed by a description of the effect of a balance weight opposite the crank, and the different influence of such a balance on horizontal or vertical engines. Then followed a consideration of the modes by which rapidly recurring strains are met and counterbalanced by the action of two engines with opposite cranks, and the effect of the air buffer in Mr. Willan's engine. This part of the paper was illustrated by curves showing the correspondence between the air compression and inertia diagrams, and the strains absorbed and those transmitted to the foundation were duly considered.

A comparison was made between the effects of a compression of exhaust and an independent air buffer, showing how the former entailed a permanent loss of useful effect, which in some measure aided in producing the economy desired by an independent method for bringing the reciprocating parts to a state of rest. The final subject touched upon related to the balancing of revolving cylinder engines where pistons and cylinders alike turned round upon their own independent centres, whereby a complete dynamic balance was secured so far as reciprocation was concerned, but replaced by a series of variations in angular velocity which, although influencing the true balance, did not appear outside the engine. The author remarked that this system transferred the limited speed of engines from dynamic relationships of their reciprocating parts to considerations of centrifugal force, and the best velocity of inlet and efflux of steam through the ports and passages, and marked a distinct advance; and although those of the present time might be of most immediate interest, yet it was well to remember systems of balancing which possessed features of interest in the past, and to pay some attention to those changes which the future might have in store.

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IRREGULAR WEAR OF LOCOMOTIVE TYRES.*

THE tendency of locomotive tyres to wear irregularly—that is, to form flat places, or to wear the tread out of its original cylindrical form, concentric with the journal—is one of the most annoying and expensive of the minor trials to which a railroad master mechanic is subjected. This trouble is aggravated when roads pass through sandy districts. At first sight the most natural conclusion is that the tyre varies in hardness, or resistance to abrasion, and this undoubtedly is the cause of a portion of the trouble, but from an extended series of observations the writer is compelled to conclude that a material portion of the trouble lies outside the tyre itself. This conclusion has been arrived at from the following observations:—

First—The tyre of several locomotives showing serious flat places have been slipped around on the centre, then trued up and placed in service. The flat places in every case formed again at the same place relative to the centre, but in a different place on the tyre.

Second—Observations made on a large number of tyres running in a sandy district showed that the flat places grouped themselves with a close approach to uniformity, occupying nearly the same position with reference to the pins and counterbalance.

The above clearly indicates that there are cases of irregularity in the wear of tyre due to the forces which are in action in operating the locomotive, and it is the purpose of this investigation to partially determine the nature, extent, and influence of these forces.

For this purpose engine 316 was taken, the dimensions bearing on the question being as follows:—

Diameter of cylinder, 16in.
Stroke of piston, 24in.
Diameter of drivers, 62in.
Total weight on drivers, 54,000lb.
Boiler pressure, 160lb.
Cylinder pressure, 130lb.
Cut-off, 6in.
Speed per hour, 40 miles.
Weight of reciprocating parts, each side, 480lb.
Weight of main rods, 269lb.
Weight of main rod taken as reciprocating, 117lb.

The total weight of reciprocating parts was counterbalanced, the counterbalance being equally divided between the wheels.

With the above data Table I. has been computed, showing the forces in action at each ten degrees of a revolution, the zero point being taken as that point at which the right-hand driving wheel pin passes the forward centre.

TABLE I.

FORCES IN ACTION ON ENGINE 316 MOVING AT 40 MILES PER HOUR.

Degrees.	Weight on Rail.					Rotative Force at Pin.	Ratio of Rotative Force at Rail to Weight on Rail.
	R. F.	L. F.	B. B.	L. B.	Total.		
0	13,500	19,230	13,500	17,340	63,570	12,910	·081
10	13,216	18,974	12,836	17,282	62,308	15,283	·098
20	12,985	18,702	12,187	17,105	60,979	18,377	·121
30	12,831	18,237	11,580	16,825	59,470	20.467	·137
40	12,742	17,598	11,035	16,441	57,815	22,268	·154
50	12,733	16,811	10,599	15,965	56,068	23,407	·167
60	12,539	15,979	10,175	15,420	54,113	22,378	·165
70	12,052	15,049	9,895	14,813	51,809	17,924	·138
80	11,799	14,079	9,718	14,164	49,760	14,365	·119
90	11,632	13,500	9,660	13,500	48,292	13,798	·112
100	11,578	13,216	9,718	12,836	47,348	15,879	·135
110	11,515	12,985	9,895	12,187	46,612	17,530	·151
120	11,555	12,831	10,175	11,580	46,141	18,733	·168
130	11,599	12,742	10,559	11,035	45,935	20,004	·175
140	11,724	12,733	11,035	10,559	46,051	21,108	·185
150	11,945	12,539	11,580	10,175	46,239	20,222	·175
160	12,228	12,052	12,187	9,895	46,362	16,279	·140
170	12,641	11,799	12,836	9,718	46,994	13,870	·119
180	13,500	11,632	13,500	9,660	48,292	13,793	·112
190	14,575	11,578	14,164	9,718	50,035	15,308	·123
200	15,648	11,545	14,813	9,895	51,901	16,290	·126
210	16,697	11,555	15,420	10,175	53,847	16,988	·126
220	17,641	11,599	15,965	10,559	55,764	17,179	·123
230	18,495	11,724	16,441	11,035	57,694	17,496	·120
240	19,232	11,945	16,825	11,580	59,582	18,105	·120
250	19,408	12,228	17,105	12,187	60,928	15,745	·104
260	19,311	12,641	17,282	12,836	62,070	12,779	·082
270	19,230	13,500	17,340	13,500	63,570	12,910	·081
280	18,974	14,575	17,282	14,164	64,895	14,712	·090
290	18,702	15,648	17,105	14,813	66,268	17,137	·104
300	18,237	16,697	16,825	15,420	67,179	18,672	·112
310	17,598	17,641	16,441	15,965	67,645	19,443	·117
320	16,811	18,495	15,965	16,441	67,712	19,796	·117
330	15,979	19,232	15,420	16,825	67,456	20,261	·120
340	15,049	19,408	14,813	17,105	66,375	17,390	·105
350	14,079	19,311	14,164	17,282	64,836	13,274	·081

This table shows in the first column the position of the wheel by degrees. The second, third, fourth, and fifth columns show the pressure of each wheel against the rail, with the engine moving at forty miles per hour. The pressure of the two back wheels varies from 9,660lb. to 17,340lb., or 3,840lb. above and below the static load of 13,500lb. This variation is due entirely to the influence of the contrifugal force of the counterbalance. The pressure of the two forward wheels is subjected to precisely

* Paper read by Mr. J. N. Barr at the January meeting of the American Western Railway Club. We are indebted to the *Railroad Gazette* for our illustrations.

IRREGULAR WEAR OF LOCOMOTIVE TYRES.

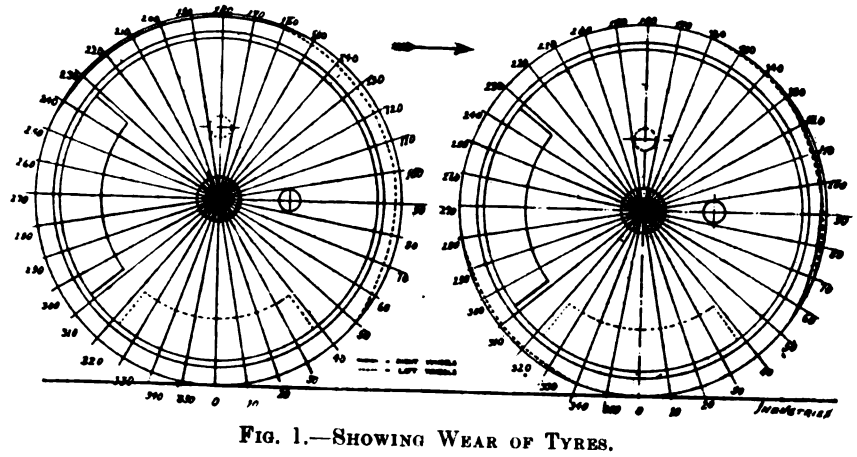


FIG. 1.—SHOWING WEAR OF TYRES.

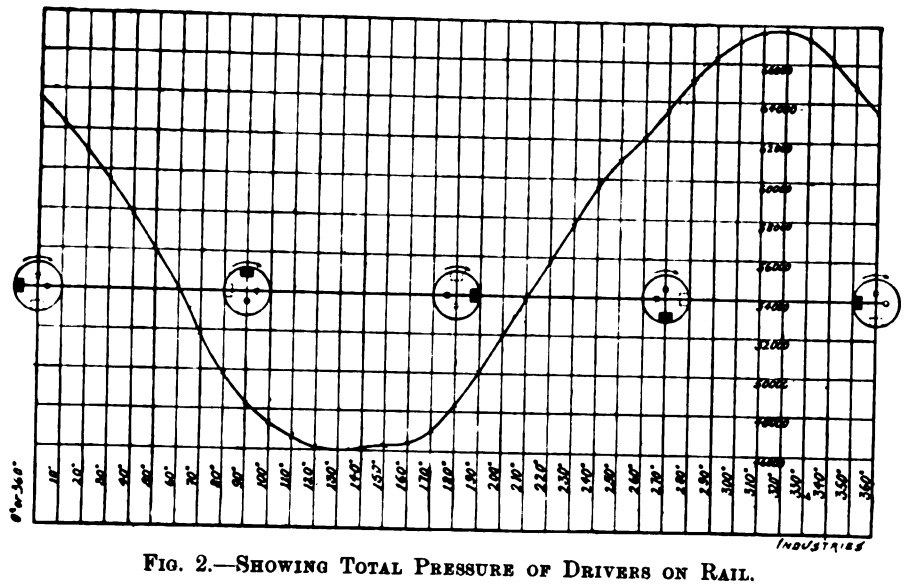


FIG. 2.—SHOWING TOTAL PRESSURE OF DRIVERS ON RAIL.

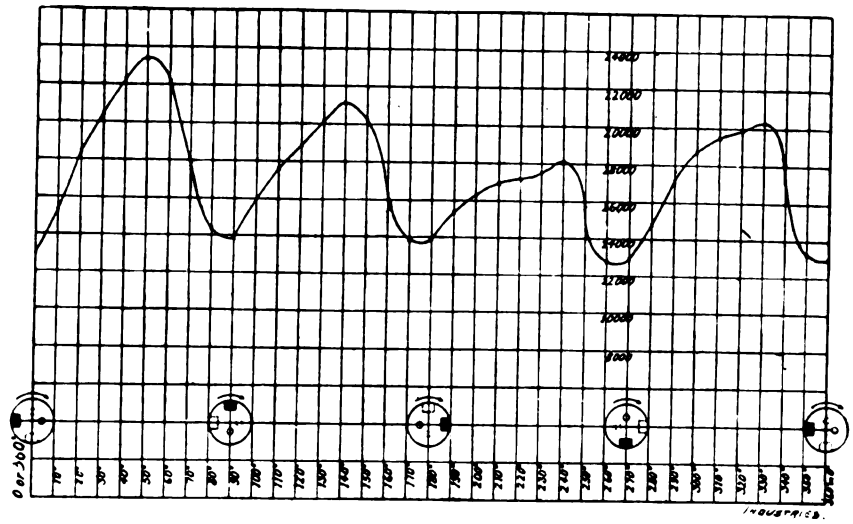


FIG. 3.—SHOWING FORCE ACTING AGAINST PIN TO PRODUCE ROTATION.

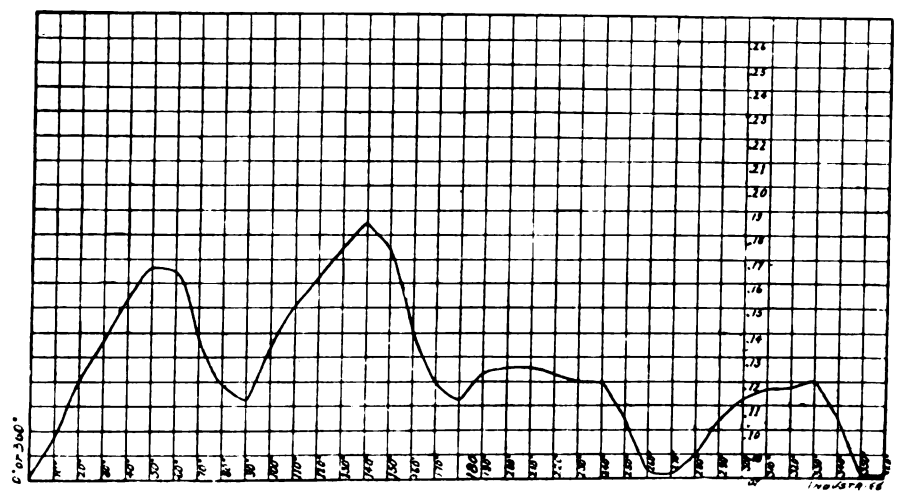
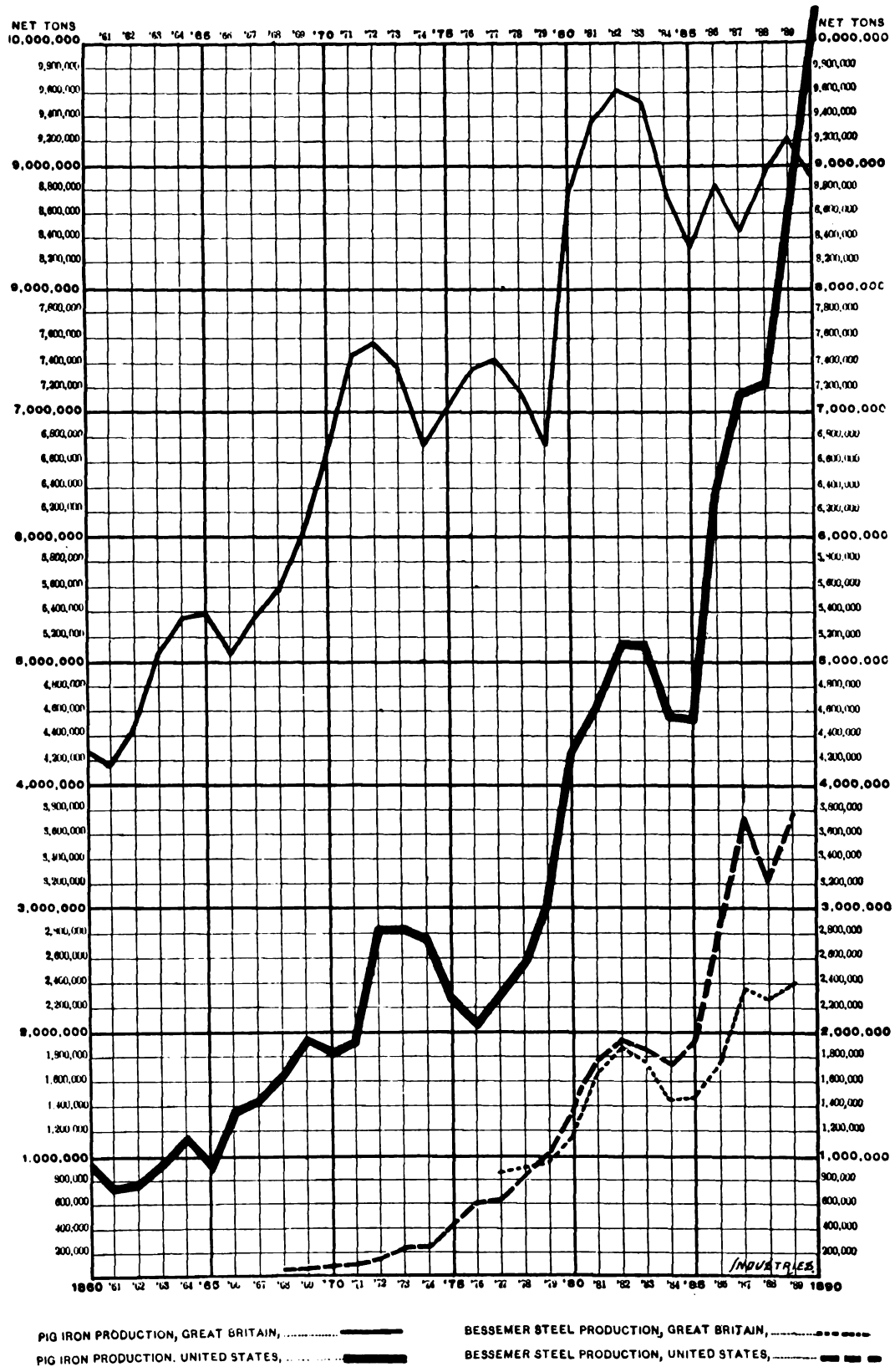


FIG. 4.—SHOWING RATIO OF ROTATIVE FORCE TO WEIGHT ON RAIL.

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IRON AND STEEL PRODUCTION IN THE UNITED STATES AND GREAT BRITAIN.



the same influence from the counterbalance, and in addition to this, the angularity of the connecting rod effects a decided modification of the pressure on the rail. The sixth column, headed "Total," shows the sum of the pressures of the four wheels upon the rail. The total pressure varies from 67,712lb. to 45,935lb., a difference of ten tons. The sixth column is represented graphically in Fig. 2. The seventh column shows the pressure against the pin normal to a line passing through the centres of pin and wheels, or the force at the pin tending to produce rotation. This column is represented graphically in Fig. 3. The rotative force at the rail can readily be deduced from these figures. The eighth column shows the relation between the forces producing pressure on the rail and the forces which have a tendency to cause the tyres to slip. The figures are obtained by dividing the force tending to slip the drivers, or the rotative force at the rail by the pressure on the rail. We will call this ratio the coefficient of slip. It corresponds in form and relation to what is known as the coefficient of friction. If the value of the coefficient of slip is equal to the coefficient of friction the wheels will be on the verge of slipping. Fig. 4 is a graphical representation of these values. The coefficient of friction between wheels and rails or the coefficient of adhesion is given by Haswell as follows:—

TABLE II.

COEFFICIENT OF ADHESION UPON DRIVING WHEELS.

Condition of Rail.	European Practice.	American Practice.
Rail very dry	·3	·33
Rail very wet	·27	·25
Ordinary condition	·2	·222
In misty weather	·15	·2
In frost and snow	·09	·16

These figures are obtained by dividing the horizontal force applied to the wheel at the rail, that is just sufficient to produce slipping, by the pressure of the wheel on the rail, and can be compared directly with the values given in the eighth column of Table I.

We will now proceed to apply the data given in Table I. to a case of wear taken from actual practice, and illustrated in Fig. 1. The wear is shown by full lines for the right-hand wheels, and dotted lines for the left-hand wheels. The depth of wear as shown is exaggerated to prevent confusion of lines, and shows just twice as great as the actual wear. On the forward wheels there are two flat places of about the same size in the same location. This varies from the general results, as in most cases the flat place on the right wheel is much less than that on the left wheel, and there seems good reason to believe that the flat place on the right-hand wheel has been modified by a soft place in the tyre. By referring to Table I. it will be seen that the coefficient of slip at 50 degrees is ·167, and that this exceeds the coefficient of adhesion for a frosty rail and that it approaches uncomfortably close to the coefficient of adhesion for ordinary condition of rail. The tendency to slip slightly, or to what is known as imperceptible slip, must be quite decided under these conditions. A corresponding flat place is found on the left back wheel, but the right back shows no flat place. Several cases show some wear on the right back wheel corresponding with that of the left back wheel, but always less in quantity, and in this case doubtless more careful measurement would have shown some wear. Considering the four flat places as shown in the neighbourhood of 80 degrees, why do they vary, always being greatest on the left-hand tyre? An inspection of the weight on rail seems to show the reason quite clearly. Table I. shows the pressure of the four wheels on the rail at 60 degrees to be as follows:—L. F., 15,979lb.; L. B., 15,420lb.; R. F., 12,539lb.; R. B., 10,559lb., and the average size of the flat places correspond with these pressures. There are two other flat places on these wheels, one on the right back at 200 degrees and one on the left forward at 310 degrees, which can scarcely be accounted for by slips, but are likely due to soft places in the tyre. As the speed of the engine increases the coefficient of slip is varied by the increased intensity of the action of the centrifugal force of the counterbalance. A change in steam pressure and cut-off also affect these values.

There is a possibility that further and closer observations, covering a sufficient number of cases to eliminate the question of variation in the hardness of the tyre, will develop the following:—Flat places will be found near the 60 degrees point, varying as shown above. Flat places will be found near the 140 degrees where the coefficient of slip reaches ·185, but much less than the preceding, on account of light total pressure on the rail and all nearly of the same size as the pressure of the wheels on the rail are all four nearly equal. Very slight flat places may also be found at the 220 degrees point and the 320 degrees point, which are two other maximum points of the coefficient of slip. It would appear from a comparison of the flat places with the weight on rail that when the pressure does not exceed 11,000lb. the tendency to abrasion from imperceptible slip is very slight. The conclusions to be drawn from the above may be summarised as follows:—

1. Flat places on driving wheel tyres are not entirely due to lack of uniformity in the wearing quality of the same.
2. The flat places have a tendency to group themselves where the coefficient of slip is greatest.
3. They vary in depth with the pressure on the rail, and when the pressure does not exceed 11,000lb. the imperceptible slip produces but little abrasion.
4. Imperceptible slip does not appear at random on any part of the wheel, but in special localities as fixed by the maximum values of the coefficient of slip.
5. The counterbalance should be as light as possible compared with the reciprocating parts, consistent with smooth riding.
6. The weight of the reciprocating parts should be as light as possible.

IRON AND STEEL PRODUCTION IN THE UNITED STATES AND GREAT BRITAIN.

THE accompanying diagram, for which we are indebted to our American contemporary *The Iron Age*, shows at a glance the production of iron and steel in Great Britain and the United States for the last thirty years. The diagram requires little description, but we may here point out the enormously rapid increase in output of pig iron in the United States, which completely eclipsed that of Great Britain in 1889, although in 1887 the output of the latter was about 1,800,000 tons more than the former. In Bessemer steel, too, a similar feature is noticeable.

THE INSTITUTE OF MARINE ENGINEERS.

A MEETING of this Institute was held on the 24th ult., Mr. F. W. Wymer being in the chair, when a paper was read "On the Application of Zinc," by Mr. Green. The author proceeded to point out the different kinds of zinc for marine boilers and the various styles of application. The cast zinc, fitted in the most approved form, was described, and the advantages and disadvantages of rolled and cast zinc were indicated.

On the conclusion of the paper some remarks by Mr. David Phillips (whose name is well known in connection with the application of zinc to boilers) were read by Mr. Wilson, in the course of which the use of cast as opposed to rolled zinc was advocated. During the discussion which followed several drawings and a number of interesting specimens were shown. The meeting was adjourned till the 3rd inst.

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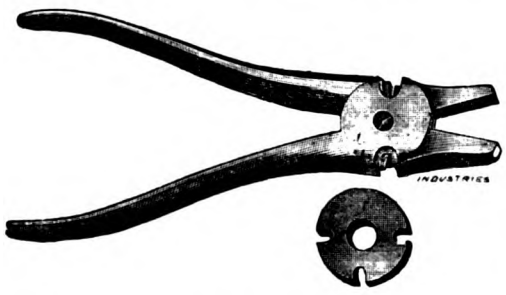
BRASS FINISHERS' PLUG GRINDING MACHINE AND TURRET LATHE.

THE machine shown in the annexed illustration is designed for expeditiously grinding the plugs of brass valves, &c., into their barrels. The plug is securely gripped in the jaws of the self-centreing chuck, which is revolved backwards and forwards by the connecting-rod attached to the driving disc, the workman meanwhile sliding the barrel between the adjustable forks upon the plug. In so doing he is able to detect (as in ordinary hand grinding) the presence of any foreign substance, and to remove it without delay. This machine is made in two sizes by the Northern Engineering Company, Limited, Halifax. In the larger machine an arrangement for holding heavy castings is fitted, consisting of a bracket and special slides with "gripping dogs." This enables the machine to be used upon a wide range of work. As will be seen from the engraving, the machine is self-contained, and is supported upon a strong cast-iron pedestal.

The same firm make a brass finishers' turret lathe. This lathe is shown on page 217, and is in many respects similar to those used in American brass finishing establishments. The bed is arranged with a cabinet with shelf for holding loose tools. The fast headstock is double geared, and the spindle has a hole through it. The loose headstock is arranged to rotate through an angle of sixty degrees, and is mounted upon a transverse traverse slide; it is also fitted with an internal and external shoot, and with lever motion for use in work which the turret tools cannot reach. The saddle is fitted with self-acting sliding motion by cones and shaft along the front of the bed, with instantaneous starting and release motion, also with quick hand traverse. The turret rest is arranged to carry six tools, and is mounted on compound slides with a swivelling arrangement indexed for taper work. The top slide is fitted with lever motion as well as screw, which is of great advantage in getting work out quickly. The chasing rest is fixed to a shaft at back of bed; keyed on to the end of this shaft is an arm, which carries a die. When the chasing rest is brought over on to the bed of the lathe, this die comes into gear with the copying screw, which is worked from the fast head spindle wheels, and the chasing tool is carried along the bed, the thread on the copying screw being reproduced on the article chucked in the lathe. When the chasing apparatus is not in use, it is lifted back again, and when resting on the backboard is clear of the turret slides. An arrangement can also be fitted for taper chasing.

THE "ACME" PLIERS.

THE accompanying engraving represents pliers made by the Higganum Hardware Company, of Higganum, Con., U.S.A., and particularly intended for linemen and others engaged in electrical construction. As will be



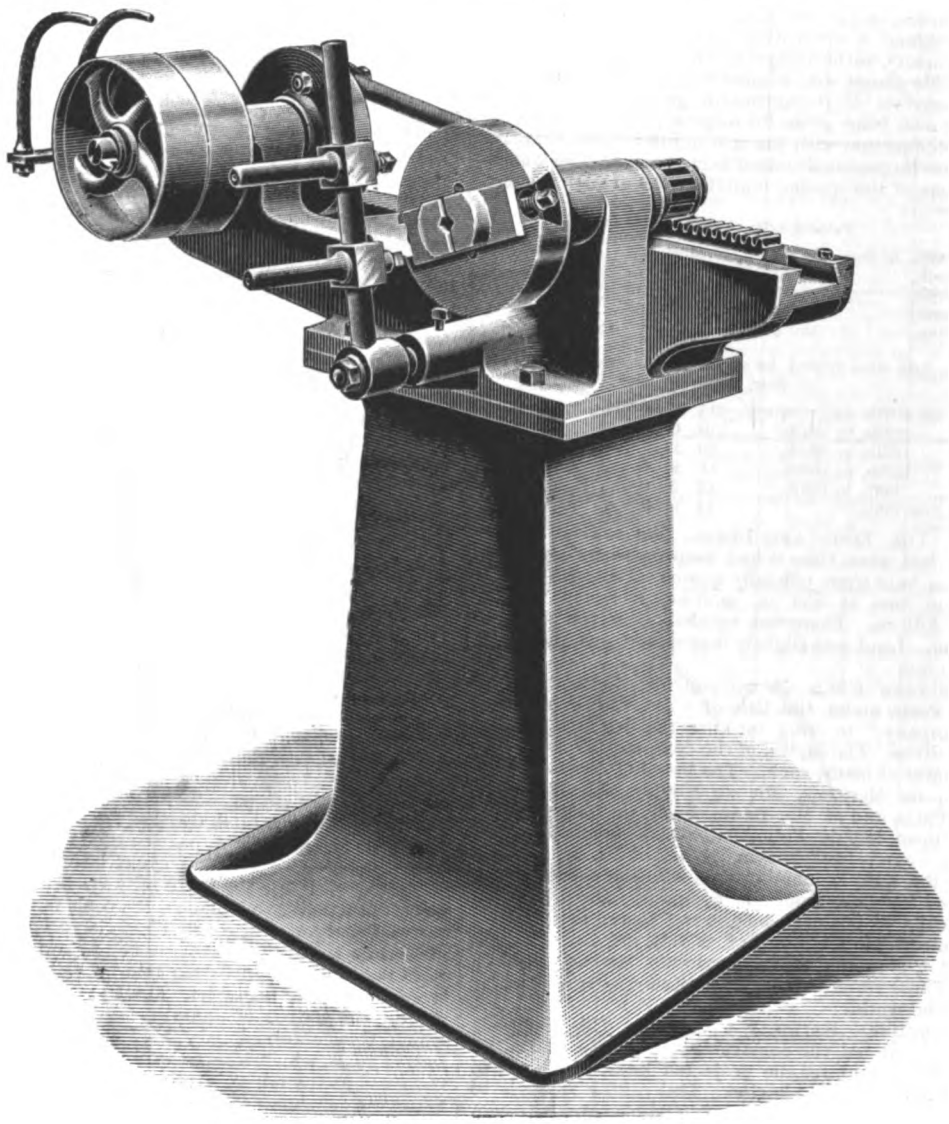
seen, the pliers combine a wire shears, the cutters of which are renewable, so that when one wears out it can be replaced at small expense and with little trouble. The illustration is taken from our American contemporary, the *Electrical Engineer*.

DECIMAL COINAGE, WEIGHTS, AND MEASURES.

A PAPER on the above subject was recently read by Mr. J. Emerson Dowson, M.Inst.C.E., at the Society of Arts, Sir Henry E. Roscoe, M.P., F.R.S., being in the chair. The author said that several public inquiries had been held, but none since 1862. In these inquiries an immense amount of valuable information was got together, but no Committee or Commission was instructed to deal with the subject of coins, weights, and measures as a whole, or to consider the intimate relations of one to the other. It would be Utopian to suppose that all must be changed at once, but the subject should be thoroughly investigated in its broadest and most detailed aspect. At the present time a decimal system of coinage had been adopted by every civilised country except Great Britain and some of her dependencies, and a large coloured map of the world was exhibited, which emphasised this fact in a striking manner. If the values of our coins, weights, and measures were founded on decimal relations, and on the same basis as our present system of notation, whole numbers and fractions could be added, subtracted, multiplied, and divided by the rules of simple arithmetic, and compound arithmetic would be entirely superseded. In the Board Schools, for instance, at least two years' teaching of arithmetic was now taken up by subjects which a decimal system would render wholly unnecessary. In the elementary schools of Belgium and France nothing was more impressive than the great simplicity of their arithmetic, compared with ours. Great as was the need for a decimal system of coinage, it was even more important that our present unsystematised weights and measures should be simplified and decimalised. During the last twenty years especially all the leading European countries had enormously increased their powers of production, and they were not only striving to manufacture all required for their home consumption, but were energetically pushing the sale of their wares in other countries. English engineers and manufacturers were in fact in keen competition with those of other countries, and our Consuls had in several instances drawn attention to the loss of trade we sustained owing to the difficulty foreign dealers experienced in understanding our language, our coinage, and our weights and measures. Several points of interest and importance were referred to, and from recently published Board of Trade statistics it appeared that in 1889, excluding British possessions, the value of the imports to and exports from foreign countries using the metric system was £348,862,574, or about 62½ per cent. of the total imports and exports. The adoption of the metric system had spread considerably, and would certainly continue to spread. India had prepared the way for adopting it, and it was probable that if it were adopted here it would also be taken up in Australia, Canada, and our other dependencies. There was a probability also that the United States and Russia would sooner or later adopt the metric system, and then there would be a uniform system of weights and measures throughout the civilised world. Apart from this, we were directly interested in doing away with our absurd weights and measures, and in simplifying our arithmetic. Other points of detail were discussed, and, in conclusion, the lecturer urged the pressing need of a Royal Commission to thorougly investigate the whole subject in the light of our present requirements. The seventy-two Associated Chambers of Commerce were all in favour of a decimal system, as well as the important Chambers of Glasgow, Edinburgh, Liverpool, and Manchester.

BRASS FINISHERS' PLUG GRINDING MACHINE.

CONSTRUCTED BY THE NORTHERN ENGINEERING COMPANY, LIMITED, HALIFAX.



GENERAL VIEW.

IRON MANUFACTURE IN NEW ZEALAND.

A NEW ZEALAND report states that it will be possible to produce pig iron there as cheaply as at home. Coal, iron ore, and limestone exist at Kamo, near Wangarei, and it is intended to erect a blast furnace there for the manufacture of pig iron. The estimated cost of production is £2 8s. 3d. per ton.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 3rd March, 1891.

Iron.—There was a little more animation in the iron trade last week. Orders came in fairly, but prices continued low; bars were easily obtained, if the order were of any importance, for 125s., and joists for 133s. a ton. Castings were quoted at 112s. 6d., sheets at 156s. 6d., and old rails at from 70s. to 72s. the ton. The Minister of Public Works has signed a convention passed with the Orleans Railway Company, authorising the construction of 267 kilometres of wide gauge, 410 kilometres of one metre gauge, and 53 kilometres of 70-centimetre gauge lines. Some orders have also been given for narrow gauge railways for Tonquin in connection with the coal mines of that country. In the Haute-Marne the situation is improving. The quotations for some of the special manufactures of this district are as follow:—

Turned axles of from

100lb. to 140lb.,	in iron	£11	5	0,	in steel	£14	1	0 the ton.
70lb. to 98lb.	,,	11	13	0	,,	14	9	3 ,,
50lb. to 68lb.	,,	13	5	0	,,	16	1	6 ,,
30lb. to 48lb.	,,	15	5	0	,,	18	1	6 ,,
20lb. to 29lb.	,,	20	1	6	,,	22	18	0 ,,

Welded tyres, with holes drilled for all kinds of vehicles, sold by the pair,

From 402lb. and upwards,	£11	13	0 the ton.
,, 222lb. to 400lb.	10	0	9 ,,
,, 162lb. to 220lb.	10	9	0 ,,
122lb. to 160lb.	11	9	0 ,,
,, 80lb. to 120lb.	12	9	0 ,,
Below 80lb.	14	9	3 ,,

Copper, Tin, Zinc, and Lead.—The copper market was firmer last week than it had been for some time past. Best Chilian bars were officially quoted at £58 15s., ordinary Chilian bars at £56 5s., and best selected Chilian copper at £61 5s. There was no change in the prices of tin and zinc. Lead was slightly dearer, and was quoted at £13 7s. the ton.

De Meritens' Cell.—A company has been recently formed in Paris, under the title of "The Industrial Electricity Company," to bring into use the cell invented by Mr. de Meritens. The capital of the company is 4,000,000fr. in 8,000 shares of 500fr. each. The board of directors consist of Mr. de Meritens, Mr. de Monteynard, Mr. de la Hante, at Paris, and of Mr. Baranoff, Mr. de Baschmahoff, Mr. de Keppen, Mr. de Potenkim, Mr. de Semkoff, at St. Petersburg. As is well known, the cell of Mr. de Meritens resembles the auto-accumulator of Mr. Jablochkoff, who has received 50,000fr. from the company. One of Mr. de Meriten's cells, of 20cm. in height and 15mm. in diameter, gave an electromotive force of ·8 volt, or ·4 volt with a current of 2 amperes at its maximum output—that is, ·8 watt. These results are scarcely likely to revolutionise the industrial world.

The Northern Railway Company.—This company has recently ordered the construction, at a cost of £3,360, of some rolling stock for the projected lines, which run to the Halles and to the Madeleine. This rolling stock is to be constructed in the company's workshops, and will consist of three six-wheeled carriages and two baggage waggons. Each carriage will be 23 metres in length, and is specially designed to travel on curves of small radius.

Tunnel under the Seine.—A project for a tunnel on the line of railway from Havre to Port Andemer is under consideration. It is to consist of a cast-iron tube traversing the alluvial stratum under the river for a distance of two kilometres and a half; the remaining portion, which runs through a chalk formation for a length of two kilometres, will be in masonry. The whole of this tunnel, of four and a half kilometres, is designed by M. Berlier, an engineer whose name is also connected with a scheme for laying tramways under Paris in metallic tubes.

BERLIN, 2nd March, 1891.

Condition of Trade.—Trade in general has not been so brisk in Berlin this year as last year, and a large number of workmen have been without employment during January and February. The long winter, which has continued with hardly any interruption since November, has brought the building trade almost to a standstill, and in consequence of this the demand for iron goods for buildings has been greatly reduced. The building trade is a very important feature of Berlin industry, as will be seen from the fact that since 1870 the population of Berlin has doubled itself, and is now 1,600,000. The canals which connect Berlin with the seaports are now free of ice, and traffic upon them is being resumed. The Berlin market is thus opened for English pig iron, and a slight impulse in the trade will probably make itself felt. Although the waterways in connection with Berlin are small, and generally used only by slow barges, they are of great importance to Berlin. The amount of goods brought to Berlin by water is greater than that brought by rail, and the re-opening of the waterways after the winter is therefore generally attended with an improvement in trade.

Railways.—The work in connection with additional lines of rails between here and Potsdam *viâ* Wannsee is being pushed forward as rapidly as possible, and it is hoped to have a third and fourth line of rails completed by October. The Potsdam station is being considerably enlarged, and when all is finished there will be a frequent service upon the new lines similar to that of the metropolitan railways. The "Ringbahn," the line which goes round Berlin, is being widened in several places, and some stations are being enlarged.

Telephones.—The employment of female operatives in the telephone offices having been found so satisfactory it has been decided to appoint only women for these posts in future. The telephone is extensively used in Berlin. There are over 12,000 telephones here, not including private installations.

Government Factories at Spandau.—Several hundred workpeople have been discharged from the Government factories, and further reductions are expected.

Petroleum in Germany.—The German Petroleum Company, whose operations have been hitherto confined to Oelheim (Hanover), have commenced work at Hagenau (Alsace), where they hope to meet with very good results.

Rolling Stock of the Prussian Railways.—During the past two years the rolling stock has been increased by 801 engines, 1,240 railway carriages, and 17,684 luggage and goods waggons. At the present time the rolling stock of the Prussian State Railways consists of 9,653 engines, 15,343 passenger carriages, and 196,798 luggage and goods vans.

VIENNA, 2nd March, 1891.

The Iron Market.—Business in most sorts of iron has somewhat increased, but prices remain unchanged. It is expected that the struggle with the German iron works will be followed by measures to prevent an increase of prices. In Hungary trade has been dull. Pig iron was largely offered for sale, and producers were willing to make concessions in the case of sales for some months in advance. These offers, however, remained without effect, and purchasers bought only for present needs.—The Hungarian Government is about to erect a new waggon manufactory. The machine works of the State railways are to be considerably enlarged, so as to permit of the manufacture of 309 waggons a year. At a general meeting of the "Nadrager Iron Industrial Company," which was on the point of being dissolved, it was decided to prolong the existence of the company in view of the present state of the iron industry. The Budapest City Railway Company announce a dividend of 10 per cent.

The Coal Market.—Notwithstanding the favourable weather there is a brisk demand for coals, both for industrial and for household purposes. It is to be regretted that the needs of this important branch of industry are neglected both by the State railways and by private railways. Whenever the demand for coals is very brisk, there is a deficiency of waggons. There is still a want of coals in Vienna owing to the stagnation of traffic a month ago. Both the Silesian and Ostrau coal mines are suffering from the difficulties of transport. The Upper Silesian coal mines during the month of January needed 4,755 waggons, of which they obtained only 3,377 waggons, so that 14,000 tons of coals, which were to have been forwarded to Vienna, remained at the mines. At the Northern railway and Ostrau mines the deficiency of waggons, as far as can be ascertained, is greater than in Silesia. It is to be hoped that this state of affairs will soon be remedied by considerable additions to the rolling stock.

BRUSSELS, 3rd March, 1891.

The Metal Market.—The situation continues to improve. Orders are more plentiful, and though prices are still unsatisfactory, business is becoming brisker everywhere. Many rolling mills in the districts of Liège and Charleroi have orders for more than two months in advance. Big joists are also in somewhat better demand. Pig iron is firmer. Before manufactured iron could recover its normal value, coal and pig iron increased in price. Some large orders for rails and angle iron for export have been received: 20,000 tons of rails for Brazil, by Messrs. Cockerell; 8,000 tons for Brazil, by Messrs. Cockerill, Angleur, & Ougreé; 3,000 tons of bridges by the workshops of Braisse-le-Comte; a large order for delivery to Greece, and some trollies for the State Railway, by a workshop of Boon. The situation, however, would be further improved if the Government would reduce the cost of transport. Ironmasters and owners of coal mines have already petitioned for these reductions, which are rendered still more desirable by the present condition of affairs.

The Coal Market.—The condition of the market continues favourable. For industrial sorts no concessions are made on orders for present delivery, but a reduction of 2fr. is made for future sales. There is a demand for coal from several quarters, which, from the condition of the iron industry some time ago, was not considered probable. An excellent trade in bricks and limestone is expected, and this renders the prospect still better. This favourable condition of affairs is to some extent darkened by strikes which are taking place in certain parts of the country, and among other places at Marihaye. Coke remains firm at 18fr., small sorts at 12fr., furnace coal at 14fr., and boiler coal at 12fr. The relighting of the coke furnaces at Liège, and at the coal mines of Horloz and de la Haye, is thought probable. The object of this would be to utilise the sorts of coal which are suitable for the production of coke, but which are not useful for domestic purposes.

Commercial Treaty between France and Belgium.—The present commercial treaty contains two kinds of clauses, the one showing the Customs duties to which goods imported from one into the other of the two contracting countries are subject, and the second set of clauses relating to questions of transit and regulations as to commercial travellers. The French Government has proposed to the Belgian Government the renewal of these latter clauses, but wishes to maintain its liberty of action as regards the question of Customs duties.

DÜSSELDORF, 3rd March, 1891.

The Iron Market.—The condition of the pig iron market is rather unsatisfactory, since new orders are scarce. The stocks at the blast furnaces were as follow:—

	Dec. 31st, 1890.	Jan. 31st, 1891.
Best puddled iron, including spiegeleisen...	36,649 tons ...	39,551 tons
Ordinary puddled iron	8,050 ,, ...	6,498 ,,
Bessemer iron	13,868 ,, ...	12,297 ,,
Thomas iron.....	29,713 ,, ...	29,722 ,,
Total.....	88,280 tons ...	88,068 tons

The stocks of foundry pig iron at the blast furnaces amounted to 24,245 tons on January 31st, 1891, against 23,736 tons on December 31st, 1890. The rolling mills are briskly employed in the execution of outstanding orders. The business of the foundries and machine works is, with few exceptions, satisfactory. The market for coarse and fine sheets is unaltered.

Chromium and Nickel Mines.—A chromium mine has been recently opened in Silesia. This discovery is of great importance, as the inland industries have hitherto been dependent on foreign supplies. The nickel ore discovered in the neighbourhood of Frankenstein is estimated at many hundred thousand tons. According to the analysis the ore contains up to 17 per cent. of nickel, and the average is from 2 to 3 per cent.

Cement Manufactory.—A limited company has been formed in Halle, with a capital of 1,400,000 marks, to establish a large cement factory.

General Engineering. — The Königsberger-Maschinenfabrik has undertaken the construction of waterworks at Scutari and Kadikui, at an estimated cost of three million francs. All the necessary engines, boilers, and pumps will be sent out from the company's works.

Difficulties of Transport.—Although the deficiency of railway waggons has almost ceased to be felt, the coal industry still suffers from the consequences of the previous stoppage of traffic. The mines in this district have begun to limit their output, since the present prices scarcely cover the cost of production.

AMSTERDAM, 2nd March, 1891.

Shipping at Rotterdam.—The Rotterdam Chamber of Commerce has published (in English) an extract from the registers kept at the harbour offices during the year 1890, showing the movements of ships during last year compared with previous years. The number of vessels cleared inwards through the new waterway—excluding 2,210 fishing vessels and 55 foreign tug-boats entered in 1890—was as follows:—

	1887.	1888.	1889.	1890.
Steamers and sailing vessels...	4,114	4,490	4,484	4,482

The tonnage entered was as follows:—

1887.		1888.		1889.		1890.
3,509,292	...	3,829,721	...	4,026,446	...	4,274,854

It will be observed that although the number of vessels cleared inwards was lower in 1889 and 1890, the aggregate tonnage shows an increase all through. This is, of course, owing to the fact that the vessels making use of Rotterdam as a port are every year larger on an average. The biggest ships cleared inwards in 1890 were steamers from Odessa, the "Rector" from that port having a draught of 24ft. 10in.

The Blitong Tin Company.—The Minister for the Colonies has stated in the First Chamber that the negotiations between the Dutch Government and the Blitong Tin Company, concerning the renewal of the concession, have been resumed, and promise an early result.

Utilisation of Waste Lands and Heaths.—The Dutch Society for the Promotion of Industry has appointed a committee to study the question of the utilisation of waste lands and heaths in Holland, with special reference to the point whether the utilisation should be made a governmental task or be left to private effort.

New Industrial Company.—The Queen of Holland has approved the articles of association of the Dutch Phosphate Company, formed with a capital of 2,000,000 guilders, to work phosphate properties in America and Europe.

Steamships in the Dutch East Indies.—The nine steamers which belonged to the English company that had the contract for carrying the mails between the islands of the Indian archipelago have been sold to a syndicate at Singapore, owing to the transfer of the said agreement to a Dutch company. The intention of the buyers is to organise with them a local steamship service, mainly along the coasts of Java.

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STOCKHOLM, 28th February, 1891.

International Telephones.—The Swedish Parliament has voted a sum of 60,000kr. for a telephone from Orebro to the Norwegian frontier at Magnor, subject to the Norwegian Government finding the money for a telephone line from there to Christiania.

New Swedish Man-of-War.—The Government has approved of the drawings for a new warship similar to the "Svea," with the difference of a ram being placed at the bows of this new ship instead of a mine tube, if this alteration should not make the cost exceed the estimate of 2,290,000kr. Tenders are to be invited for the vessel and for its engines, both from home and foreign firms. The new ship is to be ready for trial by the end of March, 1893.

Alteration of Military Rifles.—At the Carl Gustaf Rifle Manufactory the alteration of the old infantry rifles to the 1889 model is now being actively carried on. The alterations are being made with the view of adapting the rifles for a smokeless powder.

Industrial Meeting at Gothenburg.—In connection with the approaching Exhibition at Gothenburg, to be held during the summer, there will be a general meeting of representatives of all Swedish industries. The dates fixed for this meeting will be the 19th, 20th, and 21st of August.

Proposed Finnish Railway to Tornea.—A proposal has been introduced into the Finnish Landtdag urging the building of a railway from Uleaborg to Tornea. In the event of the Lulea-Ofoten railway being carried through to the Norwegian coast, and the Swedish State railways being extended to the Finnish frontier, Finland would thus obtain direct railway communication with an ice-free port on the west coast of Norway, and also be brought into direct connection with the Swedish State railways.

CHRISTIANIA, 28th February, 1891.

Timber Cutting.—The cutting of timber in the Frederikshold district will this year be considerably reduced, the low prices for timber abroad and the large stocks in all the shipping ports, making a reduction necessary. Prices are not likely to increase until the production has been lessened.

New Steamer.—The steamer "Snorre Sturlason," intended for whaling at Iceland, was launched from the Aker Engineering and Shipbuilding Company on the 23rd inst. The steamer "Transport I." had a satisfactory trial trip on the 21st inst.

Kongsberg Silver Works.—According to estimates for the approaching financial year the expenses at the Kongsberg Silver Works will be 666,000kr., and the receipts 568,000kr., leaving a deficiency of 98,000kr. This unsatisfactory result is owing partly to heavy expenses for the extension of old mines and partly to the output of pure silver having been estimated at only 4,500kgr., although as much as 6,000kgr. have been obtained in previous years.

Guano Manufactory.—A new guano manufactory is being erected at Aalesund, and will be completed during next summer. The Brekke combined drying and grinding appliance will be used. This apparatus can be used for the treatment of all kinds of fish, and produces guano in five or six hours. There is a saving of time and labour by the use of this process, and a better and more uniform product is obtained.

New Gunboat.—It is proposed to increase the Norwegian Navy by the building of one new gunboat during the present year. It is to carry one 21-centimetre breech-loading gun with shield, one 7-centimetre and one 5-centimetre rapid-firing gun. There will be a 4-centimetre armoured deck, and an armoured tower with 10-centimetre armour. Cellulose will also be used for protective purposes. The gunboat "Viking," which is in course of construction, will probably be launched this spring.

ZURICH, 3rd March, 1891.

Swiss Watch Manufacture.—Notwithstanding the severe competition of foreign countries, the watchmaking industry in Switzerland continues to make good progress. The following table, compiled from the statistics of 1890, just published, gives a comparison of the exports during the last three years:—

	1888.		1889.		1890.	
Gold watches, chronographs, &c.	29·9	...	35·9	...	38·3	millions.
Silver watches	33·3	...	39·5	...	41·7	,,
Watches made of nickel, &c., and pedometers	12·2	...	13·2	...	13·8	,,
Watch movements, fittings, and cases	6·5	...	8·5	...	8·8	,,
Watches, total	81·9	...	97·1	...	102·6	,,
Clocks, including the necessary fittings	0·1	...	0·1	...	0·1	,,
Musical bells and boxes	3·0	...	3·1	...	3·3	,,
Grand total	85·0	...	100·3	...	106·0	millions.

International Exhibition of Scholastic Geography at Berne in 1891.—Under the auspices of the "Bureau du Congrès International de Géographie," an International Exhibition of objects appertaining to scholastic geography is being organised at Berne. This Exhibition which will be open from the 1st to the 15th August next, will comprise the following sections:—(1) Instruction books; 2) the means of instruction by intuition; (3) programmes of actual geographical instruction; (4) work done by students.

MADRID, 2nd March, 1891.

The Price of Coke at Madrid.—It will perhaps excite the envy of English gas companies to hear that whilst Spanish gas coals cost about 30s. per ton at Madrid, gas coke is sold at the high price of 66s. per ton. From this sum 7s. 6d. must be deducted for excise duty and cost of distribution, and the gas works receive the remaining 58s. 6d. Since the consumption of gas coke is large, and that of gas is comparatively small, gas coke is imported from distant towns, and even from England. It is difficult to explain why coke is not made in some of the Spanish coal districts, as an excellent quality of coke could be made and sold in Madrid at about 34s. per ton.

Railway Amalgamation.—Soon after the formation of the company called the Great Central System of Spain, which is supposed to interfere with the traffic of the Northern system, another important amalgamation of lines is announced. This will consist of about 6,000 kilometres, or nearly 3,750 miles, and will thus be one of the largest in Europe. It will include the present system of the North of Spain lines, the lines from Tarragona and Barcelona to the French frontier, and the line from Barcelona to the coal basin of San Juan de las Abadesas. The principal change effected by this amalgamation is that the new company will be administered entirely in Spain, the head offices being at Barcelona, where many of the shares of these lines are held. The new company will probably buy all their plant, rails, and rolling stock from Spanish manufacturers. The Northern Railway hopes, by the formation of this company, to avoid the loss of traffic which the Great Central System would otherwise cause to its lines.

The Use of Lifts in Madrid.—Lifts are being extensively erected in private houses in Madrid. Messrs. Samain, a French firm, are competing with a local firm, and their lifts are of better construction and cheaper. There is room for an English firm to compete, as several hundred lifts will be required during the next few years. The price generally quoted for lifts for four-storied houses is £600, but this depends somewhat on the situation as regards water power.

ROME, March 2nd, 1891.

New Form of Dry Cell.—Messrs. Dalle Molle & Co., of Ancona, have lately succeeded in producing an economical and satisfactory dry cell, seven of which are stated to have the same power as ten Leclanché cells with sal-ammoniac, which are now largely used in this country. Dry cells have hitherto been imported from Germany by Mr. Gassner. The new dry cells made in Italy have been tried at the arsenal of artillery and torpedoes at Spezia, and in the telegraph offices of the Meridionali Railway Company, and the results so far obtained have been successful.

Agricultural Machinery.—A trial of seed sowers will be held at an exhibition at Foggia, Italy, on October 20th next. The Italian Government offers two silver medals, a diploma of honour (accompanied by the purchase of five of the winning sowers) to the best machine, a purse of 200 lire, and ten prizes of 30 lire each to the next best machines. Requests for admission to the competition must be sent to the Committee of Direction before September 15th.

National Exhibition at Palermo.—This Exhibition promises to be a great success. The number of exhibitors has now reached 6,000, and includes manufacturers, farmers, artists, manufacturing and agricultural schools, and the exhibitors of the international section. We may cite among the principal exhibitors Messrs. Gio Ansaldo & Co., of Sampierdarena; Messrs. Tardy & Benech, of Savona; the Societá Elvetica, the Societá di Saronno; Messrs. Calzone, of Bologna; Messrs. Grondona, of Milan; Messrs. Diatto, of Turin; and Messrs. Moriggia, of Rome.

NEW YORK, 21st February, 1891.

Locomotives.—The Government of New South Wales has recently ordered twenty-seven American locomotives, for use on a new railroad in that colony, from Philadelphia. The order is based on the advantage of American-built locomotives for climbing heavy grades and turning sharp curves. The freight locomotives are of the heaviest and strongest build, and, with tender attached, will each weigh from 80 to 85 tons, and will be sold for about $10,000 apiece. A special steamer will be ready to take the engines out when complete.

Railway Accidents in the United States.—A return has just been made showing that the number of casualties on the railways of the United States in 1890 was largely in excess of the number reported in 1889, 1888, and 1887, after making due allowance for the increasing railway mileage. The number of persons (passengers, employés, and trespassers) killed in 1890 was 806, and of injured 2,812; against 492 and 1,772 respectively in 1889, 667 and 2,204 in 1888, and 656 and 1,946 respectively in 1887. The number of passengers killed in 1890 was 59 per cent. greater than in 1889, being 172 and 108 respectively, and of employés over 70 per cent. (569 and 336). The three most serious accidents were all due to negligence, and were those of Oakland, California, in May; Quincy, Massachusetts, in August; and Shoemakersville, Pennsylvania, in September; in which 13, 22, and 22 persons respectively were killed.

PHILADELPHIA, 20th February, 1891.

New Engines.—The William A. Harris Steam Engine Company, of Providence, have recently put in a triple compound engine at the Cohannet Mills, Taunton, Mass., of 700 horse-power. They are now putting in a 1,000 horse-power compound at the Wampanoag Mills, Fall River, Mass.; also a tandem compound at the Quincy Market Cold Storage Company, Boston, Mass., in connection with their ice machine. They have just put in a compound of 500 horse-power at the Lowell Electric Light Company, Lowell, Mass., and have in process of construction a duplicate of the same for the Memphis Electric Light Company, of Memphis, Tenn. They are also building low-pressure cylinders to compound two of the engines now running at the Lowell Electric Light Company's station, Lowell, Mass., and have orders for a 400 horse-power compound for F. W. Bird & Son, East Walpole, Mass., and a 1,200 horse-power compound of same type for the Bennett Manufacturing Corporation, New Bedford, Mass.

End of Strike at Iron Works.—The Ellis and Lessig Iron and Steel Company, of Pottstown, Pa., in whose works a strike has existed against a reduction of pay, resumed operations yesterday. More than 450 men are now at work at the former rate of wages. The twenty-two men who were charged with interfering with others who wished to resume work were not re-employed. Three-fourths of the men in the nail works, all in the plate rivet, and about half in the puddle mill, are at work, instead of the total of seven hundred who were at work at the beginning of the strike. The puddlers are working at $3·50 a ton, instead of $4, which they received before the strike began.

Steel and Steel Rails.—The President has transmitted to Congress the report of the Commissioner of Labour on the cost of the production of steel and steel rails, from which the following figures are taken. Reports have been received from 618 establishments, manufacturing various kinds of iron and steel and their finished products. For comparison, the country is divided into two districts. A summary of the cost per 2,240lb. of furnace pig iron is given below:—

	Northern District.		Southern District.
Establishments reporting the facts desired	26	...	28
Cost of all materials used	$6,387,622	...	$5,450,459
Cost of all labour	$1,199,918	...	$1,515,995
Tons of product	544,377	...	649,728
Cost per ton for labour	$2·204	...	$2·341
Cost per ton for material	$11·744	...	$8·141
Total cost per ton	$13·938	...	$10·755

The following is the relative cost of materials per ton in the two districts:—

	Northern.		Southern.
Ore	$4·401	...	$1·513
Scrap, cinder, &c.	2·631	...	1·081
Limestone	0·798	...	0·701
Coke	3·014	...	3·084
Coal	2·695	...	1·566

The division of the amounts paid for Bessemer iron is shown in the following table:—

	Northern.		Southern.
Total charge to blast furnaces	$13·97 to $16·50		$9·16 to $10·61
Labour proper	3·70 to 9·44		4·32 to 7·59
Officials and clerks	·17½ to ·51		·15 to ·19
Supplies, repairs, and taxes	1·69 to 5·32		·66 to 1·21
Transportation	1·69 to 5·32		·36 to 1·5

The cost of making steel rails was, for material $21·10 and $25·11, and for wages $1·54 and $1·38, making the total cost at one establishment $24·79, and at the other $27·68.

Consolidation of Electric Lighting Companies.—A despatch from St. Louis says that the largest transaction in electrical companies ever effected in the West was completed on the 18th inst. by the payment of three million dollars by the La Clede Gas Company, for the purchase of rival electric lighting companies, and to secure complete control of lighting in St. Louis. Two-thirds of this amount was paid for the Municipal Electric Lighting Company, and the balance for the Missouri Electric Company.

Removal of the Delaware Islands.—The tenders for the beginning of the work of removing the Delaware River Islands in front of the city and widening the channel were opened recently in the Government engineer's office. There were only three proposals—that of the Penn Dredging Company of this city, whose tender, on the basis of 17,000,000 cubic yards of material and 18,000ft. of wharfing removed, amounted to $3,232,950; that of the National Dredging Company, of Wilmington, Del., on the same basis, amounting to $3,429,900; and that of the American Dredging Company, of this city, amounting to $3,919,200. The plan is for the formation of a 1,000ft. channel of 26ft., with a cross section of 55,000 square feet in 2,000ft. width, and requires the removal of two islands having a total surface area of about 25 acres. The funds now available amount to $390,000, which covers the work which must be completed by June 30th, 1892.

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IMPROVED SAND DRIER FOR LOCOMOTIVES.

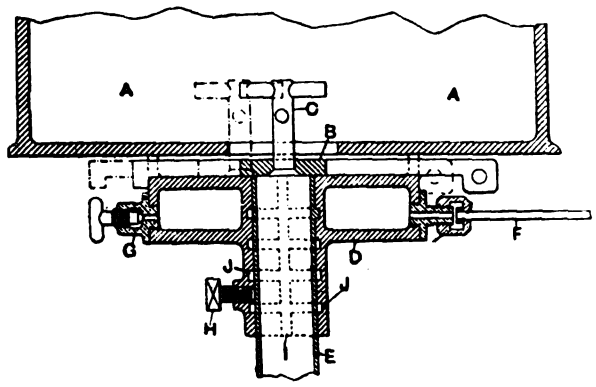


FIG. 1.

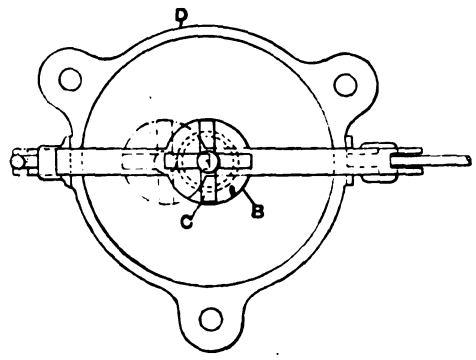


FIG. 2.

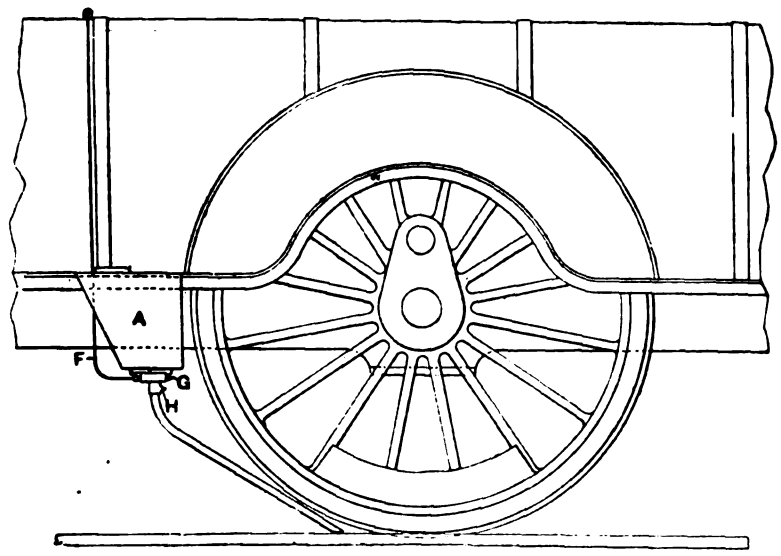


FIG. 3.

IMPROVED SAND DRIER FOR LOCOMOTIVES.

SOME time ago (see *Industries*, Vol. III., page 314) we gave an illustrated description of an improved sand drier as applied to locomotives in order to secure the necessary adhesion of the driving wheels on the rails. The accompanying illustrations show an improved form of this drier, invented by Mr. J. Macdonald, of Tokio, Japan, the agent for whom is Mr. W. E. Heys, 70, Market Street, Manchester. Referring to the illustrations, Fig. 1 represents a vertical section of the drier, Fig. 2 is a plan, and Fig. 3 shows the arrangement as fitted. A is the sand box, B is the sand valve, and C the stirrer. An annular steam chamber D surrounds the sand outlet pipe E, and is supplied with steam by means of a small copper tube F, a drip valve G being also provided to run off the water of condensation. The sand pipe is capable of vertical adjustment, and is secured in any desired position by the set screw H, and by a projection or nib on the pipe which fits into one of the annular recesses. We are informed that this apparatus has been in use on a large number of locomotives for some time in humid climates, with complete success. One line on which it is used has a prevailing gradient of 1 in 80 for a length of fourteen miles.

TRANSFORMER DISTRIBUTION.*

(*Concluded from page* 209.)

TRANSFORMERS.

The loss in the iron in transformers has till lately been very much overlooked; if it is even a small percentage of the full load of the transformer, it mounts up very seriously in station work when the transformers are in circuit all day and all night. The principle of the "Hedgehog" transformer is this: By using an open circuit the iron can be reduced in volume with a given induction. The mean length of the iron part of the magnetic circuit is considerably less, and more copper turns can be wound on without increasing this length much. The additional turns admit of a smaller cross-section of core, so that the iron is enormously reduced. The loss in copper is somewhat increased; but, as the loss in copper is only serious at full load, this does not matter.

The exciting current, though larger than in the case of closed-circuit transformers, is not a serious matter. The loss in copper is considerably smaller than the loss in iron in most closed-circuit transformers, and, as it varies as the square of the current, it is inappreciable except at full load, which very seldom occurs. The loss in iron is very small, so that the loss per day in ordinary working is very much smaller than in the case of closed-circuit transformers.

Perhaps the best way I can make this clear is by a comparison of actual transformers. As an average size of transformer, one taking 2,000 volts and a frequency of 100, and giving 15 amperes at 100 volts, may be taken, and the working compared.

A gun-metal casting forms the backbone of the "Hedgehog" transformer. It is cross shape in section, and at one end is spread out to form four legs. It also supports the lower flange, or cheek, of the winding. The four spaces have bundles of soft iron wire put in, so that the core is practically cylindrical. The cross-shaped core has been criticised on the ground that there are Foucault currents in it. The least consideration will show that there is no change of induction in it, and therefore no Foucault currents. The iron wire is bound tightly, and the two flanges are slipped into place. A gun-metal "spider" is then screwed to the top. It is finally held on by the eye-belt, but temporarily a set screw is used. The core is then wound in a special lathe in the usual way. Both the terminal board and the coil flanges gave us a great deal of trouble till we found suitable materials. There is a great need of good insulating materials that will not warp, that will insulate perfectly, and that can be worked.

The electrical particulars of a fifty 8 candle-power lamp transformer are as follows:—

Core, 13·5in. long, 2·5in. diameter. In taking the area of the core, allowance must be made for the space occupied by the backbone, and for the loss of room in using round wires. Maximum induction, 4,800. Loss of power in iron, assuming it to be of good quality, 13·5 watts. Primary, 3,920 turns of copper wire, 0·042in. diameter; resistance, 37 ohms (warm). Secondary, 200 turns, 19/0·042in.; resistance, 0·098 ohm. Loss of power in primary at full load, due to the transformed current, 21 watts; loss due to the exciting current—0·8 ampere—which is always on, 3·6 watts; loss in secondary at full load, 22 watts. Efficiency at full load, 96·15.

This transformer is shown to scale in Figs. 9 and 10.

Fig. 11 is a scale drawing of a closed-circuit transformer I have taken as representative. The primary is 400 turns of 0·042in. wire, and the secondary 20 turns of 0·176in. The loss in copper at full load is 11·3 watts, and the loss in the iron 120 watts. At full load the efficiency is 91·95, or nearly 92 per cent. The diagram (Fig. 12) shows the percentage loss at various loads of the two transformers. The ordinates are percentage loss, and the abscissæ fractions of full load. Curve II. is the "Hedgehog," and IV. is the closed circuit. It will be noticed that the "Hedgehog's" efficiency increases slightly at first, and keeps above 95 per cent. till the load is reduced to one-fifth, and above 90 down to one-tenth load, and it then begins to fall more rapidly. The efficiency of the closed form, however, begins to fall at once, and falls rapidly. In house-work the full-load efficiency is a matter of little or no consequence; the loss at very light loads is really important. A house that has a 50-light

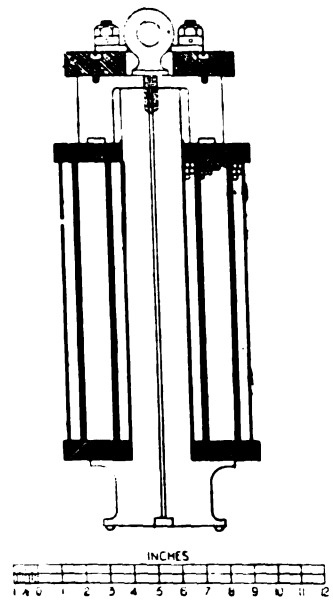


FIG. 9.

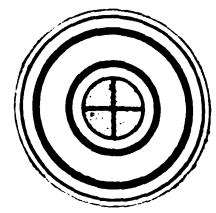


FIG. 10.

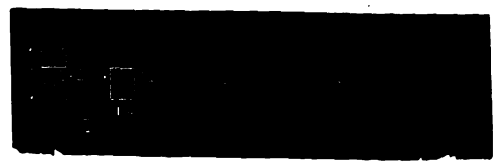


FIG. 11.

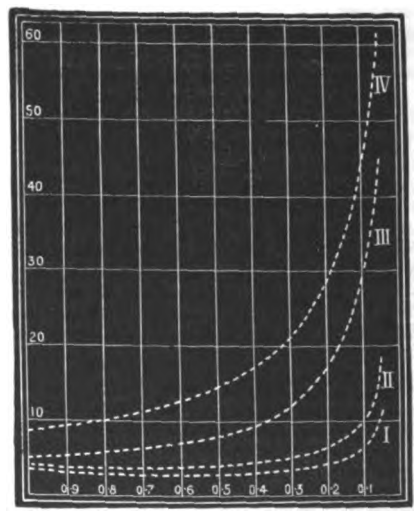


FIG. 12.

transformer is wired for 50 lamps, and that is the maximum load. As a rule, there are seldom more than 25 lamps on at any one time, and these are on during the evening only. It will be a fair average if we take four hours of half-load per day as the output of house transformers. This means an efficiency of 83·3 per cent. for the "Hedgehog," and only 51 per cent. for the closed circuit. In other words, the waste in the closed circuit is between five and six times as great as in the open circuit.

There is no chance of iron being found good enough to allow the closed circuit-form to compete with the open. There is one objection to the "Hedgehog" which must not be passed over,

* Abstract of a paper read by Mr. J. Swinburne before the Institution of Electrical Engineers on the 19th ult.

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and that is the exciting current. The exciting current in the 50-lighter is 0·31; in the closed circuit it is 0·2; so that it is quite half as much again.

DISTRIBUTION.

Even with the most efficient transformers, the house system is a very poor method of distribution. Apart from the question of loss of power, consider the outlay involved in providing each consumer with a high-pressure double-pole fuse, a transformer, an automatic device for rendering the whole arrangement safe in case of insulation giving way, perhaps a double-pole main switch, a meter, and a fire-proof safe in which all these things have to be enclosed. In addition to this, it involves a complete high-pressure parallel system of distribution, and a network of 2,000-volt underground mains, involving a heavy outlay, and probably heavy depreciation. There is no need for sub-stations; the low-pressure network may be fed at various points by transformers and feeders coming direct from the station. These transformers need not be in houses or cellars; they can be placed conveniently in the ground in cases filled with insulating oil. At the station each feeder can be regulated, and has a compound-wound voltmeter, so that an attendant can keep the pressure in the whole town constant. As Mr. Kapp pointed out in 1888 the advantage of such a system is enormous. In direct currents the low-pressure mains must be large.

Even in scattered districts it would generally pay to use small low-pressure mains and feeders. The alternate system has so many advantages over the direct in the matters of regulation and distribution, when worked on the low-pressure system, that it is astonishing that such arrangements are not utilised. For instance, with direct currents, it is most difficult to find a leak; and one leak on the positive at the west end, combined with one leak on the negative at the east, will cause serious trouble. With alternate currents, a number of small local networks may be used, each of them being complete in itself. It is not in metallic connection with any other part of the town, nor with the central station. Where it meets the network of the neighbouring district it is not metallically joined, as in the case of direct currents, but is connected through a one-to-one transformer sunk in the ground, in a case full of oil.

After the clear and able manner in which Mr. Kapp urged the advantages of low-pressure networks for alternating currents, it is most astonishing that engineers should go on with house transformers. At present, however, we are using alternating currents in just about the worst way that could be possibly devised.

CONDENSERS.

Condensers may have a very large opening in connection with ordinary alternate-current distribution. Take the case of arc lamps. For instance, suppose a station supplies a 100-volt secondary circuit by means of transformers with 2,000 volts primary pressure; and suppose there are 200 arc lamps, each taking 33 volts and 10 amperes, arranged on the 100-volt circuit, with a choking coil in series with each. Suppose, for simplicity, that there are no incandescent lamps in use. The arc lamps then take 2,000 amperes and 100 volts; but this does not amount to more than 66,000 watts, as the current is not in step with the electromotive force. The dynamos thus have to supply 2,000 volts and 100 amperes; whereas the same power, if the current did not lag, would be supplied by 2,000 volts and 33 amperes. This gives rise to several troubles. Suppose each machine has an armature wound to give 2,000 volts and 33 amperes, or 66,000 watts, it takes three instead of one to work the lamps. In addition to this, the lagging of the current weakens the field of the dynamos, so that they need more excitation to give 2,000 volts than they would need even on full load on a non-inductive resistance. Moreover, running three engines and dynamos at a third load instead of one at full load is not economical. A condenser takes a current which leads relatively to the pressure, so that it counteracts the effect of the lagging current. The 100 amperes may be regarded as compounded of 33 amperes in step with the pressure, and 95 amperes lagging a quarter of a period. A condenser of about 85 microfarads will supply the 95-ampere component, while one dynamo supplies the 33 amperes really needed by the lamps. This reasoning holds good without the curve of sines assumption.

The use of condensers to overcome troubles arising from exciting or magnetising currents of closed or open circuit transformers has already been mentioned.

The commercial manufacture of high-pressure condensers is not easy, but it may now be said that it can be carried out.

SHIPBUILDING NOTES.

ON the 14th ult. the fine screw steamer "Taurus," built by Messrs. Wm. Gray & Co., Limited, to the order of Mr. Wilhelm Wilhelmsen, of Tonsberg, Norway, went on her trial trip. The dimensions of the vessel are:—Length, over all, 288ft.; breadth, 37ft. 2in.; depth, 21ft. 2in. The engines, which are of the triple-expansion type, have been supplied by the Central Marine Engine Works, of Messrs. Wm. Gray & Co., the cylinders being 21½in., 34in., and 57in. in diameter, with a piston stroke of 39in. Steam is supplied by two large steel boilers working at a pressure of 160lb. The vessel takes Lloyd's highest class, and is fitted with all the latest improvements, including a "Yaryan" evaporator. After adjustment of compasses, a run was made to sea for above an hour at full speed, the engines making upwards of 90 revolutions per minute during that time, and a speed of 12½ knots was maintained.

ON the 16th ult. the s.s. "Justin," a steel screw steamer, built for Messrs. Arthur Holland & Co., London, by Sir Raylton Dixon & Co., Middlesbrough, took her trial trip from the Tees. This vessel is built on the web-frame principle with poop, raised quarter-deck, bridge, and top-gallant forecastle. Her dimensions are:—Length, over all, 287ft.; breadth, 39ft.; depth, moulded, 21ft. 3in.; with a dead-weight capacity of about 3,300 tons. Her engines were supplied by Messrs. Blair & Co., Limited, Stockton, having cylinders 21in., 35in., and 57in., with 39in. stroke, and gave every satisfaction.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, March 6th, at 9 p.m. Lecture on "Electromagnetic Repulsion," by Professor J. A. Fleming. Saturday, March 7th, at 3 p.m. Lecture IV., on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

SANITARY INSTITUTE.—Friday, March 6th, at 8 p.m. Paper to be read: "Objects and Methods of Inspection," by Mr. J. F. J. Sykes.

SOCIETY OF ARTS.—Friday, March 6th, at 4.30 p.m. Lecture on "The Science of Colour," by Captain Abney, F.R.S.

GEOLOGISTS' ASSOCIATION.—Friday, March 6th, at 8 p.m. Paper to be read: "On the Structures of Igneous Rocks," by Mr. J. J. H. Teall, F.R.S.

BALLOON SOCIETY.—Friday, March 6th, at 8 p.m. Paper to be read: "The Movable Dwellings Bill," by Mr. M. I. Lyons.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, March 9th, at 8 p.m. Cantor Lecture I., on "Photographic Chemistry," by Professor R. Meldola, F.R.S. Wednesday, March 11th, at 8 p.m. Lecture on "Electricity in Relation to the Human Body," by Mr. H. N. Lawrence and Mr. A. Harries.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Monday, March 9th. Paper to be read: "Electrical Engineering" by Mr. W. C. Mountain.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 10th, at 8 p.m. Ordinary meeting. Paper to be discussed: "On the Subterranean Water in the Chalk Formation of the Upper Thames, and its Relation to the Supply of London," by Mr. J. T. Harrison, M.Inst.C.E.

SANITARY INSTITUTE.—Tuesday, March 10th, at 8 p.m. Paper to be read: "The Nature of Nuisances, including Nuisances the Abatement of which is Difficult," by Mr. J. F. J. Sykes. Wednesday, March 11th, at 8 p.m. Paper to be read: "The Prevention of Infectious Diseases," by Professor A. Wynter Blyth.

SOCIETY OF ARCHITECTS.—Tuesday, March 10th, at 7.30 p.m. Paper to be read: "Land and House Property in London, and Modern Attempts to Disturb their Character," by Mr. W. Woodward.

ROYAL INSTITUTION.—Thursday, March 12th, at 3 p.m. Lecture on "Modern Chemistry in Relation to Sanitation," by Professor C. Meymott Tidy.

PRICES CURRENT, 4TH MARCH, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 17 6	.....	7 7 6	London.
„ Angles	7 0 0	.....	7 10 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 0 0	„
„ Ship and Girder			7 0 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	41/10½	Cash.
Scotch Warrants, m/n	46/4½	„
Hematite Warrants, m/n	50/10½	„

Stocks in Stores.	Scotch	545,786—Dec. for week	3,858 Tons.
	Middlesbro'	124,225—Inc. „	24 „
	Hematite	204,526—Dec. „	3,124 „

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	...	.....	...	f.o.b. Glasgow.
Gartsherrie	...	.....	...	„ „
Carnbrae ex Store	50/-	.....	50/-	„ „
Eglinton „	50/-	.....	49/6	„ „
G.M.B. „	47/-	.....	46/9	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 60/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£ s. d.		£ s. d.
Spelter:	Ordinary	£25 0 0	to	25 5 0
Copper:	British Cakes and Ingots	57 10 0	„	58 0 0
„	Chili Bars, G.O.B.'s	52 7 6	„	52 12 6
„	Other sorts, G.M.B.'s (equal to Chili Bars)	52 7 6	„	52 12 6
„	Manufactured (strong)	65 0 0		.....
Lead:	Common Pig	13 10 0	„	13 15 0
„	English Sheet	14 5 0	„	14 10 0
Tin:	Straits	90 0 0	„	90 10 0
„	Australian	90 5 0	„	90 15 0
„	English Ingots	94 0 0		.....

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: There is no change to report in the position of the copper market, which continues quiet. Values of manufactured remain unchanged, prices being well maintained, although the demand is small. Chili bars are changeable, and lower on the week, to-day's quotations being £52 7s. 6d. to £52 12s. 6d. cash, with small trade reported. Manufactured £65, "strong."

TIN: Fairly steady at last week's rates, with better inquiry.

LEAD: Quiet and unchanged.

SPELTER continues very firm, all the makers being short of stocks, and fully sold for some months to come. There is a good demand, and prices are likely to be well maintained at the present high values.

CHEMICALS.

		£ s. d.		£ s. d.
Acid:	Carbolic Crystals ...lb.	0 0 5½	to	0 0 6½
„	„ Liquid ...gal.	0 1 0	—	.....
„	Citric ...lb.	0 1 8½	—	.....
„	Oxalic ... „	0 0 3½	—	.....
„	Sulphuric ...ton	1 15 0	—	.....
„	Tartaric ...lb.	0 1 3½	—	.....
Alum:	Lump (powder 10/- ex.) ...ton	5 12 6	—	.....
Ammonia:	Carbonate ...lb.	0 0 3½	—	.....
„	Muriate (Grey) ...ton	25 0 0	—	.....
„	„ (White) ... „	26 10 0	—	.....
„	Sulphate ... „	10 15 0	—	.....
„	Liquor ...lb.	0 0 3	—	.....
Antimony	...ton	75 0 0	—	.....
Bleaching Powder	... „	6 12 6	—	.....
Bisulphide of Carbon	... „	13 0 0	—	.....
Borax	... „	29 0 0	—	.....
Benzole (90 %)	...gal.	0 4 9	—	.....
„ (50/90 %)	... „	0 3 7	—	.....
Copper Sulphate	...ton	17 0 0	—	.....
Copperas	... „	2 0 0	—	.....
Kieserit	... „	.....	—	.....
Lead:	Nitrate ... „	21 10 0	—	.....
„	White Sugar ... „	25 10 0	—	.....
„	Brown „ ... „	19 10 0	—	.....
Potash:	Bichromate ...lb.	0 0 3½	—	.....
„	Caustic ...ton	22 0 0	—	.....
„	Carbonate ... „	20 10 0	—	.....
„	Chlorate ...lb.	0 0 5½	—	.....
„	Prussiate (Yellow) ... „	0 0 10	—	.....
„	Sulphate (Basis 90 %) ...ton	4 0 0	—	.....
Precipitate:	Red ...lb.	0 3 6	—	.....
„	White ... „	0 3 6	—	.....
Salts:	Epsom {Bags ...ton	3 0 0	--	.....
	{Casks ... „	3 15 0	—	.....
„	Glauber ... „	1 10 0	—	.....
Sulphur:	Sublimed Flowers ... „	9 10 0	—	.....
„	Recovered ... „	7 5 0	—	.....
Soda:	Ash ...deg.	0 0 1¾	—	.....
„	Caustic {White 70%) ...ton	11 2 6	—	.....
„	„ {„ 60%) ... „	9 17 6	—	.....
„	„ {Cream 60%) ... „	9 10 0	—	.....
„	Crystals ... „	3 3 0	—	.....
„	Bicarbonate ... „	7 10 0	—	.....
„	Hyposulphite ... „	6 10 0	—	.....
Solvent Naphtha	...gal.	0 1 8	—	.....
Tartar, Cream of	...cwt.	5 7 6	—	.....
Zinc Sulphate	...ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: There is only a moderate amount of business passing, and values of many articles are weakening. Sulphate of ammonia is again easier, and very little doing. Sulphate of copper has lost a portion of the recent advance. Green copperas is unchanged in value, but has less inquiry. Yellow prussiate of potash remains firm; chlorate of potash also. Bichromates quiet, but steady. Foreign white sugar of lead is firm at the advance; other lead salts are quiet.

OILS.

		£ s. d.
Cocoanut:	Cochin ...per ton	36 0 0
„	Ceylon ... „	29 0 0
Cottonseed	... „	18 15 0
Cod	... „	23 0 0
Lard	... „	33 10 0
Linseed	... „	21 10 0
Olive, Spanish	... „	43 0 0
Palm, Lagos	... „	25 0 0
Rapeseed:	English ... „	29 5 0
Seal:	Pale ... „	25 0 0
„	Brown ... „	.....
Sperm	... „	48 0 0
Whale	... „	21 0 0
Turpentine	...per cwt.	1 8 9
Coal	...per gal.	.....
Petroleum	(Refined) ... „	0 0 5¼
	Spirit ...	0 0 7

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HOME INDUSTRIES.

LONDON, 5th March, 1891.

The Money Market.—There has been no feature in the money market, except the maintenance of a steady though not great demand for gold for abroad, which keeps rates fairly firm. Early this week the floating supply of money was reduced somewhat by operations in connection with the transference to the County Councils of funds collected by the imperial authorities and handed over in accordance with Mr. Goschen's scheme of two years ago. This strengthened money rates for a short time. Business on the Stock Exchange continues on a very limited scale. Last week there was a revival of serious rumours regarding the solvency of some houses concerned in South American loans, and this week these reports were again circulated owing to heavy sales of Consols for money. But the impression is that these sales, so far from indicating further danger to the market, were due to strong steps being taken to avert all risks by the provision of money to tide over the undoubted temporary difficulties of some firms. In the home railway market the declaration of the Scottish dividends has caused a sharp fall in their stocks, the strike having cut more severely into net revenues than had been calculated. American and Canadian railways have been dull and listless. Foreign bonds have been generally firm, and silver securities have improved somewhat. Industrial, miscellaneous, and mining shares have shown little life.

Institution of Mechanical Engineers.—The ensuing ordinary general meeting of this Institution will be held on the 19th and 20th inst., at 7.30 p.m., at the Institution of Civil Engineers. The President, Mr. Joseph Tomlinson, will be in the chair. The following papers will be read and discussed:—"Fourth Report of the Research Committee on Friction: Experiments on the Friction of a Pivot Bearing," "On Recent Trials of Rock Drills," by Mr. Edward H. Carbutt and Mr. Henry Davey.

Metropolis Water Supply Bill.—On the 27th ult. a meeting of representatives of district boards and vestries was held, to take into consideration the Metropolis Water Supply Bill. Sir Algernon Borthwick, who presided at the meeting, said that the evils of the present system were apparent, and a remedy must necessarily be sought. The various companies should be consolidated so as to be managed under one administration, and additional supplies of water should be obtained from Leatherhead, Rickmansworth, and other places. The cost of buying out existing water companies would only be increased by any delay. Mr. H. Wilkins, the hon. secretary of a committee of district board members appointed to deal with the subject, then presented a summary of the Bill, which proposed to confer upon an elected water trust the exclusive powers of supplying water within the metropolitan area, and for securing an equalisation of charges for such supply. The trust would consist of thirty-nine members, elected by the county electors of the water area. A board of arbitration would fix the terms upon which the water companies should be bought out. The purchase-money would be paid by stock secured on the property of the water trust, and by rates levied over the whole area. It was provided that the London County Council might take the place of the trust, but preference was expressed for the latter, seeing that the area administered would be beyond the London area. A resolution was subsequently carried unanimously that it was desirable that the water supply of London should be with the least possible delay vested in a public representative authority.

Exhibition of Meteorological Instruments.—On the 3rd inst. the annual exhibition of instruments, under the auspices of the Royal Meteorological Society, was opened in the rooms of the Institution of Civil Engineers, and will remain open until the 19th inst. This year the Exhibition includes rain and evaporation gauges, and any new forms of instruments which have been invented during the past year. A large variety of gauges are exhibited, including those of older types. Specimens of gauges used on the Continent and in the United States are also shown. The evaporation gauges include several instruments employed for measuring the evaporation from a free surface of water, and others for use with growing plants. A number of new instruments are also exhibited, among which are various anemometers, recording barometers, and cameras for meteorological photography. An interesting collection of maps of rainfall over the British Isles and various parts of the world, as well as numerous photographs of floods and meteorological phenomena, are also on view.

Compound Sulzer Engine.—We had this week an opportunity of inspecting a horizontal compound steam engine, the first that has been constructed in England on the well-known Sulzer system. The engine, which has been constructed by Messrs. Bryan Donkin & Co., Limited—who have been appointed by Messrs. Sulzer Frères, of Winterthur, as the sole makers for Great Britain and Ireland—at their works, Southwark Park Road, Bermondsey, is capable of indicating 400 horse-power with a boiler pressure of 90lb., and has been constructed for Palmer's Ordnance Works, Jarrow. We hope in a later issue to give illustrations and further particulars of this engine, which is constructed on a principle largely adopted on the Continent.

The Torpedo Gunboat "Antelope."—The Admiralty have placed the order for the machinery of the torpedo gunboat "Antelope," now building at Devonport, with Messrs. Yarrow & Co., of Poplar.

MANCHESTER, 5th March, 1891.

The Late Dr. Joule.—At the ordinary meeting of the Manchester Association of Engineers, held on the 28th ult., Mr. John Angell delivered a paper descriptive of the labours of the late Dr. Joule during his demonstration of the mechanical equivalent of heat. The paper dealt to some extent with the previous history of the subject, and was illustrated by a number of lantern views of the various forms of apparatus devised and employed by Dr. Joule in the course of his experiments. Of these and the mode of using them Mr. Angell gave a lengthy description, and concluded by showing some of the applications which had been made of Joule's work. The paper forms a very complete summary of the work of Joule in this connection, and for this reason is valuable.

Improved Slow Motion for Carding Machines.—Mr. George Paley, of Preston, has just devised a novel and ingenious motion for reducing the speed of carding engine cylinders during stripping and grinding. The whole of the mechanism is enclosed within the driving pulleys, and consists of a wheel affixed to the boss of the fast pulley with fifty teeth. A loose bush is placed inside the loose pulley on which the latter revolves, and on the inner end of the bush a wheel containing fifty-one teeth is keyed in a position adjoining the previously-named wheel. The outer end of the bush is formed with a flange, in which several holes are drilled, so that by means of a rod any rotation of the bush can be prevented. A pinion long enough to engage with both wheels is carried on a pin fastened into the web of the loose pulley, and is, of course, rotated with it. When the fast pulley is revolved during ordinary work the whole mechanism is carried round by it, but when the strap is moved on to the loose pulley for grinding or stripping, the bush is prevented from turning by the introduction of a rod into one of the holes, the rod being suitably fixed. The result is that the pinion rolls round the wheel on the bush, and, owing to the difference in the number of teeth in the two wheels, gives a rotary movement to the extent of one tooth to the wheel on the fast pulley boss during every complete rotation round the other wheel. Thus, in the case named, the rotation of the fast pulley is reduced to $\frac{1}{50}$th of that of the loose pulley, which gives a motion sufficiently slow for grinding. This motion enables mechanical stripping to be done, which has hitherto been a difficult task.

Proposed Tower at Blackpool.—The borings for the foundations for a new tower, on the model of the Eiffel Tower, have been commenced in Blackpool, on a site adjoining the promenade. The capital proposed is £150,000, much of which has been subscribed. It is intended to erect a three-storied building, from the centre of which the tower will spring. M. Eiffel has been asked to act as consulting engineer.

The Iron Trade.—The condition of local trade is very poor, and only a small business is being done. There is a widespread opinion that the price of iron will be lower than at present, and buyers are very unwilling to contract. The failures in the West Cumberland section have somewhat disorganised trade in hematites, but, on the whole, business has not suffered so much as might have been expected. Bar iron is very slow of sale, and prices are continually drooping. There is a difficulty in getting new business, which does not become less as the season advances. Generally speaking, the outlook is not a very favourable one.

The Linen and Jute Trades.—There is a fairly active movement this week on home trade account, but no improvement can be reported in the shipping branches. Manufacturers, notwithstanding the hesitation shown by buyers in placing orders, and their evident determination to keep stocks down to the lowest workable level, are disinclined to make any concessions in price, as the increase of late in cost of production places them in a much more awkward position. There is fortunately a disposition on the part of Continental spinners and manufacturers to assist the efforts of British firms in this respect, and, with the absence of the reckless cutting of prices that has characterised the action of foreign firms in previous years, the position of the trade is less uncertain. Coarse goods are not so weak as they were, and, although the demand is quiet, sellers are hopeful. Distribution generally in the warehouses has not, however, been so brisk as would have been the case had the season been at its best, and it is not expected that the year will yield results equal to those of last. The shipping demand is unchanged. There is a continuance of the dulness previously noted in the South American branch, the mails of the 3rd inst. not having brought satisfactory news. United States buyers have not yet commenced to arrive in appreciable numbers. For Canada there is not much doing. Another somewhat extensive failure has had a depressing effect, and the slowness of remittances in the Dominion puts a great strain upon the wholesale houses there. Hessians are in steady request.

GLASGOW, 5th March, 1891.

The Scottish Railways.—More than usual interest attaches to the declaration of the half-yearly dividends by the three railways affected by the recent strike. For some time the shares of all have been depressed, at first in consequence of apprehensions of a strike, and afterwards by reason of the strike itself and of the effect of the heavy losses of the companies in reducing the dividends. In Glasgow and South-Western stock there was a fall of £2 12s. 6d. in five days, in consequence of the rumours about the dividend. Caledonian and North British ordinary stock have both lost ground during the past few days, North British ordinary preference falling sharply in the beginning of the week. These falls indicate the heavy losses due to the crisis through which the companies have been passing. In addition, there has been, during the past few months, a slowness of trade, apart from the influence of the strike, and this would in any case have told against the dividends even had there been no strike.

Declaration of Railway Dividends.—The Glasgow and South-Western Company have declared a dividend for the half-year at the rate of 3¼ per cent. per annum, and the Caledonian a dividend at the rate of 3¾ per cent. per annum. The dividend of the North British Company will not be declared until the 12th inst. The ordinary stock of the North British Company has fallen sharply ever since the close of the strike, owing partly to the losses due to the strike, partly to the falling off of traffic due to the want of expansiveness in trade, and partly to the collapse of the North British scheme for the acquisition of the Glasgow and South-Western Railway. The dividend of the Glasgow and South-Western Railway is regarded as being quite as much as was expected. The winter dividend of this company was 4 per cent., 4 per cent., 3¼ per cent., 3¾ per cent., and 4 per cent. during the past five years. It must be remembered that the strike on the Glasgow and South-Western system lasted only ten days. The Caledonian dividend is so much smaller than had been anticipated that the stock dropped at once on the declaration from 116⅜ to 115¾. The dividends for the winter half-years of the Caledonian were 5¼, 5½, 4, 3¾, and 4 per cent. for the past five years. The dividend is lower than in any winter half-year since 1881. Assuming that the difference of 1¼ per cent. per annum is due to the strike, this represents a loss to the Caledonian Company of about £75,000. The ¼ per cent. per annum of difference on the Glasgow and South-Western dividend represents a loss of about £12,500. In this connection the Clyde Trust reports a decrease of revenue due to the strike amounting to between £5,000 and £6,000.

Pig Iron.—The continued depression of the pig iron market, and the obvious impossibilities of holding out, have compelled the blast furnacemen, after a strike or lock-out of twenty-one weeks, to sue for terms. They have offered to abandon their original demand for extra payment for Sunday labour, but the ironmasters refuse to take the men back excepting at a reduction of 20 per cent. The men have offered to agree to a deduction of 12½ per cent., but as yet there seems little prospect of a compromise being effected. Prices are still low, but warrants are said to be scarce, and the market has for some days been fairly firm, holders being by no means sure that a rebound from present low prices is not imminent. Meanwhile Scotch iron is going out of stores, the make of the furnaces recently put in blast being all absorbed by the current demand for special brands. The importation of Cleveland iron has been checked. The effect of the shutting down of Scotch furnaces during a period of almost utter quiescence, while the Cleveland ironmasters sent their iron into Scotland at ruinous prices, has been the reverse of satisfactory for the Cleveland makers. The failure of one of them, and the probable stoppage of the furnaces of others, may perhaps help to check the fall which has been going on in spite of the suspension of Scotch production. If, as is alleged, the Cleveland ironmasters were indirectly instrumental in facilitating the lock-out of blast furnacemen in Scotland by subsidising their union, there can be but little sympathy in Scotland for their present misfortunes. It must be said, however, in the first place that there is not an atom of direct proof that they supported the Scotch blast furnacemen in their dispute with their employers, and in the second place, that the blast furnacemen's dispute had very little to do with the stoppage of the production.

(From our own Correspondents.)

LIVERPOOL, 4th March, 1891.

The Port Sanitary Authority.—The annual report of the Medical Officer of Health was presented to the Council to-day, and contained some interesting statistics. The number of vessels inspected during the year was 3,372, of which 3,102 were found to be in good sanitary condition, and only 270 defective, the condition of the British ships reflecting great credit on the officers and men. The number of emigrants which passed through the port was 190,785, being 7,070 less than the previous year; the falling-off consisted of 10,915 English emigrants, 731 Scotch, and 818 Irish, while there was an increase of 5,394 foreign emigrants.

The Trade of Liverpool.—At the last meeting of the Dock Board it was stated that the trade of Liverpool, measured by the tonnage of vessels using the port, was making steady progress. The Board have therefore been compelled to seek Parliamentary powers for providing additional accommodation commensurate with the requirements of the port. While in 1881 the tonnage of the port was 7,894,000 tons, last year it had risen to 9,654,000, and for the first time in the history of the Dock Estate the revenue derived from rates on ships and goods had exceeded £1,000,000.

Electric Lighting in Liverpool.—At the meeting of the shareholders of the Liverpool Electric Supply Company, held last week in Liverpool, it was stated that the profits for the last twelve months amounted to £4,878, out

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of which it was proposed to pay a dividend of 3¼ per cent.; the expenditure on capital account amounted to £54,019. The number of lights supplied on January 1st, 1890, was 6,700, and on January 1st of this year 11,750, the present available engine power being for 25,000 lamps. It is proposed to extend the business of the company into the suburbs to Prince's and Sefton Park.

SHEFFIELD, 4th March, 1891.

Iron and Steel.—Messrs. Vickers, Sons, & Co., Limited, have received an order from the English Government to supply the side armour for the second-class battleship "Centurion," one of the ships built under the naval programme which was sanctioned three or four years ago. The plates will be of solid steel throughout, as the firm do not make composite plates, and they will vary in thickness from 8in. to 12in. Messrs. Cammell are to supply side armour to the "Barfleur," which will be made on the compound system under Mr. Wilson's patents. Other branches of the heavy trades are fairly well employed. The capacity of the large manufactories for turning out work of the heaviest kind here is very great. Lathes capable of dealing with work that measures 6ft. by 60ft., and weighing up to 100 tons; boring machines, with beds 100ft. long, that are able to bore shafts 60ft. in length, perfectly true from end to end; and planing machines that weigh 120 tons, are becoming quite common. The railway and rolling stock works are fully employed. Mr. C. D. Clayton, of Doncaster, is building a large shop at Mexborough for the manufacture of rolling stock and for doing repairs.

Fuel.—The prices of fuel show a tendency to decline, although the local demand is brisk. Household coal is selling at a very high price, and without much hope of an early reduction. Steam coal is in active request for locomotive use, and also the commoner qualities for general manufacturing purposes. Coke of various qualities is in rather less demand, more especially of the quality used for blast furnaces, and the stopping of the Scotch and Staffordshire ovens has contributed largely to this result. Colliery owners are now finding considerable difficulty with their men, who are threatening to strike.

The Late Mr. William Fox.—The death of Mr. William Fox occurred at Harrogate on the 27th ult. Mr. Fox was connected with various business undertakings—the Leeds Forge, the British Water Gas Syndicate, and the Yorkshire Water Gas Company.

NORTH STAFFORDSHIRE, 4th March, 1891.

The Iron Trade.—There is no improvement to record in the outlook of the iron trade in this district, and the further fall in prices, owing to the keen competition which prevails, is really of an alarming character. The fact that miners' wages are still maintained at so a high a point, by reason of which the cost of production of minerals—both coal and ironstone—is greatly enhanced, accounts for the position in which ironmasters are now placed. It is rumoured that one ironworks in the district, which was only restarted a short time ago, has gone into liquidation, and that a receiver has been appointed. Unless prices improve, of which there seems little prospect, other works will have, of necessity, to stop their mills and forges. The price of pig iron has fallen from 3s. to 4s. per ton during the last few weeks, and it is an open secret that many sales are being effected at an absolute loss to the makers.

General.—The annual meeting and dinner of the North Staffordshire Institute of Mining and Mechanical Engineers and the annual dinner of the North Staffordshire Chamber of Commerce were held at Stoke last week.

DERBY, 4th March, 1891.

The Midland Railway.—A dividend at the rate of 7 per cent., in the face of the increased price of fuel and higher wages, was announced by Mr. George Ernest Paget, the newly appointed chairman of the company, at the recent half-yearly meeting. The receipts have increased as follow:—Traffic receipts increased £226,929; miscellaneous receipts, including balance, increased £6,912; altogether an increase of £243,841. This had been absorbed as under:—Increased working expenses, £180,841; interest and dividend on increased capital, £24,880; ¼ per cent. more dividend on ordinary stock, £37,768; and increased balance carried forward, £352. A strenuous opposition will be offered by the Midland Railway Company to the schedule of maximum rates to be proposed by the Board of Trade to Parliament, which materially differs from the draft schedule prepared by Lord Balfour of Burleigh and Mr. Courtney Boyle. They estimated that, even under the last-named schedule, the revenue of the company would be compulsorily reduced by about £100,000 a year, but, bad as these were, the Board of Trade are now offering much worse terms.

CARDIFF, 4th March, 1891.

Iron and Steel.—The hematite pig iron trade is in a deplorable condition, and the news that a large company in the Cumberland district has suspended payment has not tended to brighten affairs. At Rhymney the intention to close the Bessemer steel mills was carried into effect on the 28th ult. The iron ore market is quiet, but one or two sales have been reported. Rubio ore is quoted at 13s. 9d. to 14s. c.i.f. Cardiff or Newport, 14s. 6d. Porthcawl, 14s. 9d. Port Talbot, 14s. 6d. Briton Ferry, and 14s. 3d. Swansea, for 50 per cent. iron as received.

Coal and Coke.—The shipments of steam coal continue large, but collieries do not feel the strain so much, there having been an accumulation of loaded waggons. The tone of the market has not materially changed since last week. Inquiries are not so numerous, and, owing to the closing of some steel mills, the quantity of coal for sale is likely to be increased. Prices are steady. Steam coal realises—1st quality, 14s. 9d. to 15s. 3d.; 2nd, 14s. to 14s. 6d.; 3rd, 13s. 3d. to 13s. 9d.; and 4th, 12s. 6d. to 13s. Small steam coal finds a very poor outlet, prices being quoted at 5s. to 5s. 3d. The household coal trade is fairly active, but there is no evidence of the pressure noticeable a few months back. Patent fuel is quiet.

BARROW-IN-FURNESS, 4th March, 1891.

Hematite.—There is less activity in the hematite pig iron trade, and prospects are very poor. In fact a further reduction in the number of furnaces in blast has been necessitated at the works of the Maryport Hematite Company, where only one of the four furnaces is now blowing. This company has found it necessary to suspend payment because of its inability to produce iron at a profit—one of the effects of speculation in hematite warrants, and of the accumulation of heavy stocks of metal. The stocks held in the district have been reduced this week by 3,698 tons, but still stand at 205,784 tons. Prices are practically unchanged at 51s. for hematite warrants net cash, and 52s. to 53s. for mixed Bessemer numbers net f.o.b.

Steel.—In the rail trade there is a marked quietness, and orders are given out sparingly. The mills are not regularly employed, and the outlook is cheerless. Heavy sections of rails are at £4 15s. per ton. An improvement is noticeable in the steel shipbuilding material trade, the result of recent heavy inquiries for early deliveries of plates, angles, and other sections required by shipbuilders for some important contracts which are at present in the market. As a consequence of this prices have advanced to £6 10s. for plates, while angles are at £6 and boiler plates at £7 5s. Other departments of the steel trade are quiet, except those of hoops and heavy steel castings, which are very brisk.

Barnes' Patent Steel Rail Pit Props.—Under the head of "Propping Plant for Mines," reference was made to this invention of Mr. Barnes, of Harrington, in a recent letter. It should have been mentioned that these props and supports have a series of notches or cuttings in the rails for framing them together in the several positions for which they are intended.

MIDDLESBROUGH, 4th March, 1891.

Pig Iron.—The market is firm but rather lifeless, not much business being done. Buyers of No. 3 G.M.B. are plentiful at 42s. per ton for early, and 42s. 3d. for forward delivery, but sellers hold back, since they expect better prices as the season advances. Middlesbrough warrants are 42s. 1½d. cash buyers, but there is no great demand. The stock in Connal's store on the 2nd inst. amounted to 124,568 tons, being an increase since the 28th ult. of 139 tons. In hematite pig iron East Coast brands are 54s. per ton f.o.b. sellers. West Coast brands have been quoted at 50s. 11½d. cash.

Shipments.—February has been a splendid month for shipments of pig iron, but this has been caused by the demand from Scotland, which took 37,432 tons of the total 70,499 tons. The shipments for the same month last year amounted only to 41,967 tons. The shipments of manufactured iron and steel, on the other hand, have fallen off considerably. Those of manufactured iron amounted to 18,401 tons against 22,491 tons last year, and those of steel to 17,965 tons against 30,186 last year.

Manufactured Iron and Steel.—Business is very dull, and the prospect cheerless. Prices remain as they were:—Iron ship plates, £5 15s.; steel ship plates, £6; iron ship angles, £5 12s. 6d.; steel ship angles, £6; iron bars, £5 15s.; steel rails, £4 15s. per ton f.o.t. at works, less 2½ per cent.

Dividends.—Messrs. Bolckow, Vaughan, & Co.'s directors have decided to recommend a dividend for the half-year ended December 31st last of 3 per cent., making altogether 6 per cent. over the entire year. The Teeside I. & E. Works Co.'s directors propose to pay a dividend of 7½ per cent. on the preference shares, and 2½ per cent. on the ordinary shares.

Ironmasters' Returns.—These have just been issued for the month of February, and show a decrease in the make of pig iron of all kinds of 19,362 tons, there being two furnaces less blowing. They also show a decrease in stocks of 2,940 tons, as against the amount at the end of January. The stocks at the end of February amounted to 287,341 tons.

SUNDERLAND, 4th March, 1891.

The Shipping and Coal Trade.—There is no improvement in the local coal trade, and the continuance of the Silksworth strike is being severely felt. During the month of January the revenue of the River Wear Commissioners showed a decrease of £2,147 3s. for the month Some steps should be taken to encourage other trades as the port is too much dependent upon one or two industries.

Shipbuilding and Engineering.—During the present year eleven vessels, of 25,146 tons, have been launched at this port, eight, of 18,944 tons, during the month of February, as against three, of 6,202 tons, in January. All are screw steamers, except the large sailing ship "Honresfeld," launched by Messrs. William Doxford & Sons, Pallion. Inquiries are less scarce, but few contracts have been taken this year. Messrs. Short Bros., Pallion, have secured two orders for screw steamers, one of which is of 3,000 tons deadweight on a light draught, for the River Danube trade, and the other for the Scotch coasting trade. Marine engineering establishments continue to be actively employed. Amongst the work in progress at the Southwick Engine Works (Messrs. George Clark, Limited) is a set of triple-expansion engines to be shipped to Bergen, and some "Yaryan" evaporators for steamships.

The Glass Trade.—This trade is fairly flourishing, but in the sheet and rough plate glass departments the cost of labour is severely felt. Messrs. J. Hartley & Co., after having given due notice of 10 per cent. reduction to their employés, have locked them out, as the reduced wages were not accepted.

NEWCASTLE, 4th March, 1891.

The Coal Trade.—The condition of the local coal trade has undergone little change since last week, but the qualities required for steamers' uses are less inquired for, and, to prevent an accumulation of stocks, the production will probably have to be lessened. The demand for gas and household coals has also shown more weakness, but for manufacturing coals there is still a fair amount of inquiry. The shipments of coal and coke at Tyne Dock for the week ending on the 28th ult. amounted to 96,399 tons, being a decrease, as compared with the shipments in the corresponding week last year, of 4,275 tons.

Engineering.—The overtime question continues to disturb the relations between employers and employed in this district. A meeting of operatives' representatives was held in Newcastle with reference to this matter on the 28th ult., and arrangements are in progress for the discussion of the subject with the employers at an early date. The fitting of the machinery of the second-class cruiser "Pique," which was launched from the Palmer's Shipbuilding and Iron Company's yard a few weeks ago, is now nearly completed, and the vessel will be ready for her preliminary trial very shortly. The steel crank-shafts for this vessel, each of which, though of the tubular type, weighs nearly 6 tons, have been supplied by Messrs. Charles Cammel & Co., of Sheffield, through their Newcastle agency, and the same firm have also orders from Messrs. Palmer's Company to supply the crank-shafts for the "Rainbow" and "Retribution." These vessels are also cruisers of the second class, and are being built by the Palmer's Company for the Admiralty. A further important order for shafting has been received by Messrs. Cammell & Co. from the same firm of shipbuilders, and several other good orders from Tyneside firms have recently been secured through the Newcastle agency.

Hydraulic Riveting.—The system of riveting by hydraulic power is being successfully applied to the shell plating of vessels now in course of construction in a Tyneside shipbuilding yard. In this district the application of machine riveting to ship construction has hitherto made little progress; but it would seem that attention is now being more strongly directed to the subject, with the result that the advantages of machine riveting are being appreciated.

Electric Lighting.—Messrs. J. H. Holmes & Co., electric lighting engineers, are extremely busy, having plenty of orders in hand for both land and steamship installations. Messrs. C. A. Parsons & Co. are also well supplied with work, and their establishment at Heaton is likely to be kept briskly employed for some months to come.

Newcastle Association of Students of the Institution of Civil Engineers.—The inaugural meeting of this Association was held on the 25th ult., Mr. P. J. Messent, M.Inst.C.E., being in the chair. The chairman gave a brief account of the formation of the Institution of Civil Engineers, and of the advantages of belonging to it. Mr. P. J. Messent was elected President of the Association of Students. In the name of the Council of the Durham College of Science, Principal Garnett placed a room at the disposal of the Association in which to hold its meetings.

BELFAST, 4th March, 1891.

Shipping.—In spite of the fact that shares in shipping property are not accepted as security by the Irish banks, the tonnage owned in Belfast has been more than doubled within the last five years. The Crown Steamship Company, Limited, has been formed, with Mr. D. C. Kemp as chairman, and Messrs. Wm. Gibson & Co. as managers. The "Crown of England," the company's first steamer, is being built by Messrs. Richardson & Duck, Stockton-on-Tees. Another Belfast ship, the "Ramore Head," which is to carry 6,500 tons, lately launched by Messrs. Workman, Clark, & Co., Limited, is now being fitted with her engines at Glasgow, and the same firm are finishing a large sailing barque for Messrs. W. I. Woodside & Co., of this town.

General Trade.—The linen business is just now rather flat. The supply of home-grown flax is rapidly falling off. The building trade is very active at present, and the price of bricks has increased 25 per cent. Rapid progress is being made with three large public works—namely, the new blue dock for the Harbour Commissioners, the Stoneyford Waterworks, and the Main Drainage Scheme.

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THE MANCHESTER SHIP CANAL.

(*For description see page* 231.)

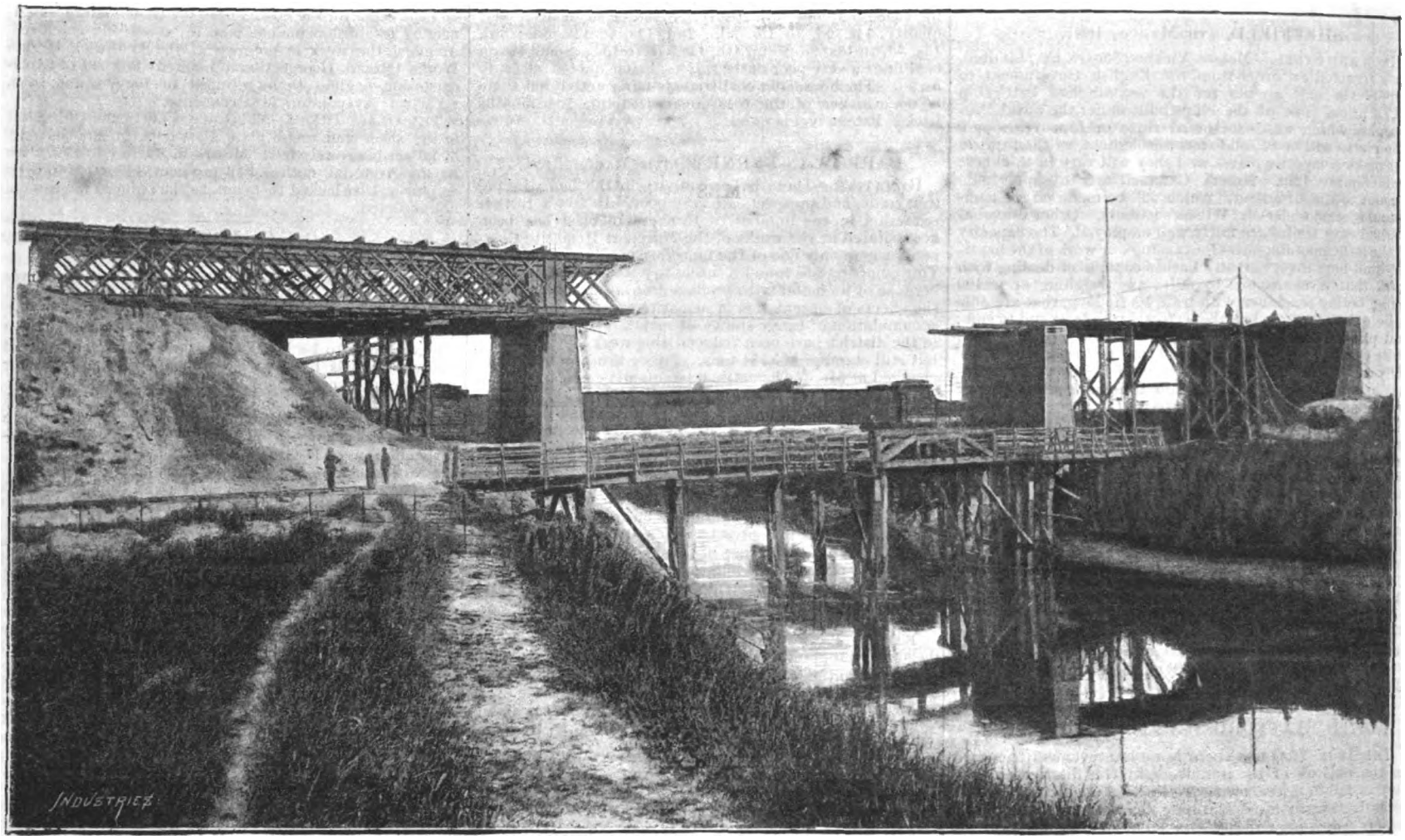


FIG. 3.—DEVIATION RAILWAY NO. 5 (C. L. CO. MANCHESTER AND LIVERPOOL LINE) VIADUCT OVER IRWELL.

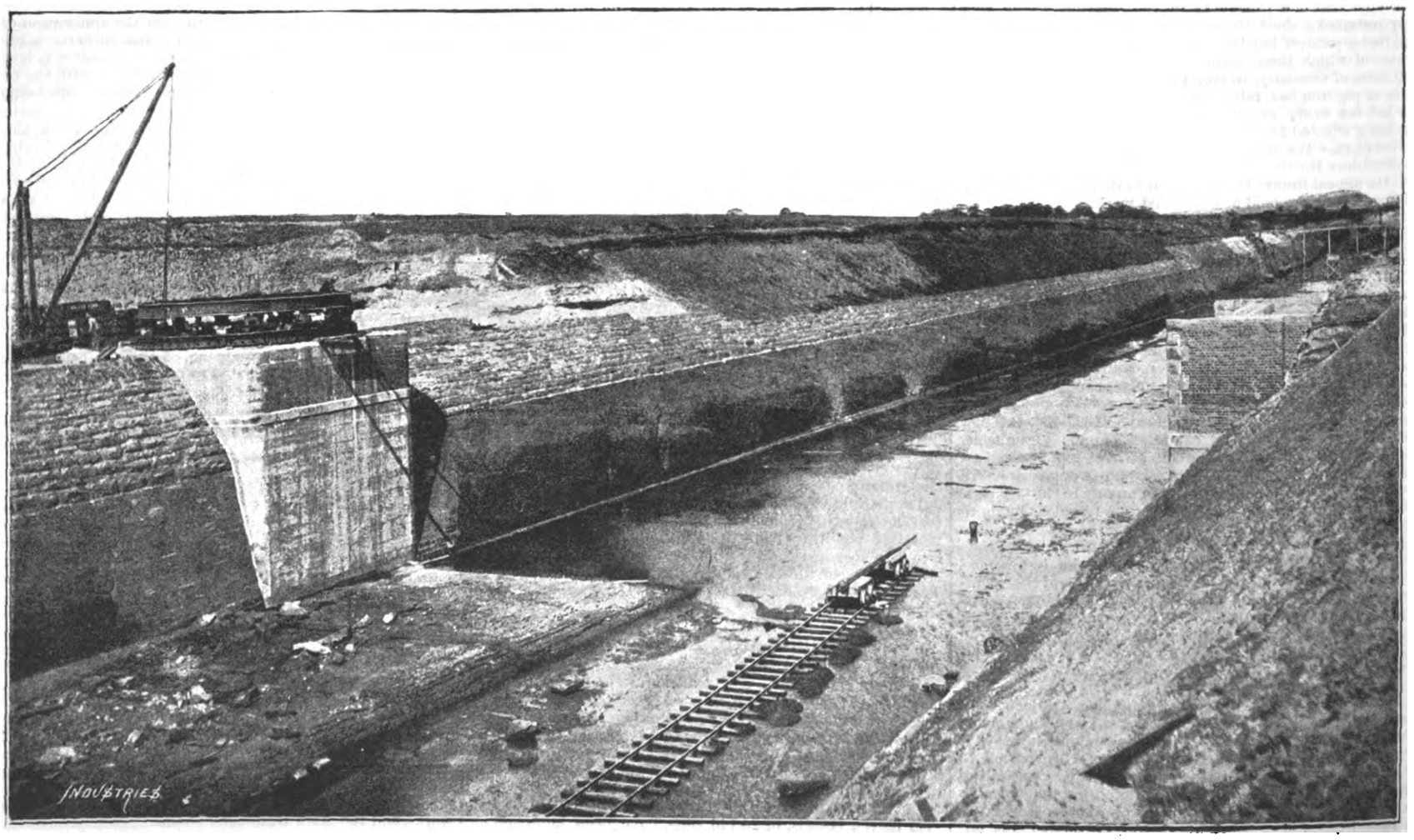


FIG. 4.—MOORE LANE SWING BRIDGE (NORTON SECTION).

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 6TH MARCH, 1891.

SANITARY PROGRESS.

THE influence of modern industry on sanitary conditions is a subject which is attracting increasing attention on the part both of the general public and the legislature. It is well, therefore, to note occasionally the progress which is being made, so that we may compare our present position with the past, and thus be able to form some idea of the direction in which we are moving. The works of such men as Sir John Simon and Dr. Farr, to whom the British public owe so much, enable us to make such an estimate as we suggest, and at the present time, when the whole subject of factory legislation is being discussed, it may be interesting to our readers if we note a few facts in the history of sanitary science. We do not require to go very far back for our starting point, for, although the problems of sanitation are very old, the efforts to solve them in a systematic manner and by the aid of science can only be said to have commenced in 1838. From that date till 1854 there was a considerable amount of activity on the part of the public, but it was carried on under a sense of the magnitude of the evils which all recognised rather than with a clear understanding of the proper remedies to be applied. No doubt a considerable amount of knowledge regarding the causes and prevention of disease had been gathered, but it was applied as the result of the pressure of a new ideal of politics and social duty rather than according to the teachings of science. Even the remedies proposed by the Commissioners whose inquiries led to the passing of the Public Health Act of 1848 and the constitution of the Board of Health were administered with more zeal than discretion. Mr. Edwin Chadwick, who directed the policy of the Board, was so thoroughly in earnest himself that he could understand neither ignorance nor apathy on the part of others, and his zeal practically drove him from office in 1854. From that date until 1866 little was done, but the stagnation was more apparent than real. Public opinion was slowly ripening on the subject, and scientific men were collecting a large number of facts, and ascertaining principles, which led in 1866 to a great outburst of legislative activity on sanitary matters. This caused the appointment of the Royal Sanitary Commission, which reported in 1871, and which has had a great effect both on legislation and administration. The principal Acts were those for constituting the Local Government Board (1871), for amending the powers of local authorities (1872), for dealing with Public Health (1875), Sale of Food and Drugs (1875), Pollution of Rivers (1876), Factories and Workshops (1878), Public Health (Interments) (1879), Alkali, &c., Works Regulation (1881), Artisans' Dwellings Improvement (1875–82); and we now have quite a large number of factory and other Bills all dealing with the subject of the sanitary conditions of our workpeople.

On the downfall of the Board of Health in 1854 little official work in sanitary matters was done for some years. The work of the Board was handed over to a single Minister, assisted by a few medical experts, among whom was Sir John Simon, and in 1858 its functions were divided between the Privy Council and the Home Office. Sir John Simon was transferred to the former, and as Medical Officer to the Privy Council he rendered excellent service, and his investigations had a great effect in shaping the Sanitary Act of 1866. Although that Act was mainly permissive, it was largely taken advantage of by the local authorities. It was only compulsory in so far that it declared it to be the duty of every local authority to provide for the inspection and suppression of nuisances, for adequate water supply, and for drainage. Moreover, it strengthened the hands of the central authority, whose officers were required to report on the shortcomings of the local bodies. The functions of the central authority have now been greatly confirmed and extended, for, although the Local Government Board has small powers of compulsion, it has large powers of sanctioning and advising, which are possibly more effective, and the numerous local bodies which have been created under the Local Government Acts have recently been most active. Indeed, medical officers of health and sanitary inspectors now form what are practically two new professions. At first sight, however, the results of all the efforts which have been made seem disappointing. In 1838 the death-rate in England was 22·4 per thousand, while for the ten years 1871–80 the mean annual death-rate was 21·27, and the difference does not seem great. But averages of this sort must be used with great caution, and detailed statistics are required before the real lessons they teach can be clearly ascertained. One rather remarkable detail is the fact that the fall in the death-rate is unequally divided between the sexes, being less for men than for women. Another detail is that this fall is unequally distributed over the various periods of life, and statistics prove that the probability of a man's reaching the age of seventy is smaller than it was, a fact to be accounted for, we suppose, by the high pressure at which we live. The greater attention which is being paid in towns to sanitary matters is making the death-rate in the towns sink faster than in the country, and the difference between the two is rapidly vanishing. For instance, in 1851–60 the death-rate in towns was 24·7, and in country districts 19·9, while in 1888 the towns stood at 18·4, the country at 16·7. The most important decreases on account of sanitary measures are in the deaths due to zymotic diseases. In the decade 1851–60, out of every million inhabitants 4,122 died from such diseases, while in 1888 there were but 1,840. Consumption has also yielded, to a considerable extent, to sanitary efforts, for we find that in 1851–60 the death-rate from consumption for England and Wales was 2·68; in 1888 it was but 1·55, a result which has, no doubt, been brought about by improved draining and ventilation of houses and factories.

The effects of occupations on health have long engaged the attention of doctors and statisticians. Clergymen and farmers are the two classes which seem to live longest. Taking the average mortality of all males at 1,000, the mortality of the clergy is represented by 556, and of the farmers by 631. High in the scale stand brewers with no less than 1,361, innkeepers with 1,521, and butchers with 1,170. Filemakers stand at the high figure of 1,667, cutlers at 1,309, plumbers at 1,202, earthenware makers at 1,742, printers at 1,071, bookbinders at 1,167, tailors at 1,051, and shoemakers at 921. In the great cotton and woollen industries, to which legislation seems at present to be chiefly directed, the figures are 1,088 and 1,032 respectively. In

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the cotton and linen industries there has been a fall in the death-rate from 10·65 to 9·99 in the first half of the working life of the operatives, and a rise from 27·90 to 29·44 in the latter half, if we compare the returns for 1861–71 with those of 1880–82. In the wool and worsted industries the death-rate has risen in the earlier period of life from 9·35 to 9·71, in the later from 23·26 to 27·50. These figures prove that there is something distinctly wrong in the conditions under which the work is done. In the silk industry, on the other hand, in which dust would be injurious to the material, arrangements are made to avoid it, and the mortality among the workers is low. This fact proves that in the cotton and wool industries a great deal might be done to improve the health of the operatives, and justifies the efforts of those who are urging legislative measures in the matter. It is rather curious to note that coal miners are remarkably free from consumption, and, if it were not for accidents, the average life of coal miners would be fairly good. In the earlier part of their careers the death-rate has fallen from 11·30 to 7·79, and risen in the latter from 22·01 to 24·04. This fact is to be noted in nearly all the chief industries, and seems to prove that improved food and other conditions have given our workpeople greater strength in their early years. Still, there are circumstances which gradually undermine their health, and make their lives, on the whole, shorter than those of the workers of fifty years ago.

THE NAVY ESTIMATES AND OUR NAVAL POLICY.

The statement which has been issued by the Admiralty explanatory of the Navy Estimates and policy for 1890–91, and the subsequent discussion, contain nothing of a very startling nature. Possibly the point which will be most clearly recognised by the long-suffering taxpayer is the fact that there is an increase of the estimates for the year of £428,500. Part of this is not new expenditure, but arises from the transference of duties to the Admiralty from other Departments, the largest item of this nature being £78,000 for naval ordnance stores, which were formerly provided for in the Army Estimates. The account for wages to seamen has been considerably increased, owing to the additional numbers required consisting largely of the mechanic and other highly-paid classes. These additional numbers have, of course, naturally affected the victualling vote, and provision has also to be made in this vote for an increase in the value of stocks of clothing, owing to the introduction of an improved and more costly material for seamen's clothing, recommended by the Committee that has been considering the subject. The amount to be expended in the year 1890–91 on new construction is estimated at £3,146,938 on the Dockyard programme and £3,512,804 on the vessels building by contract, while that for the year 1891-92 is £3,879,119 for the former and £3,547,733 for the latter. An advance in the wages of the workmen employed in Her Majesty's naval establishments at home has been granted, to take effect from the 1st April, and causes an increase of about £78,000 in the several wages votes. Vessels, costing in the aggregate £3,214,294, are expected to be completed and added to the effective strength of the navy during the year ending 31st March.

It is satisfactory to find that good progress has been made with the work being done by contract under the Naval Defence Act during the year 1890-91, notwithstanding various conditions of difficulty arising out of the great activity in mercantile shipping, and the consequent extraordinary demands both for labour and materials. The completion of the five cruisers and the two torpedo gunboats building under the Imperial Defence Act of 1888 has been delayed by the conditions of the market, both as regards labour and material, but the main cause of the delay has been the unusually long period required for the completion of the steam trials of these vessels, and for surmounting the difficulties which have arisen with their boilers. It has now been finally decided by the Board to take over the vessels without insisting upon the completion of maximum forced draught trials embodied in the contracts.

The arrangements which were made for the building of the Australian flotilla have proved completely successful. Having been built under a special Act of Parliament, it was decided that the vessels should be completed in all respects for sea, with the exception of their ammunition and consumable stores, at the works of the contractors, in the hope that delay and cost would thus be avoided in connection with the alterations which not infrequently attend trials of contract-built ships at the Dockyards. The anticipated advantage of this arrangement has been fully realised, and the trials of guns, torpedoes, and propelling machinery have all been carried out and completed before the vessels have been handed over. They will be ready for commission within the financial year 1890–91.

The size of the second-class battle-ships as built will exceed the dimensions of the original estimate. This increase in size has been approved after very full consideration, and arises chiefly from improvements in the armament, sheathing, size of boilers, and other points, which will add not only to their strength, but also to the possible length of their continuous sea service. If these vessels are completed without further demands being made upon them for additional weights to be carried in connection with the armament or equipment, they will be capable of carrying 50 per cent. more coal than was originally intended, and bunker space sufficient to carry this full supply has been provided. The experience gained by the behaviour of the cruisers during the recent naval manœuvres has been taken advantage of, and the original designs of the eight second-class cruisers of the "Apollo" class have been somewhat modified. During the past year a large number of trials have been made with gunboats, but unforeseen difficulties have occurred with the boilers when working at the highest powers intended in the design. These difficulties have been to a large extent overcome, but the maximum power under forced draught originally intended to be developed has not been obtained. The structural strength of the vessels has been severely tested during their long-continued steam trials, and several of them have been launched with machinery and boilers on board. The result has been satisfactory. The question of the modifications to be embodied in the designs for the vessels yet to be ordered is now on the point of being dealt with finally. It is further satisfactory to find that all the ships that were ordered and commenced in the Dockyards before 1889–90 will, with the single exception of the "Blake," be practically completed during this financial year, and this ship will be completed in the year 1891–92. It will yield little pleasure to marine engineers to learn that the steam trials of the past year are mentioned as the least satisfactory part of the work. The difficulties are said to have been overcome, but, as this has been done by reducing the indicated horse-power and the speed of the vessels, the difficulties have been rather shelved than overcome.

The work contemplated by the Naval Defence Act is now sufficiently advanced to enable a forecast to be made both of the date at which it will be completed and of its actual as compared with its estimated cost. The number of ships to be built was 70, of an estimated displacement of 316,000 tons, and carrying 540 guns, exclusive of machine guns and guns of small calibre. The whole of these vessels, with their armament and equipment, were to be completed and ready for commission before the 1st of April, 1894. With the single exception of one contract-built ship, whose progress has been slow, there is every reason to believe that the remaining 69 will, with their armament and reserve guns, be finished before the date named. On the whole, we think that the public have reason to be pleased with the work done during the past year, and also with the proposals for the future.

NEW CUNARD STEAMERS.

We understand that the Cunard Company are about to build two steamers larger and faster than any as yet afloat plying between Liverpool and New York, so that, notwithstanding the progress which has recently been made, the ocean race continues. Many seemed disposed to think that the recent additions to the Inman and the White Star Lines left little to be wished for as regards accommodation and speed, and were content to rest and be thankful with a speed which carried them from Liverpool to New York in a little over six days, but those responsible for shipping arrangements seem to feel that in the matter of speed the proper state should be kinetic not static, and that without advance there is very apt to be retrogression. Little more than thirty years ago, when the Cunard Liner "Scotia," the last of the paddle-steamers on the Atlantic, made the voyage from New York to Queenstown in eight days, the performance was hailed with much satisfaction. Then followed in 1867 the Inman Liner, the first "City of Paris," which beat the "Scotia" as regards speed, and exceeded her in size. She, however, was afterwards beaten by the "City of Brussels" in 1869. In 1870 the "Oceanic," the first of the White Star Liners, gave a further impetus to the race, which was continued by the sister ships, the "Britannic" and the "Germanic." In 1879 a new departure took place when the "Arizona" of the Guion Line in her first voyage easily beat the previous Atlantic record. The Cunard Line at once ordered the "Servia," a steamer of 7,000 tons, and the Inman Line the "City of Rome," which has a tonnage of 8,450. These were speedily followed by the "Alaska," in 1882, which easily beat the best running of both. Then followed the "Umbria" and the "Etruria," in 1885, which soon established themselves as the swiftest steamers on the Atlantic, and they continued to hold their own until 1889, when the "City of Paris," in her second run, excelled them in speed. The "City of New York" and the two new White Star Liners, the "Teutonic" and the "Majestic," are also faster than any of the Cunard Liners. The directors of the latter company have determined to again enter the field, and hope to beat everything that has yet been done both as regards size and speed. The issue will be watched with much interest.

THE MANCHESTER CORPORATION AND THE SHIP CANAL.

The sub-committee appointed by the Manchester Corporation to consider the request of the Manchester Ship Canal Company to assist them in the promotion of their undertaking, have issued their report, and it will be considered at a special meeting of the Council to be held on Monday next. The committee state that they have made thorough and independent inquiry into the position of the undertaking, and have carefully considered reports submitted by their own engineers, and also those of the canal officials. They find that up to December last over £9,000,000 had been spent on the canal, and that £3,900,000 are still needed to complete the work, giving a total expenditure of about £13,000,000. The total resources of the company appeared to be £10,900,000. The committee are of opinion that a sum of £2,500,000 will be sufficient for them to advance, but they are advised that it would be prudent that borrowing powers should be sought by the Corporation for £3,000,000. It is evident, the committee say, that unless most substantial assistance is promptly given the Ship Canal Company by the Corporation of Manchester, or from some other public source, the works must stop. That it cannot raise the necessary funds without such aid appears from the fact that it is unable to get the public to subscribe for £400,000 of debentures, although they are an absolute first charge on the undertaking; and even if the company could, by an energetic appeal, raise this money, there was no time for so doing. At the ordinary rate of working their present funds will not last for more than a few months, and any stoppage of the works will be disastrous, and will probably permanently cripple the usefulness of the undertaking. The difficulties, the committee believe, do not arise from any innate defect in the project, nor do they indicate that the anticipations formed of its success were unfounded. On the contrary, the committee are not aware of any circumstances that have happened since the works were commenced that would give rise to apprehension as to the probable earning power of the canal. In the opinion of the committee the sums advanced by the Corporation must rank as a charge upon the undertaking next after the debentures at present authorised, but in priority to all the shares. The committee believe that the required assistance can be given without any serious risk of throwing any burden upon the ratepayers of Manchester. The assistance should not take the form of a permanent loan of public money or a guarantee of returns, but the Corporation should require the company to issue new debentures on fair terms, which will make them an acceptable security to the public when the canal becomes a productive property; and the Corporation should obtain powers to lend all sums required for the completion of the undertaking, receiving, in return, these debentures at par. The Corporation should sell these debentures at par so soon as the improved credit of the undertaking renders them marketable. The new debentures should be issued at ½ per cent. higher interest than the present ones—namely, 4½ per cent.—and the company should have power to redeem them at par after a short period. They therefore recommend that the Council should render the company the pecuniary assistance requisite to complete the undertaking. Other corporations may join if they desire.

ALUMINIUM AND STEEL.

On the 28th ult. the inaugural lecture under the auspices of the newly-formed Metallurgical Society, in connection with the Sheffield Technical School, was given by Professor Arnold, the subject being "The

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Application of Aluminium to the Manufacture of Steel and Steel Castings." The Society, anxious to make their first gathering a success, issued special invitations to many Sheffield gentlemen connected with steel making.

Professor Arnold said that the recent literature which had been placed before them respecting the effects of aluminium on steel had been so widely discrepant that he decided, for that lecture, to make experiments of his own and lay them before the public. His researches had been made on different lines to those adopted by Mr. Hadfield, for he thought it would be superfluous to again go over the ground so fully covered by that gentleman. The lecturer then, by the aid of numerous illustrations thrown on a screen, proceeded to explain the various effects of aluminium on steel. He first dwelt upon crucible cast steel, secondly explained "blow-holes," and lastly gave illustrations of steel castings, with and without aluminium. He explained the causes, effect, and cure of "blow-holes" and "piping." The lecturer not only attempted to prove that steel made with the use of aluminium was better than that made without, but also that there was a great saving from a monetary point of view.

In conclusion, Professor Arnold said the metallurgist of the future would have to be a different man from that of the past. He knew in saying that he was going against what was said at the Firth College the other evening by Professor Anderson, the Professor of Classics. In his exposition on art proper, Professor Anderson deprecated technical education, and spoke of it as a tendency to develop the baser mechanical arts. He would say that the baser mechanical arts had made this country what she was, and if she was to maintain her position she could only do so by a vigorous development of these baser mechanical arts. In the future, as in the past, they would have to look to these baser mechanical arts to feed and clothe the toiling millions of our vast industrial empire.

The Chairman announced that the discussion on Professor Arnold's paper would take place at the next meeting of members.

Letters to the Editor.

SIBLEY COLLEGE, CORNELL UNIVERSITY.

To the Editor of "Industries."

Sir,—I see in your issue of January 30th, a very pleasant and appreciative notice of Sibley College, Cornell University, and its related schools of technical instruction, in the course of which the remark is made that "it now holds property and investments to the utmost allowed by its charter." This is an error. It was the fact, until recently, that its charter permitted the holding of only $3,000,000 (£600,000 nearly), but that provision of the charter was repealed by the Legislature of the State of New York—which State founded the University—immediately upon the discovery that it was likely to cause the loss of a bequest, which now proves to have a value of about $2,000,000 (£400,000), and which was left it by the late Mrs. Jenny McGraw Fiske. The University has actually met with this great loss; but, the horse being stolen, the stable door has been effectively locked, which gives us the privilege of receiving and holding, hereafter, any number of millions.

I am also happy to say that this institution, pledged to make its "leading object" for ever the promotion of the useful arts, now has above a million of pounds invested, and so well-placed that its trustees receive an average of 6 per cent., and have never lost a fraction of a per cent. of the principal. It expends about $400,000 a year on its legitimate work, and is now teaching 1,400 students, of whom about one-half are engaged in technical and professional studies. It still finds ample use for all available funds, and its opportunities grow with its magnitude, as in all well-managed enterprises. At the rate of growth that has astonished our friends and embarrassed its trustees and faculty during the last half-dozen years, it can find use for ten millions more during the coming decade. It is not at all unlikely that it may receive them, for it has never yet been compelled to delay a good work for lack of funds. Capitalists, seeking this kind of investment, look for places where their funds are safe and likely to give good returns.

Your readers may be interested in learning what kind of an outfit we consider proper in a course of instruction in the higher branches of mechanical engineering and the mechanic arts, such as Sibley College was organised to give. We shall have, at the close of the current, or at the beginning of the coming collegiate year, about $200,000 in equipment. It will include an "experimental steam engine" of about 200 horse-power triple-expansion, with Corliss valves, adjustable in all possible ways to enable us to make investigations of the effects of varying ratios of expansion from 0 to unity, varying steam-pressures from 2 to 15 atmospheres, varying speeds from a minimum to probably 200 revolutions a minute, and all desirable adjustments of steam and exhaust valves for other purposes. The jackets are piped separately; steam and exhaust eccentrics are fitted for operation together or independently; the engines themselves can be worked together or independently, combining a simple set of engines, compound or triple-expansion, as may be desired. A number of other engines—steam, gas, and hot-air—are used in the regular course of laboratory instruction, a collection of dynamometers, steam-boiler injectors, hydraulic apparatus, and a great variety of testing machines, including—standing in a row—one of 50, one of 100, and one of 150 tons capacity, and a number of smaller ones of various types and sizes. With such an outfit, we handle 200 students in the laboratory, having 450 (nearly) in all classes, including graduate students engaged in research

Yours, &c.,
R. H. Thurston, Director.

Ithaca, N.Y., U.S.A., 15th February, 1891.

THE INSTITUTE OF CHEMISTRY.

To the Editor of "Industries."

Sir,—Having been entrusted with the privilege of assisting in the auditing of the accounts of the Institute of Chemistry, I cannot refrain from correcting the false impression that is likely to be caused by the concluding paragraph of the first part of your article on the Institute of Chemistry. From this it would appear that the salaries of the secretary and of his clerk were the sole payments made by the Institute. As a matter of fact, however, the total amount paid for salaries and wages during the year was only £178. Of the chief item of expenditure—examination expenditure—you make no mention. This is decidedly unjust, as the Institute is primarily an examining body, and practical examinations are held at six centres at considerable expense.

In these days of technical education it is surprising to see a journal of such standing as yours advocate the replacement of theoretical training by the almost extinct process of apprenticeship. The slightest acquaintance with the laboratory of an analytical chemist renders evident the unsatisfactory character of the education to be obtained there. Day after day there is the same class of work, and the pupil finally becomes an accomplished analyst of manures, or salt-cake, or stomachs, or whatever may be the substance he has daily examined, without being able to conduct a simple qualitative analysis. Compare this with a well-organised course of instruction as given in the laboratories of our universities and technical schools.

Your proposals for the enhancement of the usefulness of the Institute are, I consider, thoroughly unsatisfactory. With a council composed of residents in London, the Institute of Chemistry of Great Britain and Ireland would acquire a parochial character, and, with the other changes you suggest, you would convert the Institute into a trade union existing with the object of extorting premiums from the confiding parents of aspiring analysts.

Yours, &c.,
Bennett H. Brough.

London, 28th February, 1891.

To the Editor of "Industries."

Sir,—I have read your two articles on the Institute of Chemistry. To borrow a phrase from Carlyle, the articles in question contain some things which are near the mark, others further from the mark, and others altogether far away from any mark. In the first category is the suggestion for converting the profession of chemistry into a close corporation; in the second, the not too exact comparison between an examining and qualifying body like the Institute of Chemistry, and a learned Society such as the Institution of Civil Engineers. The latter society is on all fours—not with the Institute of Chemistry—but with the Chemical Society. Altogether far away from any mark is the strange suggestion that the representative of "scholastic and collegiate chemistry should be welcomed as guests, and, if of sufficient eminence, admitted as honorary members, but should have no voice in the management of its (the Institute of Chemistry's) affairs;" and also the equally strange idea that "there is a considerable number of professional chemists, many of them men of the highest eminence and commanding ability, who have not a shade of a notion of the accuracy, originality, technical knowledge, and executive faculty absolutely essential for a successful consulting chemist, and who would be as incompetent to do his work, or even understand it, as he theirs."

The writer of this article, when he penned the former of these two paragraphs, could hardly have been aware that the Institute mainly owed its foundation to those "scholastic and collegiate" chemists of whom he speaks so disparagingly, or he would possibly have hesitated to suggest so striking an application of the principle of "*Sic vos non vobis.*" Altruism has its limits.

The second paragraph unavoidably suggests the inference that these articles were not written by a chemist—or, at any rate, not by a chemist who views his profession as a science, and recognises the subordinate position which routine work holds, and always must hold, in relation to scientific research. The "scholastic and collegiate" chemists, whose acquirements are here so summarily dismissed, would be found competent to perform the work of a "successful consulting chemist" at a moment's notice, and with the utmost efficiency, whereas the converse of this proposition by no means holds.

You are right in maintaining that the Fellows should have more power, and the Council less; in error, in your desire to substitute an exclusively "practical" (*i.e.*, artisan and rule-of-thumb) training for a comprehensive and scientific one; right, in attacking the monopoly of training possessed by a few rather hastily-chosen collegiate bodies; right, in reminding the Council that it is time to be up and doing; and wrong, in viewing the Institute merely as a hall-marking trade machine, and not as an engine for the education and approbation of the votaries of a noble science.

Yours, &c.,
Bryan Charles Waller, M.D., F.R.C.S., F.I.C.
Masongill House, Cowan Bridge, Kirkby Lonsdale.
26th February 1891.

MR. KAPP'S CANTOR LECTURES.

To the Editor of "Industries."

Sir,—The Secretary of the General Electric Power and Traction Company, Limited, has sent you last week for publication two of the letters which have passed between me and his company, but he omitted to send you copy of a letter which I had previously written to the company, and which I now append. Any of your readers seeing only the two letters selected by the Secretary for publication must naturally come to the conclusion that the immediate cause of my withdrawing certain figures was the Secretary's letter, and that his hint about legal proceedings may have had something to do with it. This was, however, not the case, as your readers may see from the enclosed copy of a letter I wrote to the company a day before I received their letter. To this letter the company made no reply, and also ignored it when sending some of the correspondence to you. I now ask you to publish it in order to dispel the impression that I had to be asked to do that which any fair-minded person would naturally do of his own accord.

As regards the general question of personal responsibility for figures given in a lecture, I would point out that a lecturer is expected to give his own views, and to do this on his own responsibility when the matter under discussion relates to theory or experiment, or any other question which he can test for himself, but that he cannot take this responsibility in matters which he cannot test for himself. All that can be required of him in such cases is that he shall take reasonable precautions to obtain the most reliable information possible, and then give the information, citing his authority. This I have done. Whenever the company or their predecessors invited me to inspect their work, I found Mr. Frazer in chief command, and even last summer, when taking part in the visit of the Electrical Engineers to the Edinburgh Exhibition, I found Mr. Frazer acting as cicerone. It was therefore perfectly natural that I should apply to him for information, and give the figures supplied by him on his authority. It would have been an absurd presumption on my part had I attempted to criticise or alter the figures given me by so high an authority in traction business as Mr. Frazer is, and therefore I put them into my lecture exactly as he gave them. On the other hand, when I discovered that the company repudiate these figures, it would have been equally presumptious to argue the matter with them, and I was therefore equally ready to substitute the company's figures. If the company supply me with their correct figures, I shall insert them on their authority when the lectures are printed; if not, the two tables in dispute must be left out altogether.

Yours, &c.,
Gisbert Kapp.

31, Parliament Street, S.W.,
3rd March, 1891.

[Copy.]

Messrs. The Electric Traction and Power Company, Limited,
Maldon Crescent, Prince of Wales Road, Kentish Town.

Dear Sirs,—I was surprised to hear last night from Mr. Snell that he considers the figures I gave in my Cantor lecture with reference to the Barking Road tramway incorrect. When towards the end of last year I applied to Mr. Frazer for information about the working of battery cars, I was under the impression that this gentleman was the member of your company who had the entire control of your traction work, and I therefore took the figures which he gave me as authentic and correct. If, however, as Mr. Snell asserted last night, the figures are not correct, it appears desirable that the necessary corrections should be made in the tables I gave at the Society of Arts lecture; and I shall do this if you will kindly supply me with the exact figures.

Yours faithfully,
Gisbert Kapp.

Erba, Wimbledon, February 20, 1891.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—As Mr. Lovett refers to my letter which you were good enough to publish in a recent number of *Industries*, you will, I trust, allow me a few lines for reply.

Mr. Lovett says that such gas stoves as he has tried lack radiating power, and considers that the vice to which they are most prone is a tendency to discharge their products of combustion into the air unless these products be allowed to escape at so high a temperature that much waste results. I freely admit that many gas stoves possess these defects, but that all do is, I think, scarcely to be asserted. Taking the accusations against them, we have, first, their supposed want of radiating power. This, I believe, is largely caused by the selection of a refractory substance unsuitable for its office. Considerable search has been necessary to find a "best" material. The monstrosities in platinum wire, asbestos, and the like are still fresh in our memories, and their delinquencies have condemned their more worthy fellows. Nowadays better things are to be had. Asbestos rightly disposed, iron frets, and, lately, perforated fireclay balls, have displaced them for good. Those who have been scorched by the little gas fire that serves to warm my balance room would, I am sure, testify—were it necessary—to the improvement there has lately been in such matters.

Next, as to the discharge of the products of combustion into the room warmed by the stove. It occurs sometimes on lighting the fire, because the flue is cold, but provided this be really efficient, the trouble will disappear as it gets warm. The same condition—viz., the efficiency of the flue, determines whether the burnt gases shall escape at a temperature unnecessarily high. Secure a good flue, and either let a portion of it be in the room to be warmed, or use instead a gas fire, the body of which, as well as the actual grate, serves as a source of heat, and there will be little cause for complaint. Too great economy of gas, resulting in robbing the products of combustion of all their available heat, will bring its own punishment in the shape of a sluggish draught.

Stoves that embody these points are, no doubt, made by several firms, but the one of whose goods I happen to have most experience is that of T. Fletcher & Co., and Mr. Lovett could doubtless obtain specific information from them. One more word, sir, and I have done. There has been still no proposition made as to the means by which the scheme is to be financed. I trust Mr. Thwaite or some other correspondent will give us the benefit of his views on this part of the subject.

Yours, &c.,
B. B.

London, 2nd March, 1891.

THE MANCHESTER SHIP CANAL.

II.

In continuation of our description of this interesting work, we publish on page 228 a view of the Moore Lane swing bridge and of the viaduct over the River Irwell in Deviation Railway No. 5.

Fig. 3 shows the viaduct over the River Irwell, carrying the deviation line No. 5 to take the traffic of the Cheshire Lines Committee between Liverpool and Man-

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chester, at a point between Flixton and Glazebrook. It carries four lines of way, and is constructed of brick arches, with blue brick face and Bramley Fall stone quoins and voussoirs. The girders of the bridge crossing the canal are of steel, and of the ordinary lattice girder type, the flooring consisting of cross girders and longitudinal rail bearers.

The Moore Lane swing bridge, shown in Fig. 4, crosses the canal at a point a few miles below Warrington, and may be taken as typical of several other bridges along the route. The superstructure is now very near completion, but the illustration shows the work as it appeared last June, with little more than the roller path attached. The bridge is 238ft. long, divided in two arms of 140ft. and 98ft. long respectively, the longer arm spanning the canal, and the shorter or tail end spans the slope of the bank. The width of the bridge is 25ft. between the main girders, giving a roadway between the kerbs of 19ft. 6in., with a single footpath 5ft. wide. The girders are 27ft. 8in. deep at the centre over the angle irons, the depth of the short end being 8ft. 9in., and the long end 6ft. The booms are 2ft. 3in. wide, of the ordinary trough shape, the verticals being 24in. by $\frac{1}{2}$in. thick, and the angles 6in. by 6in. by $\frac{5}{8}$in. The whole weight of the structure is about 580 tons, and in addition to this is the kentledge, in the shorter arm weighing 120 tons. With the exception of the floor-plates the structure is of steel throughout. The booms are stiffened at the centre of the bridge to maintain the extra stress when swinging; the plates consisting of two $\frac{1}{2}$in. plates and one $\frac{9}{16}$in. plate, the latter running the whole length of the girder. The vertical plates are increased to 3ft. deep, connected at the top with an inch plate by means of angle irons, 6in. by 6in. by $\frac{5}{8}$in. The ends of the girders are closed by means of $\frac{7}{16}$in. plates. The cross girders are spaced 14ft. apart, and are 2ft. 9in. deep in the centre over the angles, and are attached to the vertical struts of the main girders by angles 8$\frac{1}{2}$in. by 4in. by $\frac{1}{2}$in. Six longitudinal road beams are fixed to the webs of the cross girders, and these in their turn receive angles, and the whole is then plated with buckle plates $\frac{3}{8}$in. thick. The plates are covered with asphalte $\frac{3}{4}$in. thick, then an inch layer of sand, on which are placed the 5in. wood sets to form the roadway. The shorter arm, which contains the kentledge, consists of an iron box girder and three kentledge girders, 3ft. deep above the angles, securely fixed to the main girders. Under the centre of the main girders are fixed four heavy web girders, 3ft. 6in. deep at the centre and 2ft. at the ends, each having three webs, stiffened by plates and angles. The kentledge forms the paving at the shorter end, no wood sets being necessary. A circular girder, 2ft. 11$\frac{1}{2}$in. wide, is fixed under the centre bearing girders, 2ft. deep, and with two webs. This girder carries the cast-iron upper roller path, which has four arms fixed to the bridge centre by means of a cast-iron collar. The bridge turns on live rollers 2ft. 5$\frac{1}{2}$in. long and 15in. diameter at the centre, the pressure per lineal inch on the rollers being calculated at 800lb. The lower roller path is attached to the granite stones of the pier. The pier consists of Portland cement concrete foundation, in the proportion of 8 to 1 inside and 4 to 1 on the face, up to water level; above this level the inside is of brick, with blue brick face, a granite fender course, 18in. deep, being fixed between the concrete and the brickwork. The bridge is actuated by means of three-throw hydraulic pumps, made by Sir W. G. Armstrong & Co. The bridge can also be turned by hand if necessary.

THE INSTITUTION OF CIVIL ENGINEERS.

At a meeting of this Institution on the 3rd inst., the President, Sir John Coode, K.C.M.G., being in the chair, a paper was read "On the Subterranean Water in the Chalk Formation of the Upper Thames, and its Relation to the Supply of London," by Mr. J. Thornhill Harrison, M.Inst.C.E.

The author stated that the question of the supply of water to London from the chalk formation had on several occasions been discussed at the Institution, and that at least two schemes with this object in view had been unsuccessfully promoted in Parliament, the cause of failure in each case being identical—namely, the fear that the volume of the water in the rivers, deriving much of their supply from the chalk, would be largely diminished, to the serious injury of persons interested in such streams. By reference to the Report of the Royal Commission on Water Supply, 1866, and to the opinion of Dr. Evans, the author showed how strong were the fears of this character entertained by persons who had studied the subject, and stated that unless apprehensions of this nature were shown to be groundless, and unless he was prepared to give convincing proofs that no such injuries would be caused to rivers by the proposed abstraction of water from the chalk, it would be useless to bring forward the present paper. The author's intention was, therefore, to show not only that the Upper Thames chalk basin could afford the requisite water supply in abundant quantities, but also that the necessary volume might be safely withdrawn without detriment to the Thames or to any of its tributaries.

Before dealing with the question of quantity, the experiments of the late Professor Ansted were cited, and the distinction made by him between the upper or flint-bearing chalk, and the darker coloured lower chalk, or clunch, was explained. These latter beds, which were capable of holding much more water than the upper chalk, surrounded the valley of the Thames, and formed, by upheaval, the lofty ridges encircling the Thames basin. One square mile of dry upper chalk 1 yard thick contained nearly 3,500,000 gallons of water, and, when saturated, it held 200,000,000 gallons; while the same area and depth of lower chalk, when dry, held 12,000,000 gallons, and, when saturated, 180,000,000 gallons of water. The water in the chalk was probably conveyed to the point of issue by means of fissures, and these fissures, no doubt, accounted for the convection of the chalk water from the neighbourhood of Devizes to the Thames, between Wallingford and Streatley, a distance of 40 miles. Dealing with the relative proportions of the rainfall which sank into the chalk and the amount evaporated from the surface or absorbed by vegetation, the observations of Messrs. Lawes and Gilbert, of Mr. Greaves, and of Messrs. Dickinson and Evans were discussed, and it was pointed out that while Mr. Dickinson had found that out of a rainfall of 27·843in., 10·65in. passed through 3ft. of chalk, Sir J. B. Lawes and Dr. Gilbert had observed that out of a mean rainfall of 31·451in., during the years 1871 to 1880, 14·04in. passed through 20in. of soil and 13·241in. through 60in. In order to practically test these results, a series of actual measurements of the rainfall and of the discharge from a large area of the chalk would be advisable. In the absence of such statistics, in order to form an approximate estimate, the Wandle basin, with a drainage area of about 56 square miles, was selected. From observations by Mr. Braithwaite on the flow of the Wandle, the mean volume discharged from the above area was stated by the author to amount to 30,000,000 gallons per diem, which was equal to 13$\frac{1}{2}$in. of rain falling annually on 56 square miles. This depth was fairly in accord with the previous computations, but it was exceeded by the estimate formed by the late Professor Ansted, who considered that at least 18in. out of a mean annual rainfall of 26in. in the East of England were received into the mass of the rock. Proceeding to apply these data to the chalk basin westward of London, the daily discharges from the principal rivers were first calculated; these were assumed to be:—

From the Thames, Kennet, and Wye	150,000,000 gallons.
From the Colne and Lea.....	100,000,000 „
Total	250,000,000 „

These rivers discharged the surplus water from an area of about 1,200 square miles, and the above volume represented an annual rainfall of about 5in. There remained then, on the basis of Mr. Dickinson's experiments, about 5$\frac{1}{2}$in. still to be accounted for, or according to Messrs. Lawes and Gilbert's experiments, and the estimate based upon the flow of the Wandle, about 8in. of the rainfall which was not discharged by the ordinary channels, and the question presented itself, What became of this water? Mr. Homersham had suggested that large volumes of chalk-water, which he deemed equivalent to a daily supply of 408,000,000 gallons, at present escaped into the sea, but the author affirmed that in consequence of the existence of the great fault across the London basin, south of the Thames, this egress to the sea was barred. From a geological consideration of the London basin, he concluded that the only escape for this water seawards was over the surface of the London clay at Datchet, near Windsor, where that clay was at an elevation of about 47ft. above ordnance datum, being there covered with a bed of gravel 12ft. in thickness and 1 mile in width, the clay stratum constituting a species of weir. This gravel bed was stated to be in the nature of a great reservoir; it extended from Datchet westward to Maidenhead, overlying the lower tertiary beds and the chalk, and attained in places a thickness of 30ft. The water in this bed did not depend for its supply on the Thames, but, on the contrary, it added to the volume of the river as it passed by. The amount of water it contributed to the Thames was shown, by gaugings, to vary from 137,000,000 gallons per diem to 17,000,000 gallons, and these fluctuations were probably due, as was pointed out, to the regulation of the water level in the river by the weirs. After entering this vast gravel bed, with an area of some 40 square miles over the unalterable weir at Datchet, the water from the chalk, according to the author, found its way, by hidden springs, into the Thames between Maidenhead and Thames Ditton, causing an increase in the volume of the river, which varied according to gaugings taken at different dates, from 249,500,000 gallons per diem in April, 1884, to 45,000,000 gallons daily in November, 1890.

Attention was next directed to a second gravel bed, lying to the north of the London clay barrier between Slough and Kingston, which covered an area of about 50 square miles between Burnham on the west and the eastern part of London. This bed also formed an extensive reservoir and an underground river, by which a large volume of water was carried to the Thames. This gravel was crossed by the river nearly at right angles between Kingston and Brentford, where it was for the greater part of the distance an open tidal stream without locks, and the water could thus pass from the gravel into the river at all times, except when the tide was up. Between Teddington and Kew the volume of the Thames was largely increased; the increment amounted to little short of 440,000,000 gallons daily in a dry season, and the author argued that from this source alone a daily volume of 100,000,000 gallons might safely be withdrawn for the supply of London and its suburbs for centuries to come, without interfering in any way with the volume of water which was collected and carried by the Thames between Maidenhead and Teddington. If this supply were adopted the present daily withdrawal of 100,000,000 gallons from the Thames at Hampton might be discontinued. By observation of the level of springs in the chalk about Marlborough it was shown that at Christmas, 1890, the level of the water in the chalk-downs was upwards of 400ft. above the outlet over the London clay at Datchet. The author estimated the area of the collecting ground for the Windsor reservoir at 630 square miles, and that of the Slough reservoir at 570 square miles. Various methods were pointed out for intercepting these underground waters before they passed into the river. The ultimate choice of the Slough or the Windsor gravel beds for the source of the London supply would depend upon which of the two proved to be better in quality. If the water from the Windsor reservoir were to be preferred, the author stated that a scheme suggested by him in 1884 for its collection and carriage to London might be adopted with certain modifications. In this case the water abstracted at or near Dorney would have to be replaced by an equal quantity taken from the Slough reservoir and discharged into the Thames above Windsor.

Three schemes were propounded by the author for the interception of the water forming the underground river in the Slough gravel; of these he stated that the cheapest would be the construction of a culvert in the nature of a dam in a northerly direction from Hampton to Cranford. To this culvert the water would be admitted under control, but the surplus water would be allowed to flow over it at a lower level than that at which it at present stood in the gravel. The other methods were also in the nature of collecting culverts, passing either from Salt Hill to Farnham Royal or from Uxbridge to Langley Marsh.

Books Received.

A Souvenir of the Visit of the Iron and Steel Institutes of Great Britain and Germany to America: Sketches and Incidents of Journey. By A. Morieu. Cardiff: Daniel Owen & Co., Ltd.

Electric Transmission of Energy, and its Transformation, Subdivision, and Distribution: A Practical Handbook. By G. Kapp, C.E. Third Edition, Revised. London: Whittaker & Co.

The History and Development of Steam Locomotion on Common Roads. By Wm. Fletcher, M.E. London: E. & F. N. Spon.

Reviews.

Practical Notes for Electrical Students. By A. E. Kennelly and H. D. Wilkinson. "The Electrician" Printing and Publishing Company. 1890.

This book, as is stated in the preface, consists mainly of a reprint of a series of articles which appeared in the *Electrician* under the title of "Letters for Learners and Unprofessional Readers." The object of the authors has been to produce a simple practical treatise, requiring no greater mathematical acquirements on the part of the reader than a knowledge of simple equations and of the simple trigonometrical functions. The authors are to be congratulated upon the manner in which they have carried out their programme, and their work will be of value to many who are engaged in the electrical industries, and are precluded, either from want of time or from the lack of a mathematical education, from seriously attacking the theory of the subject. One very valuable

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feature of the book consists in the frequency with which numerical illustrations of a really practical character are introduced. Bearing in mind the class of readers whom they are addressing, the authors avoid as far as possible the use of mathematical symbols, replacing them by actual numbers taken from some practical example. Another good feature is that the illustrations are thoroughly up to date, and are not mere reproductions of antiquated forms of apparatus.

After a few introductory remarks, an excellent summary is given of the requirements of a good primary battery, and this is followed in Chapter II. by a critical discussion of the chief primary batteries in common use. The statement made in this chapter that the e.m.f. of a Clarke standard cell at 66° Fahr. is 1·45 volts is not correct, except with the qualification that the volts are B. A. volts. The value in true volts is 1·35. Chapter III., on E.M.F. and Potentials, is rather brief, but the graphical treatment of the subject makes it exceedingly clear as far as it goes. The next two chapters deal with resistance and current respectively, and these are followed by three chapters on current indicators, their use and calibration. These chapters are full of useful hints and practical details, and students of much wider acquirements than those for whom the book is primarily intended may derive considerable benefit from their study.

Considerably more than half of the present volume is occupied by the concluding chapter—on Magnetic Fields and their Measurement. In this chapter graphical methods are again very freely employed, with great advantage. The lines of force in various simple cases are illustrated by means of iron filing diagrams. The comparison of the intensities of magnetic fields and of the strengths of poles of magnets are then considered, and the construction and use of a simple form of magnetometer are explained in detail. A very good summary, both of Hughes' and of Ewing's investigations, are given in this chapter.

THE "SHIPPING WORLD" YEAR BOOK. Edited by Evan Rowland Jones, United States Consul. 1891. London: Office of the *Shipping World*.

The fifth issue of the *Shipping World* Year Book is every whit as valuable as its predecessors. The "Port Directory," carefully brought down to date, alone renders it an almost invaluable companion to the master of any ship, but especially of the ocean-going "tramp," as well as to the shipowner. The section devoted to tariffs of all nations is perhaps fuller and more reliable than any similar annual list. Its use to exporters is very obvious; they may obtain from it, in a few minutes, information which extensive correspondence might be necessary to elicit from a number of consuls. The digest of the Shipping Acts, the condensed report of the Load Line Committee with the tables of freeboard, and many other tables—useful alike to shipowner and ship captain—show that the publication is maintaining the high standard set in the issues of past years.

THE MARINE ENGINEER'S ANNUAL AND ALMANAC FOR THE YEAR 1891. Liverpool, Glasgow, and Greenock: D. McGREGOR & Co.

This annual is really an excellent shillingworth. It is packed with matter well brought up to date and extremely useful to the practical seagoing engineer. It contains the regulations relating to the examination of engineers, the Board of Trade rules, and a great quantity of official and scientific information. Several of the most valuable papers read during the year to the professional societies are given in full abstract, and notices are given of the chief novelties in marine engineering and of large new steamers launched during the past year.

THE CALCULATION OF THE E.M.F. OF SIMPLE VOLTAIC CELLS.

By DR. OLIVER LODGE, F.R.S.

I HAVE been often asked by the Editor to write concerning the calculation of the electromotive force of voltaic cells from thermo-chemical data.

It is pretty well known now that the power, or activity, or rate of expenditure of energy, of an electric current is EC.—in other words, is equal to the current multiplied by the e.m.f. which drives it; also that the chemical action going on in a cell per second is proportional simply to the current flowing through it; while the energy of that same chemical action can be, and in many cases has been, measured by determining the heat evolved when the process is conducted in a suitable calorimeter. Given these facts, it follows at once, what was pointed out by Sir W. Thomson in 1851, that the e.m.f. of a cell is a calculable quantity. It is, indeed, simply the number of gramme-degree heat-units produced by the actual chemical action occurring among a gramme-equivalent of the materials, divided by 48,000. This expresses it in volts direct.

But then, as Sir William did not forget to point out, this is the resultant and actual e.m.f. of the cell only in case there are no other sources of energy available to it beside the chemical action. It is the e.m.f. of the cell in so far as that is due to chemical action. It does not, for instance, give us the e.m.f. of a dynamo or of a thermopile. Neither does it give us the entire e.m.f. of anything which partially behaves as a dynamo or a thermopile. If the cell draws upon chemical action alone for its energy, then its voltage is as stated—viz., the thermal value, per dyad-gramme-equivalent, of its total chemical action, divided by the number 48,000. But if it draws also upon motion across magnetic fields, which is unlikely, or upon unequal distribution of heat, for its energy (positive or negative), then, of course, there is an additional e.m.f. to be taken into account, and the resultant voltage of the cell will be the algebraic sum of the components.

Now, wherever there are junctions we are liable to find these extra electromotive forces, not due to any chemical action occurring there, but deriving the necessary energy from heat only; so that some junctions may cool themselves, utilising their heat energy in propelling the current, while others may heat themselves, opposing the current with a corresponding e.m.f. In a galvanic cell are many such junctions, some metallic, on which it is comparatively easy to make experiments, with the result of finding that they are almost inert; others liquid or liquid-metal, on which precise quantitative experiment is extremely difficult. Whether these are also approximately inert, or whether they are, as thermopile junctions, very active, may however be judged by some simple observations, such as the following. Interpose a metal diaphragm in any given liquid after the manner of a porous cell, and pass a current through it. Insert thermometers, one near each face of the metal, and observe their indications. One face (or junction between liquid and metal) will often be found to get hotter, the other, perhaps, to get cooler—precisely what happens when a current is sent through a thermopile; proving the existence of a helping e.m.f. at the cooling junction, an opposing e.m.f. at the heating junction. As an example, the well-known case of zinc or tin may be quoted (Faraday, Exp. Res. 1027, 1028), where the heat appears, not on the side where the metal is being dissolved away, but on the other side, where hydrogen is being liberated, and where one would have thought that, since chemical combination is being here undone, absorption of heat ought to result. It is just because chemical and thermal effects are thus mixed together at metal-liquid junctions, that it is so difficult to disentangle them experimentally, though Bouty has made an energetic attempt to do so.

To be able to predict the behaviour of any given cell, and to calculate its e.m.f. completely, it is not indeed necessary to know what is going on at every separate junction; it is sufficient to take them all together, and to ascertain what the total evolution or disappearance of heat is at the whole lot of junctions together during the passage of a unit current for a unit time. In other words, we must measure, if we can, the heat reversibly evolved or absorbed by the cell during the passage of a unit quantity of electricity through it. That is, we must determine $\frac{dH}{dQ}$, the ratio of the heat evolved to the quantity of electricity conveyed.

This we may suppose likely to be done by stirring the cell and determining its temperature before and after a given production of current for a known time. Only then we should get mixed up the irreversible or frictional generation of heat, as well as the still more disturbing energies of chemical reactions. But fortunately Helmholtz has pointed out that in all reversible heat effects the second law of thermodynamics may be called to our aid, and a cell which behaves in this thermal manner may be treated like a heat engine.

For, just as the main theory of ordinary mechanical heat engines is contained in the statement that the work done in an infinitesimal cycle is

$$dp\,dv = J \cdot \frac{dT}{T} \cdot dH,$$

where $\frac{dT}{T}$ is the efficiency of the engine and dH is the heat carried from the source during the expansion dv, and where dp is the change of pressure appropriate to the change of temperature dT in the working substance; so also with an electrical heat engine, the work done in a cycle by it is

$$dE\,dQ = J\frac{dT}{T} \cdot dH,$$

where dH is the heat conveyed from the source during the passage of a quantity of electricity dQ, and where dE is the change of e.m.f. appropriate to the change of temperature dT. Thus, then, in order to determine $\frac{dH}{dQ}$ which we saw was the quantity needed to be known before e.m.f. can be predicted, it is sufficient to make obervations on $\frac{dE}{dT}$, the rate of change of e.m.f. with temperature. For, from the above equation,

$$\frac{dH}{dQ} = \frac{T}{J} \cdot \frac{dE}{dT},$$

T being, of course, absolute temperature, and J the mechanical equivalent of heat.

Now, whether the e.m.f. of a cell increases or decreases with temperature is a thing very easily observed, and its rate of change is easily measurable. A Daniell scarcely changes at all. Its e.m.f. is nearly constant at all temperatures. For, though the difference of potential at one of its junctions increases with temperature, that of the other decreases almost as much, and there is nearly a balance; as was shown, I think, by Clifton, or by Ayrton and Perry.

But with Clark cells, or with Leclanché, this is by no means the case; the e.m.f. varies with temperature very appreciably (decreasing as the temperature rises in the case of Clark's), and accordingly a thermometer is inserted in all Clark's cells intended to be used as standards of e.m.f.

Cells, then, which have a positive or negative value for $\frac{dE}{dt}$ will have a corresponding value for $\frac{dH}{dQ}$; in other words, they will cool or heat themselves when they produce a current. They act in a manner like thermopiles as well as like chemical cells, and derive their energy from heat as well as from chemical action. To the value of their chemical e.m.f., as already calculated, another term, the thermal e.m.f., has to be added or subtracted—viz., the thermal energy consumed during the passage of a unit quantity of electricity, that is $J\frac{dH}{dQ}$. This quantity $\frac{dH}{dQ}$ is sometimes written $\Sigma(\Pi)$, meaning the algebraic sum of all the Peltier effects occurring in the cell, and its value as opposition e.m.f. is simply

$$T\frac{dE}{dT},$$

the units being the same as those in which the change of e.m.f. dE is expressed. Naturally, they will be volts.

So the whole expression for the calculated voltage of any galvanic cell whose e.m.f. varies with temperature is, at any temperature t° C., writing θ'' for the thermal value of its chemical action expressed in water-gramme degrees per dyad-gramme equivalent—*i.e.*, per 16 grammes of oxygen, 65 grammes of zinc, 2 grammes of hydrogen, 216 grammes of silver, &c.—

$$E = \frac{\theta''}{48000} - (274 + t)\frac{dE}{dt}.$$

The difficulty often felt about the e.m.f. of simple voltaic cells, when considered from the purely chemical point of view, now disappears. Consider some single fluid cells, with the elements respectively, say, zinc and platinum, zinc and copper, zinc and tin, or even zinc and zinc. In each case zinc is dissolved at one side and hydrogen evolved on the other. There is no difference whatever in the chemical reactions; therefore, on merely chemical grounds, it might be supposed that the e.m.f. of each—*i.e.*, the energy imparted by each to the current—was the same. But of course, in fact, they are entirely different, varying from well over a volt to zero. The reason is plain. At the surface where zinc is being dissolved very little heat effect occurs; it is at the other plate (that against which hydrogen is liberated) that the main thermal action is to be looked for. At the platinum surface, while clean, there is not much heat evolved; hence there is a minimum of obstruction here, and a maximum of resultant e.m.f. altogether. At a copper surface there is more heat, at a tin more still, and at a cathode zinc surface there is most. Hence in these cases the cell heats itself during the passage of a current in the natural direction (cooling itself if a current were driven the other way, as through a charging storage battery), and the energy of this reversible heat is obtained at the expense of the current-propelling force. The resultant e.m.f. of the cell is therefore the less as the reversible heat evolution is more. Moreover, as has been shown, the e.m.f. of such cells will decrease with temperature, and the rate of decrease affords the easiest *experimental* method of determining how much of the e.m.f. is chemical and how much is thermal.

The question is often raised as to whether all the chemical actions occurring in a cell are available for

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propelling the current, or whether a distinction must be drawn between "adjuvant" actions, such, for instance, as the combination of zinc with oxygen, and "non-adjuvant," such as perhaps the solution of zinc oxide in acid.

All such questions can in general terms be answered thus:—Whatever be the chemical action that occurs, it must either liberate some energy or not. If it does liberate energy, this energy has to be accounted for. Either it takes the form of heat on the spot or it does not. If it does not, it must help to propel the current; it must, in fact, be transferred to the current, which accordingly gains energy at the rate EC. If, on the other hand, it does result in heat on the spot, then of course it cannot at the same time propel the current. It can only alter the distribution of temperature of the cell and act in a thermal manner, like the evolution of heat in a thermopile would act, behaving differently according to the locality in which it is liberated.

Attention must, however, be paid to the words "on the spot"—*i.e.*, the spot where the specified chemical action occurs. Now the main chemical action undoubtedly occurs at the surface of the dissolving zinc plate, and whatever heat is *there* produced is not available for propelling the current; but, so far as I know, there is no experimental ground for asserting the appearance or disappearance of any notable quantity of heat at this precise place. If that be so, then *all* the chemical action goes to propel the current.

If heat appears somewhere else, that means that the current is being there opposed, but it does not mean that it has not at one place received the full propulsion due to the complete chemical reaction. If cold appears somewhere else, then that means that the current is being there assisted by an extra or thermal force; and there are cells which cool themselves bodily during the passage of a current. Such an action at first sight appears paradoxical, and contrary to the second fundamental principle of thermodynamics; but it is to be remembered that the action does not go on "automatically" or "unaided." The main propulsion is accomplished elsewhere, at the expense of a quantity of chemical energy, and whether some heat energy is able to assist or to oppose the main force is a mere accident of sign, depending on the direction of the current. It is as when, a submarine tunnel having, by great expenditure of other energy, been made, water is enabled to do work by falling below the sea level, contrary to its usual habits.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At a meeting of this Institution, held on the 26th ult., Mr. Swinburne's paper on "Transformer Distribution" was discussed. An abstract of this paper is concluded on page 224 of our present issue.

Mr. Esson said the discussion on Mr. Mordey's paper left things in a very unsatisfactory state, for no figures were given by which the offered explanation of the experiments could be confirmed or confuted, and at the close of the discussion the author himself admitted that some self-induction was necessary for successful parallel working. Speaking of Mr. Swinburne's armature-reaction theory, he said Dr. Hopkinson included armature reactions in his term "self-induction," and remarked that it would be difficult to deal with self-induction as exhibited by alternators without including these reactions. On the subject of transformers he remarked that the true efficiency was the ratio of the useful energy supplied by the secondary during lighting hours to that put into the primary in the twenty-hour hours, and that upon this ratio the efficiency of the system mainly depends. Coming to the examination of Mr. Swinburne's figures for the efficiency of the closed circuit type, he found this efficiency rather understated. He thought all would agree that it is of great importance to make the "all-day efficiency" as high as possible, but he doubted whether Mr. Swinburne took the best way of doing this.

Mr. Mordey said he did not propose to touch upon the first part of the paper, and would confine himself to one definite subject. On alternators he did not at present wish to add anything to the practical contribution that two years ago he had given to the study of the subject. On many of the minor points of distribution he agreed with Mr. Swinburne's conclusions. From its present interest he thought the design of transformers was the most important subject dealt with in the paper, and to that he would confine himself. The author had arrived at his present conclusions by a zigzag path, as was seen by a reference to the Journal for 1888, in which appeared Mr. Swinburne's remarks in the discussion of a paper by Professor Forbes. He (Mr. Mordey) would first sum up the author's present grounds for preferring open circuit transformers. They were—(1) That iron is wasteful, hysteresis loss heavy and continuous; (2) that losses are easily ascertainable by calculation only, from C^2R in the conductor, by Ewing's or Hopkinson's curves for hysteresis (which he stated is constant for all loads), and by calculation of the eddies; (3) that these phenomena in iron and the action of transformers being understood fully only "phenomenal iron" can improve closed circuit transformers; (4) that tests of closed circuit transformers by various observers showing high efficiency are wrong; (5) that magnetising current was large even in the closed circuit type.

On the question of these losses, Mr. Mordey said that careful tests were needed to decide the points, not calculations. Many independent observations on closed circuit transformers by various methods—such as the calorimeter method, used by Professor Ayrton and others; the "split dynamometer" method, devised by Mr. Blakesley, &c.—had shown the efficiency to be very high. The method he had himself devised and alluded to in 1889—viz., finding the steady temperature to which the transformer is raised when working at a known output, and then determining the loss by supplying, with direct currents, sufficient power to maintain this temperature—led to similar results. Recent tests of a 6 kilowatt transformer of his own design by the latter method gave the loss on open circuit as 110 watts, and at full load 205 watts, of which 176 are accounted for by C^2R in the copper. This leaves only 29 watts for the iron losses at full load, whereas at no load they amounted to 110. On calculating the theoretical iron loss from Ewing's curves, it came out 180 watts at the magnetisation employed. These results show that as the loss in the copper increases the iron losses diminish, and that conclusions based on the assumption that the iron losses are constant and can be calculated from Ewing's curves are erroneous. On the basis of the above tests, the efficiencies at various loads of the particular transformer were calculated to be as follows, the first and last being determined by experiment, the intermediate filled in by calculation:—

Load.	Efficiency.
Full	96·7
¾	96·2 approx.
½	92·1 „
⅛	86·7 „

At no load the total loss was 1·8 per cent. of the full output, and the apparent loss (viz., C × V) 3·1 per cent., the lag between e.m.f. current (determined simply from the ratio of the true to the apparent waste) therefore being 53° and 54°. On the subject of "all day efficiency," which the author finds to be very low in closed circuit transformers, Mr. Mordey gave the following numbers as relating to the transformer above mentioned, which was one of the Brush Company's ordinary type:—

Full load for 4 hours	(20 hrs.)	All day efficiency.
¾	„	86
½	„	82·7
¼	„	68·6
⅛	„	52·6

He remarked that the small difference between the steady temperature of transformers working at no load and at full load was noticed by him in 1889. For instance, in one case this rise of temperature was 48° F. at no load, whilst at full load it was 43° F. only. From this observation no one could infer that either the transformer was very inefficient, or that the loss in the copper was very small, or that some other explanation was needed. Now he knew that neither of the first two suppositions was correct, hence the necessity for some other explanation. Just before the meeting Professor Ayrton had shown him some tests of one of his transformers, made by Blakesley's method. These tests conducted by Professor Ayrton confirmed his own. These tests, together with many others, made by disinterested observers, all point to the conclusion to which he had been led—viz., that the losses in the iron decrease with the load.

He submitted that these results, if correct, upset every one of the author's bases. But even if the author's contentions were true, the low "plant efficiency" obtained would seriously interfere to prevent the practical use of transformers constructed in accordance with his views. The author confessed to three-tenths of the plant being required to supply the magnetising current, but stated that closed circuit transformers require two-thirds as much, which is by no means the case. The use of condensers would reduce this great disadvantage of open circuit transformers, but it must be remembered that condensers would also reduce the small disadvantage of closed circuit transformers. If satisfactory condensers could be obtained (and he congratulated the author on the progress he seemed to have made in that direction), he thought the outlook for closed magnetic circuits was better than ever.

Mr. Crompton said that in the first place the number of hours required for transformers to attain a steady temperature was much greater than Mr. Mordey would have us believe, for he (Mr. Crompton) had kept them running for thirty hours, and still the temperature was not constant. Referring to "all-day efficiency," he said most people speak of the efficiency of transformers being 90 per cent. at half load, as if that was their normal working condition. This load was far above the average output even during lighting hours. Taking the case of a customer whose lighting bill, at 8d. per unit, amounts to £20 a year, he said such a house would require a 50 to 60-light transformer, and the average consumption throughout the year would be 70 watts. The transformer would thus be working on an average at $\frac{1}{16}$th its full load. On the question of "storage" he could not agree with Mr. Swinburne's opinions, for in stations subject to uncertain loads the employment of accumulators to the extent of 20 or 30 per cent. of the total output enabled the working expenses to be reduced immensely.

Mr. Addenbrooke remarked that Mr. Swinburne was under a wrong impression when he stated that probably no existing company intended changing their system of supply, for he (Mr. Addenbrooke) well remembered that when Mr. Ferranti took out his first patents for transformers, the subject of sub-stations and low-pressure distribution was thoroughly appreciated by the inventor. At that time, however, it was impossible to found sub-stations, but it had always been the intention of Mr. Ferranti, as well as of the House-to-House Company, to adopt this system whenever they could.

Mr. Evershed said the action was much easier to understand on the armature reaction theory than by the older ideas about self-induction. Referring to the compound machines mentioned, where the magnets are excited by a redressed alternating current, he inquired how the sparking could be got over? In conjunction with Mr. Vignoles, he had made many experiments on the loss by hysteresis in different samples of iron, and had never found a sample give more than 25 per cent. more loss than Ewing's specimen; only one sample gave this value, and it was an ordinary bar taken out of a smith's shop. In most cases the losses are about 5 per cent. more than that found by Ewing. On the subject of efficiency of transformers he said Mr. Swinburne had not taken a good design of closed circuit converter with which to compare his "Hedgehog."

Mr. Swinburne here remarked that in his British Association paper he had given the best proportions of copper and iron for the closed circuit form, but in this paper he had taken an average of the various forms in the market.

Mr. Evershed said that to be anything like a good design there should be much more copper in it. The subject of open *versus* closed circuit transformers had occupied his attention for some time, and he found that, if the iron circuit of one of the latter form was cut, its efficiency is increased. Such being invariably the case, he said, Why not "go the whole hog or none," and do away altogether with the iron core. Recently he had worked out the dimensions of a 10 horse-power transformer made on this plan, and found that at a frequency of 210 the weight was 200lb., and the saving resulting from the absence of a core amounts to 20 per cent. per annum on the cost of the transformer.

THE ELECTRIC TRANSMISSION OF POWER.*

The formulæ of Table II. of the last lecture are developments of Sir William Thomson's well-known law for the most economical conductor for the electrical transmission of energy; the law itself is based upon erroneous assumptions, the chief of which is that power has the same value at the receiving end as at the generating end, and to be of practical applicability requires to be modified according to the table. The higher the voltage employed the less the cost of copper in the conductors, but the greater the cost for the insulation of the conductors and for the generating and receiving plant, and from this it follows that there is a certain voltage at which it will be most economical to work. The maximum voltage at which continuous current machines will work satisfactorily depends upon the commutator and upon the general insulation of the machine, and at present the limit is from 2,000 to 3,000 volts.

Table IV. of the last lecture gives the total capital outlay for the electrical parts of several power transmissions actually carried out by the Swiss Oërlikon Works, who have also erected the Schaffhausen installation, which we will now briefly describe.

As an example of a large and successful transmission plant, the installation at Schaffhausen, on the Rhine, may well be taken. The power is transmitted from a

* Abstract of Cantor Lecture delivered at the Society of Arts by Mr. Gisbert Kapp, M.Inst.C.E., on the 2nd inst.

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turbine station across the Rhine to the Schaffhausen spinning mills, a distance of about 750 yards. At the generating station there are four turbines, each of 350 horse-power, of which only two are at present in use, and the energy delivered at the turbine pulleys is sold to the mill owners at the rate of £2 16s. per horse-power per annum. From the turbine pulleys two six-pole dynamos are driven by cotton ropes, each dynamo having an output of 330 amperes at 624 volts when running at 300 revolutions per minute. These machines are over-compounded, so as to give a constant potential of 600 volts at the motor end of the line, and in ordinary working are coupled in parallel. At the receiving station there is a twin motor of 380 horse-power, and two other motors, each of 60 horse-power. The twin motor is six-pole, and the smaller motors two-pole, and the power is transmittd from them to the mill shafting by cotton ropes. Full particulars of the machines are given in the accompanying table. There are four main conductors, all overhead, each having a sectional area of ·437 square inch, and being supported by iron towers 46ft. high; the span across the river is 330ft., and each of the remaining spans are 430ft. The guaranteed commercial efficiency reckoned from the turbine pulleys is 78 per cent., the variation of speed of the motors between full and no load not more than 3 per cent., the life of a set of brushes not less than 2,000 hours, and of a commutator not less than 20,000 hours. The total cost of the electrical part of the plant, including iron towers and erection, was £6,800.

THE SCHAFFHAUSEN TRANSMISSION PLANT.

	Generators.	Twin Motor.	Small Motors.
Number of machines	2	1	2
Normal horse-power	300	380	60
Number of poles in magnet fields	6	6	2
Revolutions per minute	300	300	350
Terminal voltage	624	600	600
Normal current, amperes	330	500	81
Diameter of armature, inches	47½	42½	23⅝
Length of armature core, inches	20	20⅜	22½
Radial depth of armature core	8	7	4⅜
Section of armature conductor, square inches	·103	·078	·0287
Number of armature conductors	316	316	540
Number of commutator segments	158	158	90
Loss in armature resistance per cent.	1·46	1·52	2·7
Induction in armature, C.G.S. measure	7,500	7,600	15,800
Shunt resistance, ohms	140	143	295
Loss in shunt excitation per cent.	1·35	1·68	—
Main turns per magnet	6	4	—
Loss in main excitation per cent.	·3	·2	—
Type of armature	Drum	Drum	Cylinder

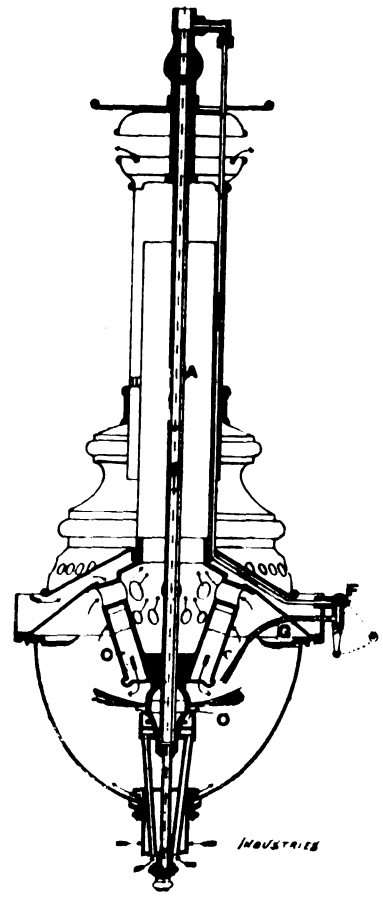
At Niagara there is about 3½ million horse-power running to waste, and of this the Cataract Company intend to utilise 125,000 horse-power by transmitting it to towns and places where it is required. The maximum distance for transmission will be about 20 miles. The electrical transmission of so great a power is at present rather beyond engineers, but in a few years the difficulties surrounding the problem will doubtless be overcome. In the recent competition instituted by the Cataract Company, out of fifteen different schemes seven proposed electrical transmission, six pneumatic, and two hydraulic; of the electrical schemes, two advocated alternating current transmission at 5,000 and 10,000 volts, and the remaining five continuous current transmission at potentials varying from 1,600 to 4,500 volts. The company are at present making a tunnel 30ft. high, 20ft. wide, and 6,700ft. long, which will form the tail race from the water motors to be erected.

The use of alternate current generators and motors for large transmissions has much in its favour; there are no commutators, and by having transformers at both ends of the line the working potential may be 10,000 or 25,000 volts, or even higher still, while the potential at the machines is only a few hundred volts. An ordinary alternate current dynamo can easily be run as a motor, but, as such, it is not self-starting, and if overloaded to the extent of 50 or 100 per cent., may get out of step with the supply current and come to a standstill. There is another method of alternate current transmission, known as the "three-phase current" system, which has neither of the above objections; it is a development of the Ferraris two-wire and of the Tesla three-wire systems, but with it the transmission and plant efficiencies are much greater than with the Tesla system. An objection to the Ferraris system is that the speed of the motor is not self-regulating, but may vary from zero to the synchronising speed according to the load. The action of the Ferraris, Tesla, and "three-phase current" systems was very clearly explained with the help of models and diagrams.

At the conclusion of the lecture several electrical machine tools were shown in action. These included a drilling machine, which held itself to the iron plate to be drilled by means of powerful electromagnets, mining tools, and a tube cutter. A transformer was also shown suitable for use with oil insulation; such a transformer has lately been used at Messrs. Johnson & Phillip's works, to transform from 2,400 to 17,000 volts.

STEUTH'S REGENERATIVE GAS LAMP.

WE illustrate below a new form of regenerative gas lamp which is being introduced into this country from Germany by Mr. F. H. Cheesewright, 60, Haymarket, S.W. As will be seen from our illustration, the gas is supplied to the burner O, which is an ordinary annular argand, through the tube A. Above the burner is situated a conical copper regenerator C, which is of special construction. The invention relates chiefly to the means adopted for supplying a small quantity of air to the burner from below by an arrangement of tubes communicating with the external air at the



bottom of the lamp, as shown in our illustration. A further novelty for this kind of burner is an arrangement for enabling the ignition of the lamp to be effected from the outside of the glass shade, which consists of a supply pipe passing from the top of the burner down one side of the regenerative portion of the lamp to the small stop cock F, which, when open, allows a small jet of gas to burn at the end of the tube G sufficient to ignite the burner when desired. We await the trials which it is proposed to make with this lamp against the other forms of regenerative burners already in the market.

NOTES ON ALLOYS.

IX.

SINCE our last article on this subject Messrs. Heycock & Neville have communicated to the Chemical Society a second paper on the molecular condition of metals when alloyed with each other. It will be recollected that they have already shown that one atomic proportion of a metal when dissolved in tin produces a lowering in the solidifying point of that metal equal to that which, on the theory of osmotic pressure, should be produced by one molecular proportion, and they therefore concluded that metals dissolved in tin have monatomic molecules. They have carried out similar experiments, using bismuth, cadmium, and lead as solvents, and find that most metals in these solvents also have monatomic molecules. The chief exceptions which the authors have met with are thus summarised:—Arsenic, both in bismuth and cadmium, gives a fall of one-third that of most other metals; antimony, when added to bismuth, gives a rise in the melting point; in cadmium, zinc, palladium, and mercury give smaller falls than the other metals, whilst silver gives a very pronounced rise. Of the fourteen metals dissolved in lead, five would appear to have monatomic molecules, while mercury, bismuth, and cadmium are diatomic, and tin tetratomic. This investigation seems to show that the number of atoms in a molecule of a metal depends not only on the temperature, but on the kind of solvent employed.

Greene and Wahl have also studied the alloys of sodium and lead. They prepared them by direct combination of the two metals, by reducing litharge with charcoal in the presence of caustic soda, and by heating litharge with sodium tartrate after the method proposed by Vanquelin and Serullas. The alloys are all brittle and crystalline, and contain from 3 to 31 per cent. of sodium. The alloy richest in sodium is green, and instantly blackens on exposure to the air. The densities are higher than that of simple mixtures of the two metals, and they give the formulæ Na_2Pb_2, Na_2Pb, and Na_4Pb for the compounds which they have prepared by these methods.

As interesting to electricians we give the values for the specific resistance and temperature variations for the alloys which are commonly employed for electrical work. The following table summarises the results obtained by Mr. Mordey, of the Brush Company:—

	Specific Resistance.	Temperature Variation per 0° C.
Copper	1·00	0·396
Soft iron	5·27	0·691
Brass	6·05	0·164
German silver	8·88	0·080
Piano wire	16·00	0·517
Platinoid	20·00	0·044
Arsenical copper	28·50	0·061
Hadfield's manganese steel	37·10	0·229

W. Hallock has recently shown that an alloy of two or more metals can be readily prepared by first mixing the filings of the constituent metals in the given proportions, and then allowing the mixture to remain for some time at a temperature above the melting point of the alloy to be formed. He was led to carry out these experiments, and thus establish the law enunciated above, from reading W. Spring's well-known experiments upon the formation of Wood's alloy by pressure. It will be recollected that in this research the filings were first mixed, then compressed under a pressure of 6,000 atmospheres, and the block of metal so formed again filed up and compressed, when a homogeneous alloy was produced. Hallock argued that if in any part of the mixed filings the four constituent metals were in contact a molecule of the alloy would be produced, and if the temperature be above its melting point it would flow away, and in so doing probably bring another four particles of the dissimilar metals in juxtaposition, and so tend to continually produce the alloy from the admixture without pressure or melting any of the constituents. The law was established by producing Wood's metal in a test tube from the filings of the constituent metals at the temperature of the water bath—*i.e.*, at 130° below the melting point of the tin, which is the most fusible of the constituent metals. The tin lead alloy was similarly prepared by allowing the mixed filings to remain at the temperature 190°–200° for some days; and the formation of the well-known sodium potassium liquid alloy by the mere contact of the two metals at ordinary temperature is cited by Mr. Hallock as confirmatory evidence of the generality of his statement.

Two recent processes for the manufacture of ferro-aluminium have been patented by Faure, and by Pratt and Pearson. The former consists in passing the vapour of ferric chloride over bauxite and charcoal heated to redness. The vapours so formed are then led over scrap iron, also at a red heat. The iron is attacked by the aluminium chloride vapours, forming ferro-aluminium and ferrous chloride. The latter is condensed and heated again in a current of air, when it is converted into oxide and ferric chloride, which volatilises, and is ready for a fresh operation. Pratt and Pearson's process is one for making an aluminium cast iron in an ordinary blast furnace. This is effected by calcining the iron-stone with clay, coke, and fluor spar, instead of lime, but the authors do not state what is the maximum amount of aluminium that can be introduced into the iron in this way. A German patent (No. 54132), by Petit Devancelle, covers the preparation of aluminium-bronze from the alloys of copper with tin, zinc, or lead. When any of these alloys are heated with aluminium sulphide, the sulphur unites with the second metal, forming its sulphide, and a copper aluminium alloy is produced containing from 5 to 10 per cent. of aluminium.

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According to L. Dienelt (D.R.P., 54,216), German silver gives very unsatisfactory castings if the nickel is not thoroughly incorporated with the molten copper. He suggests that the nickel should be first fused, and when it is completely fluid, the copper added thereto. Zinc, tin, or lead can then be added to the fused mixture. The most satisfactory mixture is copper 4, zinc 2·5, lead 0·75, nickel 0·5, and tin 0·125 parts, making 7·875 parts of German silver. He claims that this alloy is as white as German silver, can be worked as easily as brass, and is cheaper than ordinary German silver. Tin is the best metal to use as a solder for this alloy, as, being white, the joint is not apparent. The molten alloy is very fluid, and the patentee states that it gives very sharp and well-defined castings.

An alloy containing 9 parts of lead, 2 of antimony, and 1 of bismuth has the property, like other antimony alloys, of expanding on cooling. It has been suggested that such an alloy could be utilised for repairing cracks in cast iron. Of course, it is readily fused, and therefore could not be employed for any work which might subsequently be subjected to a high temperature.

BEESWAX AND ITS PURIFICATION.

MM. A. and P. Buisine have lately completed an examination of the various processes employed for bleaching beeswax, which throws some light on the variation of the quality of commercial white wax. They find that wax is generally bleached by simple exposure to the air and light, the colouring matter being slowly oxidised. Pure oxygen and ozone can also be employed for this purpose, but light is absolutely necessary to bring about the change. They also state that in the absence of free oxygen—*e.g.*, in carbonic acid, nitrogen, or a vacuum—light slowly decolorises yellow wax. Yellow wax differs from wax bleached by exposure to the air in containing less free acid, a smaller saponification value, and a higher iodine absorption. In the bleaching process, then, not only is the colouring matter completely destroyed, but the non-saturated fatty acids and hydrocarbons present in the wax absorb oxygen and form saturated compounds having a smaller iodine value. In practice, the bleacher generally adds from 3 to 5 per cent. of fat to the wax before exposure to light to increase the rapidity of the bleaching action and to diminish the brittleness of the finished product. A bleached wax to which this small quantity of lard has been added can be recognised by its higher saponification equivalent and a slight increase in the amount of free fatty acids. Oil of turpentine added in small quantities to the wax acts in the same way as lard. When animal charcoal is employed for bleaching crude beeswax, its composition is very slightly altered; it is, therefore, easy to identify a wax which has been bleached by this treatment. Certain oxidising agents—such as potassium permanganate and bichromate in acid solution—are also employed with very good results for bleaching beeswax. Hydrogen peroxide has also been used with success. Reducing agents, sulphites, hydrosulphites, and sulphurous acid have no action on the colouring matter, and chlorine and bleaching powder cannot be employed, as, in addition to destroying the colour, the chlorine is retained by the wax and so modifies its properties that it is rendered useless for many of the purposes for which it is manufactured. The authors, in their paper in the *Bulletin de la Société Chimique de Paris* (1890, 470), give tables of their analyses of wax bleached by all of these methods, which will be found useful to those who have difficulties in getting wax of definite composition.

Notes.

JAPANESE NAVAL POLICY.

It is stated that the Japanese Government intends to lay before Parliament a very extensive naval policy, the details of which will excite interest in shipbuilding circles in this country. The Japanese have never concealed their ambition to make their country the Britain of the East, both as regards its navy and its mercantile marine, and already both of these have attained very considerable importance. The Government, however, thinks that the former is too small, not only on account of the work it has to do, but also as compared with the navies of foreign Powers, and it is proposed to obtain or build twenty-five ships, exclusive of those in course of construction in Japanese and foreign yards, so as to make the total available ships in the navy seventy-five. The ordinary appropriation for the navy is about one million sterling, an amount which the Admiralty authorities say is barely sufficient to allow for ordinary tear and wear. They have, therefore, drawn out a special programme, extending over seven years, and which they intend to lay before Parliament, and ask for a special grant, sufficient to enable them to construct or buy during the current year two belted cruisers and three torpedo boats, and the demand will be repeated from year to year till the programme has been completed. Some of the vessels will be constructed in Japan, but the most of the work will be done in foreign yards.

PREPARATION OF OXYGEN FROM THE AIR.

E. Peitz has patented in Germany a new process for obtaining oxygen from the atmosphere, which seems to possess certain advantages over the older processes, and which, like Mr. Kassner's method (see *Industries*, Vol. IX., page 508), is based on the employment of lead oxide for this purpose. Lead oxide and chalk are heated together in a current of air, when carbonic acid is given off and the following reaction takes place:—

$$2CaO + PbO + O = Ca_2PbO_4.$$

When cooled to a dull red heat carbonic acid is led over the mass at such a rate as to reform calcium carbonate and evolve pure oxygen gas, thus:—

$$Ca_2PbO_4 + 2CO_2 = 2CaCO_3 + PbO + O.$$

The mixture in the retort can be reconverted into calcium plumbate by reheating in a current of air to a bright redness.

BELGIAN IMPORTS AND EXPORTS IN 1890.

The following list of imports and exports in Belgium during last year shows that, while there was a marked increase in imports, there was also a slight increase in the exports, as compared with the previous year:—

	Imports in Tons.		Exports in Tons.	
	1890.	1889.	1890.	1889.
Coal	1,727,011	1,004,624	4,537,708	4,272,700
Coke	65,119	18,545	1,062,930	1,219,959
Briquettes	—	—	310,842	317,164
Iron ore	1,644,421	1,805,210	171,392	155,108
Rough cast steel	9,883	6,532	453	3,168
Steel rails	756	1,107	73,867	69,672
Rolled steel	3,779	3,430	26,121	36,874
Worked steel	1,053	1,308	8,983	8,503
Raw pig iron	250,952	238,361	11,309	14,773
Old iron	18,634	24,996	11,757	7,801
Iron wire	3,811	3,262	2,340	4,843
Iron rails	156	609	12,857	14,642
Sheet iron	1,859	2,026	45,679	55,842
Iron (various)	10,089	11,662	217,960	257,884
Nails	665	572	10,103	13,801
Worked iron	3,673	3,724	35,244	37,324
Worked pig iron	2,381	2,215	30,896	28,127
Total tons	3 744,242	3,128,183	6,570,441	6,518,185

COAL IN BURMAH.

The coalfields in the Upper Chindwin District and the country between the Myitthia and Yu rivers have been examined. The total area is 175 square miles. According to the *Indian Engineer*, the seams are described as numerous, though the majority of them are of small thickness, but few exceeding 3ft., and one only measuring 10ft. The coal, however, is of first-rate quality, hard and bright, and makes excellent fuel. A syndicate has been granted a lease of six square miles, and will begin mining at once. The Thayetmyo field has proved a failure, owing to the insufficient quantity of the coal and the disturbed strata; but the Theingudaw fields on the right bank of the Irrawaddy promise to repay the lessees. In the Northern Shan States there would appear to be abundance of coal. It crops out in the Lashio and Hamma districts, being found in the beds of streams. Dr. Noetling made a surface examination of the country, and at Lashio he traced one seam of 30ft. thickness for two miles. So far as it has been proved, this coal is rather poor in quality, being very light and liable to crack when dry, but it is said that this may possibly be due to long exposure to air and water in the river bed. Until a series of borings has been made, its true quality can scarcely be declared. Lashio is too far distant from Mandalay for the coal to be worked in paying quantities now, but when the railway is extended through the Northern Shan States, as it is certain to be in a few years' time, this drawback will disappear.

THE WORLD'S POPULATION IN 1890.

The following table from the Proceedings of the Royal Geographical Society for January, 1891, is of interest:—

	Population.	Average to a Square Mile.	Increase per Decade per Cent.
Europe	380,200,000	101	8·7
Asia	850,000,000	57	6
Africa	127,000,000	11	10
Australasia	4,730,000	1·4	30
North America	89,250,000	14	20
South America	36,420,000	5	15
Totals	1,487,600,000	31	8

This table shows that if the population were equally spread over the differents parts of the globe, there is not much fear of over-population for many years to come.

FRENCH IRON AND STEEL STATISTICS.

The following statistics show the quantity of iron and steel imported and exported in 1890, as compared with 1889:—

Imports.	1890.	1889.
Cast Iron.	Kilogrammes.	Kilogrammes.
For temporary admission	115,457,700	107,165,700
Paying duty	20,648,000	13,025,000
Total	136,105,700	120,190,700
Wrought Iron.		
For temporary admission	17,624,500	13,109,100
Paying duty—		
Forge scales	100,552	153,699
Charcoal bars	7,303,978	7,840,686
Coke bars	3,704,020	3,762,701
Rails	211,069	62,090
Angle and T irons	207,157	61,907
Rods	59,611	142,083
Hoop iron	121,577	79,668
Sheet iron	851,590	1,168,262
Galvanised iron, &c.	2,109,711	1,706,584
Iron wire	259,864	313,232
Total	32,553,629	28,400,012
Scrap iron	8,218,683	15,063,762
Slag	29,203,558	22,532,991
Steel.		
For temporary admission	2,745,300	3,949,600
Paying duty—		
Rails	812,427	90,111
Axles and tyres	990,371	922,498
Bars and sheets	2,926,927	2,743,097
Ordinary plates	214,620	138,842
Hoop steel	166,678	155,243
Steel wire	553,815	581,935
Total	8,410,138	8,580,826
Exports.		
Cast iron	171,243,000	120,007,000
Wrought iron	66,689,797	67,614,113
Steel	43,815,320	36,819,126
Scrap iron (wrought and cast)	26,852,468	17,616,802
,, steel	439,055	326,097

THE COTTON INDUSTRY.

The weaving trade does not improve; in fact, the depression previously referred to last week continues, with the tendency here and there for more looms to stand idle. The estimate of weaving machinery quite at a standstill is now put at 20,000 looms, chiefly in East and North-East Lancashire. Some discussion has been reported of an effort to get general short time in manufacturing, but no progress has been made in this direction, and it is felt that, owing to the position of producers being so diversified, success will not attend those who are asking for concerted action. Rumour has it that a great deal of money has been lost in weaving recently. Last week one old firm in Blackburn came to grief. The only hope for those who buy yarns is that coptwist and weft values are receding. It is certainly a very long time since 32's coptwist touched 7½d., its present value. Moreover, the prolonged lessening of production is sure to have its effect upon the great Eastern outlets. The nearer and minor outlets are helping the market a little, but the want of demand from Bombay and Calcutta is a serious blow to the industry. Cotton spinning, as distinct from weaving, is also in a bad condition. Not only have Oldham spinners large supplies of dear cotton, but they are finding great difficulty in obtaining delivery of yarn orders taken at much higher rates than those now current. Stocks of bundles and cops are getting rather burdensome in first hands. There is some discussion as to whether the recent advance in wages should not be taken back by the employers.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

16th February, 1891.

2746. Triscott, C. M. P. H. ... Appliance for loading repeating firearms.
2751. Fell, J. ..... Steam boilers.
2753. Tomlinson & Porter ... "Gassing" and finishing silk and other yarns.
2758. Wilson G. A. ..... Apparatus for folding and collecting sheets of paper.
2759. Leather, J. ..... Apparatus for ventilating mines.
2760. Nall, J. ..... Dovetailing machines.
2761. Healey, B. D. ..... Combination chambers of furnaces.
2765. Nichols & March ..... Gas locomotives.
2769. Sturrock & Macdougald Stuffing-boxes for fluid pressure motors, &c.
2771. James, T. ..... Axle-boxes for railway vehicles.
2778. Dennis & Avis ..... Railway signalling apparatus.
2779. Skilton, J. A. ..... Heating and ventilating apparatus.
2780. Coddington, V. W. ..... Separable pulleys.
2781. Coddington, V. W. ..... Pulleys.
2782. Newman, T. ..... Pipe wrenches.
2784. Wallwork, J. ..... Apparatus for placing fog signals.
2785. Tropenas & Wells ..... Apparatus for the determination of carbon in steel.
2794. Spence, J. ..... Apparatus for adjusting saws of stone-cutting machines.
2795. Barber, S. ..... Apparatus for cleaning coal, coke, metal ores, pulps, &c.
2796. Guy, C. W. ..... Crushing mills.
2797. Duffield, C. ..... Tunnelling machine.
2806. Lea & Trueman ..... Apparatus for returning water of condensation to boilers.
2811. Heidelmann, W. ..... French circular hosiery machines.
2815. Rouzay, M. ..... Gas or petroleum engines.

17th February, 1891.

2821. Matthews, J. ..... Movable spanner.
2827. Rigby, R. ..... Mandrels for drawing thin metallic tubes.
2835. Jenkin, C. F. ..... Rope gearing for driving cranes
2843. Blakeney, W. H. ..... Apparatus for delivering mails to trains in motion.
2845. Walton, W. ..... Mechanism for feeding bisectional wire into card-setting machines.
2850. Mauser, P. ..... Safety mechanism of breech-loading small arms.
2854. Baxendale, W. ..... Steam boilers.
2858. De Pass, E. ..... Ring-spinning frames (*Imbs*).
2860. Dalglish & Boyd-Wilson ..... Brake-controlling mechanism.
2869. Floyd, J. N. ..... Steam pumping engines.
2870. Newton, H. E. ..... Web printing machines (*H. Hoe & Co.*).
2871. Newton, H. E. ..... Cylinder boring machines (*Worthington*).
2881. Little, H. W. ..... Steam engines (*Little*).
2882. Arnold, L. G. ..... Railway car brakes and buffers.
2883. D'Auria & Robert ..... Direct-acting steam pumping engines.
2889. Thompson, W. P. ..... Apparatus for the manufacture of gas from petroleum (*Sanford*).
2891. Eves, J. V. ..... Flax machinery.
2896. Pigeot, E. ..... Horse nail machinery.
2898. Williams, H. A. ..... Apparatus for rolling wire.
2905. Marston, C. E. ..... Steam boilers.

18th February, 1891.

2929. Williams, H. ..... Mechanism for governing gas and oil engines.
2932. Lister, E. J. ..... Apparatus for polishing wire.
2939. Fielding, J. ..... Gas motor valve apparatus.
2949. Munns, W. H. ..... Stencil printing apparatus (*Harrison & Heiskell*).
2951. Munns, W. H. ..... Pipe wrench (*Sproull & Sproull*).
2953. Munns, W. H. ..... Machines for cutting irregular shapes (*Niermann*).
2954. Munns, W. H. ..... Mechanism for converting rotary into reciprocating and other motion (*Coburn & Coburn*).
2961. Hartig, H. ..... Expansion gear for steam engines.
2967. Barstow & Shaw ..... Boiler furnaces.
2974. Murrie, J. ..... Boiler feed and alarm mechanism.
2975. Barraclough, T. C. ..... Machinery for manufacturing metal barrels.
2976. Hughes, F. ..... Gas engines (*Cordenous*).
2988. Baldwin, F. R. ..... Vacuum boiler tube cleaners.

19th February, 1891.

2997. Thompson, W. P. ..... Rotary swaging machines (*Collins*).
3009. Field, R. ..... "Streamers" employed in looms.
3014. Clapham & Greenwood Steam boilers.
3026. Lindley, F. A. ..... Paper-making machines.
3027. Broadhurst, H. B. ..... Jacquard apparatus.
3033. Spencer & Ralston ..... Stop cocks or valves.
3035. Thwaite, B. H. ..... Apparatus for manufacturing Portland cement.
3036. Stratton, J. M. ..... Steam boilers.
3043. Bohm, W. D. ..... Pumps.
3062. Darby, J. H. ..... Steam engines.
3068. Gallagher, H. ..... Machinery driving gear.

20th February, 1891.

3074. Fielding, J. ..... Gas regulator for gas engines.
3075. Fielding, J. ..... Governing apparatus for gas engines.
3087. McGee & McGee ..... Thread winding machinery.
3093. Trier, F. ..... Lubricators.
3097. Breadner, E. ..... Picking bands for looms.
3098. Breadner, E. ..... Machine for dyeing, drying, chroming, washing, mangling, and plaiting textile fabrics.
3100. Dearden, E. ..... Machinery for manufacturing wheels for railway vehicles.
3111. Bailey, J. ..... Apparatus for making rugs.
3121. Barker, R. W. ..... Car couplers (*Frost*).
3122. Bohl, J. G. ..... Spinning tubes.
3125. Dvorkovitz, P. ..... Apparatus for making gas and distilling crude hydrocarbon oils.
3128. Pickard, A. ..... Square hole drilling machines.
3129. Richardson & Coates ... Crushing machines.
3138. Paulick, G. ..... Machine for tying up the cards in jacquard machines.
3151. Fry, H. W. ..... Apparatus for crushing grain.
3160. Hammesfahr, E. ..... Rotary engine.

21st February, 1891.

3165. Ferguson & Fleming ... Compound steam engines.
3173. Brown, Coop, & Hurst Band-cutting machines for cloth, &c.
3188. Eckert & Hentschel ... Machines for making buttons.
3201. Dunbar, J. ..... Dredgers.
3215. Grenfell & Baron ..... Lathes for the manufacture of screws.

ELECTRICITY.

17th February, 1891.

2862. Dewey, M. W. ..... Electric fire engines.
2902. Grimston & Wilson ..... Electric locomotives.

18th February, 1891.

2985. Edwards, E. ..... Apparatus for stirring malt and grain (*Sandt & Sturm*).

19th February, 1891.

2999. Bigland & Burns ..... Arc lamps.
3003. Mayer, E. W. ..... Element for electric battery.
3030. Ward, M. R. ..... Propelling vehicles by electric motors.
3049. Mills, C. K. ..... Circuit controller and alarm (*Woolcott & Wilmot*).

20th February, 1891.

3127. Cruyt, W. ..... Apparatus for indicating loss or diminution of current in circuits.

21st February, 1891.

3191. Dolivo-Dobrowolsky & The Company Allgemeine Elektricitäts-Gesellschaft ..... Transmission of alternating differential phase currents.
3198. Poudroux, F. ..... Galvanic batteries.
3199. Harold & Jenkins ..... Switches.

CHEMISTRY.

16th February, 1891.

2747. Hutchinson & Harboard Utilisation of slags in conjunction with finely divided oxides of iron.
2798. Altman, H. J. ..... Solutions and salts for electro-deposition.
2805. Lake, H. H. ..... Colouring matters (*A. Leonhardt & Co.*).
2812. Zeitler, J. N. ..... Converting carbonate of lead, obtained from sulphate of lead with carbonate of sodium, into basic salt.
2817. Imray, O. ..... Colouring matters (*The Society of Chemical Industry*).

19th February, 1891.

3034. Fanta, F. ..... Producing oxygen gas. (22nd October, 1890.)
3057. Faure, C. A. ..... Production of aluminium alloys. (2nd December, 1890)

21st February, 1891.

3210. Gemmell, T. ..... Treatment of auriferous and argentiferous ores.

MISCELLANEOUS.

16th February, 1891.

2776. Horton, J. ..... Sensitive ball tap.
2789. Price, W. L. ..... Armour plates.

17th February, 1891.

2853. Middleton, J. J. ..... Covering for steam boilers, &c.
2873. Burdon, L. L. ..... Manufacture of seamless compound ingots and wire.
2904. Mannesmann, R. ..... Manufacture of metal tubes.

18th February, 1891.

2928. Dearden, E. ..... Manufacture of wheels for railway vehicles.
2991. Mannesmann, R. ..... Rails for railways.

20th February, 1891.

3072. Cadman, S. ..... Oil cans.
3101. Limb, T. ..... Miners' safety lamp.
3116. Ehrhardt, H. ..... Punching and shaping iron and steel blocks.

21st February, 1891.

3189. William Gilpin, Senior, & Co., Ld. ..... Augers, bits, drills, and other boring tools.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

18463. Vallet. 18643. Higginbottom.

1890.

813. Imray (*Moerchen*).
838. Mannesmann.
839. Mannesmann & Mannesmann.
842. Mannesmann.
1157. George Young, Frank Pearn, & William Crippin.
2798. Cockburn.
2895. Lindsell (*Tuke*).
3050. Smith.
3063. Clark.
3128. Munden.
3375. Frederick William Margetts & Sarah Chatfield.
3690. Isherwood.
3990. Dodd.
4027. Walker.
4171. Negrier.
4235. Rees.
4368. Pullan, Mann, & Gill.
4498. Marlow.
4560. Teague.
4592. Parfitt.
4684. Foord.
4753. Eckstein.
4761. Mensing.
4813. Jenner.
4909. Brewster.
4946. Imray (*Farbwerke vormals Meister, Lucius, & Brüning*).
5043. Sellars. (22nd April, 1890.)
5209. Lake (*Maxim*).
5257. Edwards (*Haugensen*).
5418. Horn (*Perkins*).
5451. Hefford.
5470. Mügel.
5497. Kenyon, Sen., Kenyon, Jun., Kenyon, & Kenyon.
5529. Pike.
5596. Woodruff.
5632. Pink.
5673. Salomon.
5681. Shill.
5702. Hansen.
5719. Taylor.
5736. Imray (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).
5776. Gottschalk.
5794. Puskas.
5816. Hall & Kay.
5844. Leachman.
5891. Kerr.
5898. Howat.
5922. Oriolle.
5936. Kelly.
5962. Maynard.
5975. Hart-Davies (*McDonnell*).
5983. Faxon.
6005. Sayer.
6019. Carter & Aynsley.
6088. Brook.
6193. Spratley.
837. Mannesmann & Mannesmann.
840. Mannesmann.
841. Mannesmann.
1014. Caird.
2594. Jensen (*Underwood*).
2610. Bostel & Loosley.
2708. White & Hill.
2834. Tipping.
2987. Billington & Holding.
3096. De Ferranti.
3222. Bolton.
3509. Sahlström.
3530. Gehrckens.
3618. Showell & Baker.
3910. Horn (*Melick & Leslie*).
4008. Higginson.
4086. Barley & Stevenson.
4205. Gass.
4260. Thompson (*Young*).
4457. Edwards (*Stroehmer*).
4531. Downing (*Lalance & Elsner*).
4596. Pitt (*L. Cassella & Co.*).
4717. Sauvée (*Canet*).
4758. Genet & Philippe.
4806. Morison.
4856. Brooke.
4920. Waterman.
4966. Wilson & Wilson.
5001. Lake (*York*).
5031. Drayton & Wilkins.
5158. Stanbury.
5205. Wilton.
5245. Davidson.
5384. Brockbank & Poole.
5442. Burghardt.
5468. Bozza.
5478. Lake (*Parker, Barber, Estens, & Atkinson*).
5501. Hewitt.
5502. Gillet.
5535. Low.
5612. Sanders.
5671. Salter & Ely.
5678. Kalb.
5690. Beetlestone.
5718. Brickley.
5722. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5741. Chadburn & Findlay.
5753. Leggott.
5758. West.
5793. Puskas & Schlenker.
5808. Prichard, Snape, & Sherratt.
5867. Packer.
5897. Brown.
5912. Smith.
5934. Nisbet.
5947. Crosbie & Warwick.
5968. Lovelace.
5977. Wright & Mackinlay.
5978. Masters.
5992. Newton & Quiggin.
6015. Hamilton.
6025. Fletcher.
6138. Clarke
6197. Bott & Bonehill.

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6210. Williams.
6405. Breeden.
6540. Fawcett.
6668. Vigers.
6684. Richardson.
6789. Simons & Smith.
6853. Poupard & Lewis.
6993. Kellner.
7490. Yates.
7509. Maggs.
7522. Elders.
7986. Boult (*Muller & Friede*).
8303. Johnson (*Badische Anilin & Soda Fabrik*).
9627. Smith.
12186. Clay.
13318. Henley, Henley, & Spurrier.
14103. Thompson (*Y Garcia and del Castillo*).
14215. Lea.
14281. Bott, Sheppard, & Barnard.
14965. Cafferey.
15263. Wall.
16688. Messervey.
16900. Browne (*Remus*).
17293. Collis & Le Feuvre.
18085. Keep.
18245. Mey (*Hendel*).
18274. Van Guericke.
18849. Cohnen.
19190. Le Mieux.
19305. Thomson.
19356. Comrie.
19561. Fussell. (12th July, 1890.)
19861. Collier.
20066. Miles.
20217. Barnes. (11th July, 1890.)
20502. Troxler & Gedicke.
20523. Odenbrett. (3rd June, 1890.)
20540. Thompson (*Coffin*).
20692. Tillinghast.
20817. Van der Elst & Lowenstein.
20930. Rosson.
20974. Sellers.
20985. Lake (*Götter*).
21169. Allison (*Friend*).
21214. Thompson (*The Remington Standard Typewriter Manufacturing Company*).
6217. Griffin.
6486. Imray (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis*).
6807. Middlemore.
6986. Peakman & Yates.
7393. Langham.
7502. Munzenmaier & Spraudel.
7881. Szczeniowski & Piatkowski.
9458. Mellor & Mellor.
9579. Parish.
10626. Edgell.
13240. Folie-Desjardins.
13799. Lake (*The Electric Secret Service Company*).
14124. Anderson (*The Singer Manufacturing Company*).
14899. Acland & Holmstrom.
16658. Reeves.
16881. Pease. (7th April, 1890.)
17268. Wilbaux.
17704. Green. (8th April, 1890).
18266. Davies & Dutson.
18571. Sims.
19188. Valiant & Dancel.
19281. Woodward.
19322. Lake (*Koehler*).
19496. Munsie.
19638. Bruse.
19820. White.
20054. Davison.
20126. Dutton.
20223. Turner.
20494. Bisbee.
20516. Eckhardt.
20525. Shaw. (16th June, 1890.)
20672. Gartner & Talcott.
20705. Boult (*Galliott & Favarelle*).
20878. Domon.
20961. Gribben.
20976. Lake (*Burgess*).
21143. Rhodes.
21196. Evans.
21228. Ellinwood.
21237. Dewey.
21241. Hutchinson.

1891.

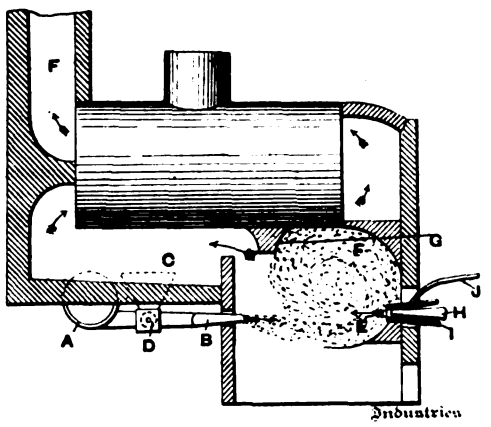
86. Pankhurst. (16th June, 1890.)
154. Saltzmann.
188. Ruckdeschel.
202. Gessner.
225. Tower.
297. Bickerton.
327. Böhm.
397. McGrath.
406. Donald.
474. Koellner.
526. Haseltine.
531. Aarstad.
577. Twite.
594. Stresemann & Braun.
667. Thompson (*The Hess Electric Storage Battery Company*).
858. Boult (*Schweissinger & Hoffmann*).
892. Haddan (*Helwig*).
949. Swinbourn.
1015. Gray.
1037. Jennings.
1056. Reuss.
1097. Lee.
1114. Churchward (*Robertson*).
51. Gendron.
55. Clinton & McNamara.
155. Kirsow.
198. Euler.
208. Brandeis & Schmolka.
293. Little.
321. Warren.
378. Browne (*Remus*).
401. Adams.
472. Veska.
512. Thompson (*Meyer*).
529. Schlüchtner.
586. Atkinson & Atkinson.
597. Boult (*Stokes*).
669. Puluj.
722. Grubbs.
758. Rines.
859. Harbinger.
872. Grisdale.
929. Hart & Bone.
978. Howorth & Howorth.
1018. Reed.
1088. Jennings.
1094. Neave.
1102. Schnauder & Schlegel.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Safety Valves.—*G. Weir & J. Weir, Cathcart, Lanark, N.B.*—The invention has for its object to ensure the equal pressure upon all parts of the surface of contact of the valve. A cylindrical casing fixed concentrically over the opening in the boiler has fixed in its lower end a valve seating of the ordinary construction, on a line with the upper edge of which suitable holes are formed in the casing for the escape of steam. Screwed into the upper end of the casing is a tubular piece, the lower end of which projects into the interior of the casing, and has a convex spherical surface. Screwed into this tubular piece is a suitable cover, through which is passed a key, also passing through a slot in the upper end of the valve spindle, so limiting the latter's movement. This valve spindle, which passes downwards through the tubular piece, has keyed loosely to its lower end the valve proper. Just above this valve a convex spherical flange is formed on the valve spindle, upon which, as well as upon the convex surface of the tubular piece, discs embracing the valve spindle, and formed with concave surfaces, are pressed by means of a suitable helical spring surrounding the valve spindle. From the above it will be seen that a universal joint is formed between the valve spindle and the actuating spring, and between the stationary part against the surface of which the latter bears. Claims: A spring loaded or safety valve having universal joints as described.—No. 4061. March 15th, 1890. 6*d*.

Steam Boiler Furnaces.—*W. P. Thompson, London. (A. Mason, Brooklyn, U.S.A.).*—The invention relates to a method of and apparatus for burning coal and hydrocarbon fuel in combination. The coal, in a finely pulverised state, and air are injected together into the furnace by means of a fan A shown in the accompanying illustration, through a nozzle B, the coal being fed into a hopper C, and thence into the tube D leading from the fan



to the nozzle. The inside of the combustion chamber is formed by means of deflectors E F G of a circular form, so that the coal injected into the furnace is held in suspension until complete combustion has taken place. The oil is injected into the furnace by means of a nozzle placed in the opposite side of the furnace to B and slightly higher than B. This nozzle consists of a steam nozzle H placed inside a second nozzle I, through which air is induced into the furnace, carrying with it the hydrocarbon fuel supplied from a tube J. In a modification the inventor uses one or more suitable burners located in the furnace chamber somewhat higher than the ashpit, with ample surrounding space for the ashes to descend into the pit without clogging these burners, and at the same time maintains a fire of coal around and above the oil or vapour burner or burners with pulverised coal atoms in suspension and general distribution throughout the chamber, together with the requisite amount of air for the support of combustion as above described. Three claims are made.—No. 16760. October 21st, 1890. 8*d*.

Car Couplings.—*A. H. S. Davis, Washington, & A. C. Brown, Minneapolis, U.S.A.*—Referring to the annexed illustrations, Figs. 1 and 2 are side elevations of adjacent drawheads, Fig. 3 an end elevation, Fig. 4 an inverted plan, and Figs. 5, 6, and 7 details of an automatic attachment to cars, already fitted with links and pin couplings, constructed according to this invention. A is the ordinary drawhead bar, and B B^1 clamping plates clamped by bolts on the upper and lower sides of A (Figs. 1 and 2). Formed on B^1 is a pendant C (Fig. 6) provided with notches C^1 for supporting the link lifter D (Fig. 7), by means of lips D^1. The other end of D is in the form of a cross-bar, and is fitted to slide horizontally in a bracket E. This link lifter D is so formed that when raised and drawn forward the lips D^1 will engage in

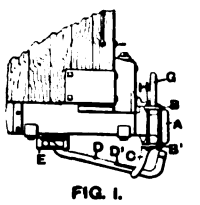


FIG. 1.

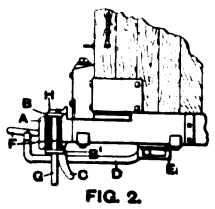


FIG. 2.

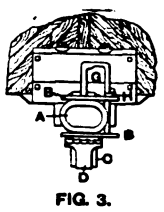


FIG. 3.

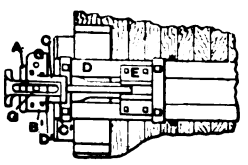


FIG. 4.

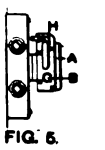


FIG. 5.



FIG. 6.

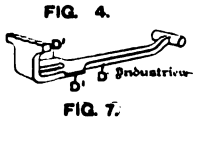


FIG. 7.

one of the slots C^1, so supporting it in a position that it holds the link F ready for engagement. G is the coupling pin, formed of a U shape as shown (Fig. 3), in one leg of which is formed a suitable notch, into which a catch H on the plate B engages when the former is in a raised position. When the cars are brought together the link lifter D strikes the opposite car, and is so forced backwards, by which action the lips D^1 are disengaged from the notches C^1, and D, together with the coupling link, is allowed to fall. During this operation a projecting part of the catch H strikes the car, so disengaging the former from the notch in G, and allowing the latter to fall and complete the coupling. Seven claims are made.—No. 15484. September 30th, 1890. 8*d*.

Metal Saws.—*G. Ryder, Bolton.*—In constructing saws for cold sawing metals the inventor forms the saw with a spiral periphery in place of a circular form, and provided with teeth round the whole of its periphery. Where a self-acting feeding motion is applied to the table of the machine on which the metal to be cut is secured, the inventor feeds the table toward the saw intermittently by positive gearing from the saw spindle, so that the material is advanced just after the largest diameter of the saw has passed through the metal. The inventor also proposes the formation of milling tools with spiral surfaces. Claims: A revolving cutter formed with its cutting edge arranged spirally, and either with or without tapered edges as described.—No. 5042. April 1st, 1890. 6*d*.

Yarn Beams for Looms.—*J. & R. Lindsay, Dundee, N.B.*—The invention has for its object to improve and simplify the construction of yarn beams for looms, and it consists principally in making the end flanges or discs of such beams of comparatively thin steel or wrought iron shaped to give the requisite strength or stiffness and provided with suitable bosses by means of which they are fixed on the barrels of the beams. The inventors prefer to combine this improved construction of end flanges with the arrangement described in a prior patent, No. 1916 of 1890, in which the drag appliances are applied to separate pulleys geared to the beam by toothed wheels. Claims: Making the end flanges or discs of yarn beams of looms of comparatively thin plates of steel or wrought iron, with the outer edges flanged outwards, the said end flanges being entire or in halves.—No. 12175. December 30th, 1890. 6*d*.

Reversing Gear for Electric Cars.—*G. R. Baldwin, Montreal, Canada.*—Referring to the annexed illustrations, Fig. 1 is a section of a reversing apparatus embraced by this invention, Fig. 2 being a plan showing the apparatus applied to an electric car, and Fig. 3 a detail thereof. As shown in Fig. 3, the two axles of the car are connected together by means of suitable gearing, and the shaft A is driven by means of the gear wheel B from a pinion on the armature shaft of an electric motor C. The gearing B is mounted loosely on A, and has fixed to its elongated hub a pinion D (Fig. 1). Mounted to revolve loosely on the hub of B is a disc E carrying studs F on which revolve the

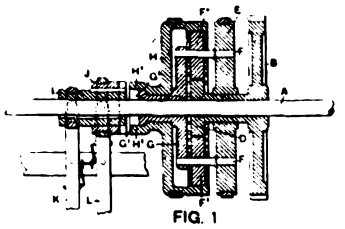


FIG. 1.



FIG. 3.

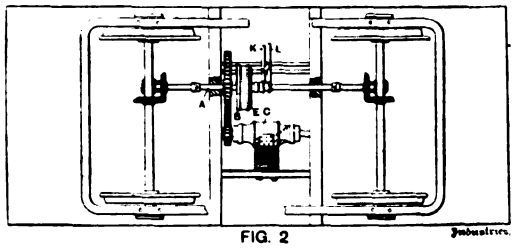


FIG. 2.

pinions F^1 gearing with D, the other ends of the studs F being fixed to a disc G. Mounted upon the elongated hub of G is an internal gear H gearing with the pinions F^1. Suitable hand-brakes surround the disc E and the gear wheel H, which, by means of suitable levers, may be applied as desired by the car conductor. The outer faces of the hubs of the wheel H and the disc G are provided with teeth H^1 G^1 (Fig. 2), which mesh with similar teeth on sliding clutches I J, the former mounted on A and the latter upon the former, and operated respectively through levers K L. The method of operation is as follows:—If it be desired to throw the shaft into gear so that it shall revolve in the same direction as the wheel B, the brake on E is applied so as to bring the disc G to a stop, and the clutch I is thrown into gear. The brake on E is then released, and the brake on H applied, the result of this being that the internal gear H is brought to a standstill, and the driven pinion D continuing to revolve, the idle pinions F^1 are dragged around between the two gears, and the disc G and the shaft A are given a rotation in the same direction as the disc B, but at a considerably less speed. If it is desired to bring A to a standstill, the brake on H is released. The internal gear H will then begin to revolve, and the brake wheel E become stationary. If it be desired to give the shaft an opposite rotation to that of the wheel B, the clutch I is withdrawn, brake on H then applied (brake on E being released by the same movement), clutch J is thrown into gear with H, and the brake on H released and the brake on E applied. This brings the brake wheel E and the disc G to a standstill, and the idle pinions F^1 are held on stationary bearings. The continued revolution of the driven pinion D causes the idle pinions to revolve in the opposite direction, which motion is transmitted to the shaft A through the clutch. The inventor also describes a modification of the above arrangement. Nine claims are made. —No. 14194. September 9th, 1890. 8*d*.

Brick Making Machines.—*S. Witt, Southampton.*—The inventor forms a machine for the above purpose as follows:—A wheel of suitable diameter is journalled in suitable framework, and has formed in its periphery recesses of a length, width, and depth similar to the bricks to be pressed. The bottoms of these recesses or moulds are movable, one bottom being connected to the bottom of the mould formed at a diametrically opposite position in the wheel. The length of these rods connecting the pairs of movable bottoms is such that whilst one bottom is situated at the lower extremity of its mould the other bottom will be situated at the upper end of its mould. Above this wheel a "pug mill" is placed wherein the clay is prepared, and when so prepared is pressed down a shoot, of a size and shape similar to that of the moulds in the wheel, into the said moulds by means of a plunger working within the chamber of the "pug mill." Beneath the wheel a horizontal endless band runs on suitable rollers upon which the bricks are delivered from one mould as the clay

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is pressed into the mould placed in a diametrically opposite position in the wheel. Claims: (1) In a brick and tile-making machine the mode or method of moulding bricks and tiles in a revolving drum or wheel, as described; (2) a brick and tile-making machine constructed substantially as described.—No. 5180. April 3rd, 1890. 8*d*.

MACHINES FOR MAKING WIRE MATTRESSES.—*C. H. Hard, O. G. Franks, & A. E. Loomis, all of Oneida, New York State, U.S.A.*—Referring to the annexed illustrations Figs. 1 and 2 are side elevations, Fig. 3 is a plan, and Figs. 4 and 5 details of a machine, constructed on the principle of this invention, and for the

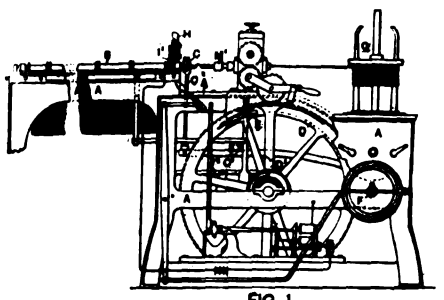


FIG. 1

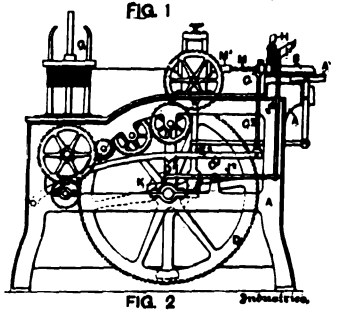


FIG. 2

Industries.

above purpose. Sliding in an elongation of the framework A is a slide A^1 having a longitudinal slot therein, on each side of which are the two grooved rollers B for supporting the mattress as it is formed. These rollers are geared together, and are revolved by means of a ratchet wheel on the end of one of them, into which engages a pawl or a lever C actuated through levers C^1 C^2 from a cam D^1 on the wheel D. The slide A^1 is given a slight reciprocating motion by means of levers E E^1 E^2, the latter of which is moved in one direction at each revolution of the wheel D by means of a suitable arrangement of cams on the end thereof, which are engaged by a cam on D. The wheel D derives motion from the main driving shaft F, as also do the reels G on which the wire is wound, and from which it is fed to form the mattress. These reels are geared with F by means of suitable intermediate frictional gearing so arranged that the speed of the reels may be regulated as desired. At the end of the rollers B is a bracket H (Fig. 4), in which is fixed the fixed knife I and the movable knife I^1, the latter being actuated through levers J J^1 J^2 from a cam K on D. In a line with the axis of the space formed by the opposite grooves of the rollers B is the wire-threader M around which the wire, after being forced by means of feed rollers L through the helical die M^1, passes to the space between B. The rollers L are driven from D, part of which is cut away (Fig. 5) in order that the said rollers may not be actuated during a certain period of the operation of the machine. A suitable automatic electric stop mechanism is also applied to stop the machine should the spirally formed wire not take its proper course. The described mechanisms of the machine are so arranged in relation

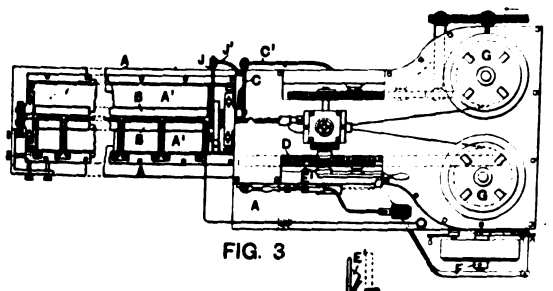


FIG. 3

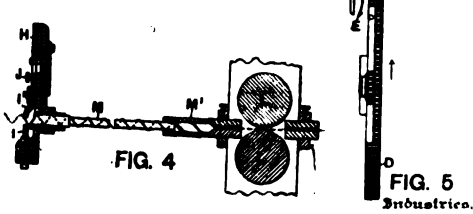


FIG. 4

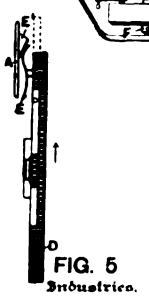


FIG. 5

Industries.

to each other that, in the process of weaving the mattress, the feed-rolls L draw the wires from the reel under the proper tension, and are passed through the twister M^1 which imparts a spiral form to the wires. The wires thence pass to the threader M which guides and pushes them into and along the space or channel between the rolls B B above the axis thereof, and at the same time imparts a rotary motion to the wires, the rolls B B remaining stationary. When the wires have thus been carried along between the rolls B B to a distance equal to the length of the mattress to be woven, the feed-rolls L automatically stop, and during this time of rest the pawl on the lever C turns the rolls B B sufficiently to carry the aforesaid wires slightly below their previous position without losing hold thereof, and then the knife I^1 descends and severs the wires. At the same time the sliding frame A^1 is moved slightly longitudinally, and thereby the upper helices of said wires are carried out of range with the wire held in the threader M. By the time this is effected the feed rolls L are again set in motion, and the coiled wires, which are then passed along between the rolls B B, intertwine with the upper helices of the wires held between the rolls as before stated. In this manner each pair of successive wires intertwines with the last preceding wires, and each turn of the rolls B B allows a corresponding portion of the woven fabric to drop. The fabric thus woven is supported in a suspended position from the rolls, and passes down through the slot in the elongation of the frame A. Ten claims are made.—No. 17717. November 4th, 1890. 8*d*.

PUNCHES AND DIES.—*F. B. Bristol, Waterbury, Connecticut State, U.S.A.*—The invention has reference to dies and punches for cutting sheet metal annular or serrated blanks for belt fasteners. The dies and punches for this purpose are formed of a number of separate sections joined together by bolts passing transversely through them, or other suitable means, each section being provided with cutting edges tapered uniformly to a point, the combined sections forming a continuous angular or serrated cutting edge. In this manner better cutting edges are obtained, and in case of breakage the broken part may be renewed without necessitating the formation of a new die or punch. Claims: A die or punch for cutting belt fastener blanks composed of a number of sections, each provided with cutting edges tapered uniformly to a point, said sections being jointed together by means of bolts to form a continuous serrated cutting edge, substantially as described.—No. 20907. December 23rd, 1890. 6*d*.

COMPOUND STEAM ENGINES.—*W. H. Allen, R. Wright, & R. W. Allen, all of London.*—Fig. 1 in the accompanying illustrations is a longitudinal vertical section, and Fig. 2 a horizontal section through the cylinders of an engine constructed according to this invention. A is the high-pressure cylinder and B the low-pressure cylinder, and C is a steam jacket surrounding A the central valve D D^1, and part of the low-pressure cylinder B. High-pressure steam is admitted into the jacket C through the steam pipe at E, and from this jacket the steam enters the steam chest F, through a port G, between the two pistons D D^1, which form the central valve. The piston valves D D^1, which are connected together by a rod H actuated by eccentrics in the usual manner, fit and

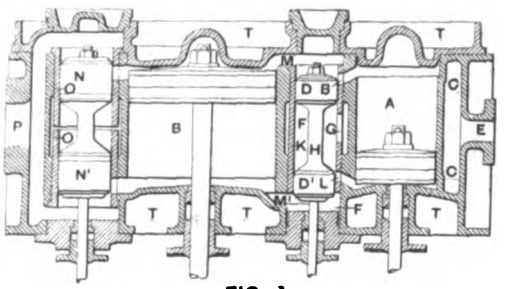


FIG. 1

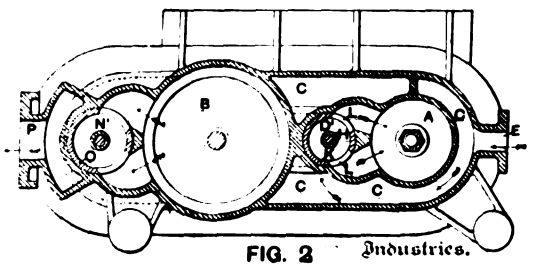


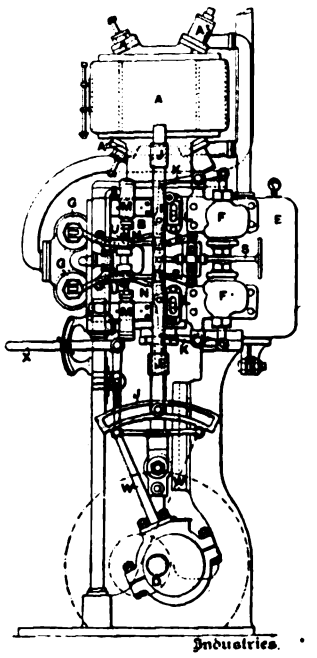
FIG. 2

Industries.

work in a case K provided with ports L, by which the steam between these valves is admitted as desired to the two ends of A alternately, is cut off at the determined times, and is allowed to pass directly to the corresponding ends of B. The inner edges of D D^1 serve to cut off the steam admitted to A, and their outer edges uncover the same ports and allow the steam to pass from the ends of A alternately into the ends of the steam chest F, and thence into the ports M M^1, leading direct into the ends of B. B is provided with a separate exhaust valve also consisting preferably of two piston valves N N^1 working in a casing O, the ends of which communicate with the exhaust pipe at P, and are operated by an eccentric in the usual manner. The exposed parts of the engine at T are preferably packed or covered with asbestos or other suitable non-conducting material. Claims: (1) The valves D D^1 in combination with the valves N N^1; (2) the steam jacket C, admission pipe E, port G, valve casing K, valves D D^1, ports L and M M^1, and exhaust valve N N^1, all arranged as described and illustrated.—No. 4892. March 28th, 1890. 8*d*.

PRESS DIES.—*S. Fox, Leeds.*—The invention relates to the construction of dies for pressing steam-boiler flues or other like tubular articles. For this purpose the female die is formed in two parts, the lower part being internally of the size to which the flue or tube is to be drawn. The upper part, which is bolted upon the lower part, and is made in two parts so that it can be easily removed, is formed internally with a tapered hole tapering downwards so that the lower end is of a similar size to that of the hole in the lower part. The surface of this tapered part is concentrically grooved, so that, as the heated disc of metal is pressed into it by the male die, it is successively acted upon by the ridges. The male die is made collapsible, and is composed first of a small circular punch, around which are arranged metal strips approximately triangular in cross-section, and held together by two steel rings, and between the projecting edges of these are three segmental pieces, which together form the die. The operation is as follows:—A disc, with a central hole formed in it, having been heated, is placed over the female die, and the male die caused to descend until only a small flange of metal remains in the upper or tapered part of the female die. This upper part is then removed, and by means of a suitable collar on the male die, that part of the metal standing above the surface of the remaining portion of the female die is pressed flat upon the said surface, so forming a flange. By now causing the punch in the centre of the male die to descend, the end of the tube is forced out, and the male die is then removed by first removing the central punch, the steel rings, the triangular pieces, and the segmental pieces in the order named. Claims: The arrangement substantially as described.—No. 4640. March 25th, 1890. 8*d*.

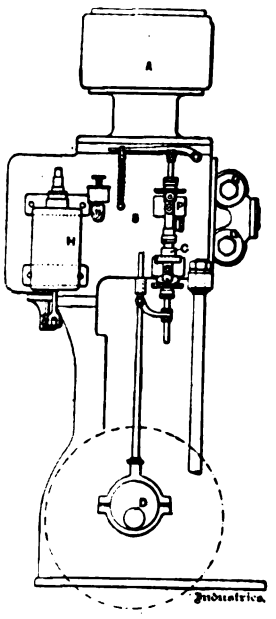
HOT-AIR ENGINES.—*W. de la Touche, Paris, France.*—In the accompanying illustrations Fig. 1 is a front elevation, and Fig. 2 a rear elevation of a marine engine constructed on the principle of this invention. A is the air pump, around the cylinder of which is formed a reservoir for containing liquid hydrocarbon



Industries.

FIG. 1.

supplied to the injection pump C, operated from the main crankshaft D. A^1 are the air suction valves of A, and A^2 the force valves through which and suitable pipes the air is forced into a reservoir E in connection by means of valves F with the main cylinder B, the exhaust from the latter escaping through valves G. A hand-pump H is provided for charging E when starting the engine. The introduction of the air and petroleum is effected by means of a rod I having a click, which rod is actuated by a "Stephenson" link motion J sliding in guides J^1. This rod actuates at the same time (1) the valves F for the introduction of air into the cylinder, by acting for a certain time upon the levers K through the medium of the small tappet which allows the said valves to fall back when the angle for the lift has been described, and guides L for the introduction of air; (2) the slides M for the admission of the petroleum, by means of levers N pivoted at N^1, and upon which act the arms O of a lever P pivoted at P^1 to I. Above and below this lever N are arranged the tappets Q fixed at the ends of the bell-crank levers R pivoted at R^1. By operating the hand wheel and screw S, the nut T is moved backward or foward as desired, thereby effecting the forward or backward movement of the pins U on the bell-crank lever R. By this means the tappets Q are operated, and they are encountered by



Industries.

FIG. 2.

the arm P. When this arm encounters a tappet Q the corresponding arm O of the lever P releases the arm N; (3) the outlet valves G are likewise actuated by the rod I by means of the levers U pivoted at U^1, and provided with rollers U^2, which are alternately raised by the projecting parts V on the rod I. The ignition is produced in the cylinder by an electric spark. The link motion J is for the purpose of keying two eccentrics W symmetrically upon the shaft so as to keep one-fifth of a revolution behind the crank. By means of the lever X the motion may

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be changed. Claims: An engine worked by gradual expansion and actuated by the ignition of liquid petroleum, the heating material employed, when introduced into the engine cylinder, being at a pressure equal to the pressure in the interior of the cylinder at the time of the ignition, the air which is to be admitted to be expanded being introduced with or without pressure previous to the heating material, and the construction of engines in accordance with the principle above set forth.—No. 2384. February 13th, 1890. 8*d*.

APPARATUS FOR MEASURING GRAIN.—*M. Cashin & G. Shanklin, both of New York, U.S.A.*—This device is for the purpose of measuring grain or other such dry matter, and for delivering it into barrels or other suitable receptacles. Fig. 1 in the accompanying illustrations is an end elevation, and Fig. 2 a side elevation partly in section of an apparatus for this purpose. Supported

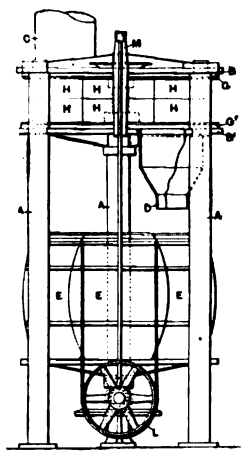


FIG. 1.

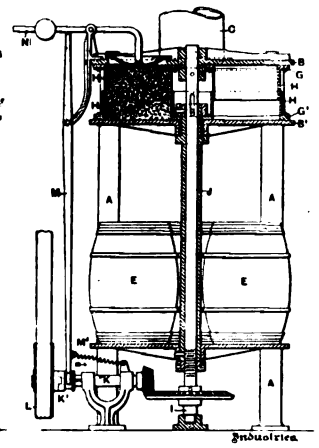


FIG. 2.

on columns A, and at a suitable distance from each other, are two plates B B¹, the upper of which has formed on one side of it an orifice communicating with the charging spout C, and the lower having an orifice communicating with the delivery spout D, through which the measured material is delivered into the barrels E placed upon a turntable F. Between B and B¹ are situated two plates G G¹, each carrying a half of the four telescopic measures H, the upper of which is connected direct and revolves with the vertical shaft I. The lower plate G¹ is fixed to a sleeve J capable of longitudinal movement on I, so that the capacity of the measures H can be varied. As the plates G G¹ revolve together with measures H, the latter will be automatically filled from C and discharged from D, as will be understood. Fixed on the intermediate driving shaft K, from which I is driven, as shown, is a clutch K¹, by means of which K is connected with the driving pulley L. This clutch is operated in order to stop the motion of the machine when the supply of grain is exhausted, as follows:—The lower end of a lever M pivoted, as shown, tends by means of spring M¹ to throw K¹ out of engagement. The other end of M, however, engages a notch on a lever N, so preventing this action until the lever N is allowed to be raised at that end by the falling of its opposite end (formed as shown in Fig. 2) into one of the measures H through an orifice in B. Claims: (1) In a grain-measuring device, the combination of the turntable G upon the shaft I and having one half of the measures H, the turntables F and G¹ upon the sleeve J, which rotate with said shaft and are adjustable vertically, said turntable G¹ having the other half of the measures H, the stationary floor B, and the vertically-adjustable floor B¹, said floors and turntables having orifices that communicate respectively, with charging and delivery spouts C and D, as set forth; (2) in a grain-measuring device, the combination, with the revolving and perforated turntable G, having the attached measure H, and with driving mechanism having clutch-connection with a fast and loose pulley of the governor, as described.—No. 15745. October 4th, 1890. 8*d*.

TUBE CUTTER.—*C. Wicksteed, Kettering, Northampton.*—The cutter embraced by this invention is for the purpose of cutting out boiler and such like tubes from the interior. In the annexed illustrations, Fig. 1 is a longitudinal section and Fig. 2 a cross section on line Z Z of a tool for this purpose. The body A, formed as shown, carries, and is adapted to be turned by, a ratchet

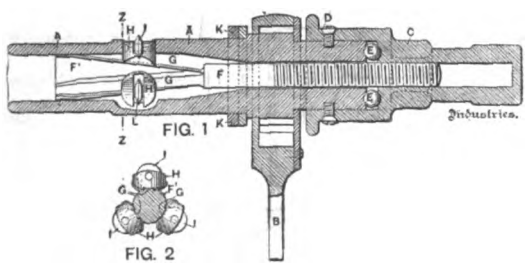


FIG. 1

FIG. 2

handle B. The cap C is secured to A by means of screws D running in a groove in the latter, balls E being placed between the ends of each to take the thrust of A. Screwed into C and passing freely through A is a screw F, the outer end F¹ of which is tapered as shown, and has formed on its surface dovetailed ways G upon which slide the holders H of the cutters I. From the above it will be seen that, by revolving C in a suitable direction, the screw F can be drawn into the body of A or forced towards the end thereof, so causing the holders H to be forced outwards from or withdrawn into A. Claims: In a tube cutter (1) a cutter which is withdrawn into the body of the tool as described; (2) a tapered bolt F F¹ having dovetailed faces G for the purpose described; (3) the combination with a tapered bolt F F¹ having undercut working faces of a cutter box H adapted to carry the cutter and also dovetailed to engage with the faces of the bolt as and for the purpose described; (4) the combination with the cutter operating bolt of a body extension A¹ for the purpose of serving as a guide for and also for protecting the said bolt; (5) the combination and arrangement of parts constituting the complete tube cutter substantially as described and illustrated. —No. 2274. February 12th, 1890. 6*d*.

ELECTRICITY.

SWITCHES.—*A. J. Kingdon, London.*—The switch embraced by this invention is a double-pole switch, for use with high tension currents. This is constructed in the following manner:—A long roller of wood or other insulating material is pivoted in suitable brackets fixed to the base of the switch. Near the ends of this roller metal arms or springs project, which make contact with spring or other metallic pieces fixed to the base, which is preferably of slate. A third radial rod fixed to the centre of the roller has pivoted to it a second and long rod, by the operation of which the spring arms, which are preferably of a U shape with the ends turned outward, can be brought in electrical connection with the contact pieces to which the circuit wires are connected. Claims: The combination in an electrical switch—(1) Of a roller of insulating material with one or more metal contact arms; (2) a roller carrying a metal contact arm and an operating lever pivoted to an arm attached to the roller; (3) a roller carrying contact arm with an operating rod at right angles to it and pivoted or geared to it; (4) in combination with a switch-board of horizontal rollers operated by vertical rods; (5) the improved switch and switch-board as described.—No. 4275. March 19th, 1890. 8*d*.

ARC LAMPS.—*A. Gay, Brighton, & R. Hammond, London.*—The invention relates to the use of two motors for regulating the positions of the electrodes in arc lamps. One motor is traversed by the main current, and is so proportioned in relation to the resistance against which it works that it remains at rest when the normal current is flowing; when the current increases above the normal point this motor commences to rotate and draws the carbons apart. The second motor is placed in a shunt circuit around the arc, and is likewise so proportioned that when there is a normal difference at the terminals of the motor it is stationary. When the difference of potential increases, however, the motor rotates and moves the carbons nearer to one another. The motors are arranged on the opposite ends of a horizontal shaft journalled in the upper part of the lamp frame. In the centre of this shaft are arranged two pulleys, to which are connected two cords attached at their other ends respectively to the upper and lower carbon-holders, in the form of slides sliding on two or more vertical rods, and so disposed that the rotation of the shaft causes the carbon-holders to slide in opposite directions, so that if the shaft is revolved in one direction the slides move towards one another, and if in the other direction from one another. Claims: (1) An electric arc lamp, in which the position of the carbons is regulated by two rotary electric motors, one of which is traversed by the main current of the lamp and is in series with the carbons, and the other of which is in a shunt circuit around the voltaic arc, the two motors being so arranged that the rotative force of the one is opposed to that of the other, and balances it when the voltaic arc is of its normal length; (2) the construction of electric arc lamps substantially as described.—No. 4991. March 31st, 1890. 8*d*.

WELDING METALS.—*W. P. Thompson, London.* (*C. L. Coffin, Detroit, Michigan State, U.S.A.*)—According to the invention the welding operation of metals by the aid of electricity is performed under water. For this purpose a trough is used, in one side of which is formed a stuffing box. Through this works a slide, carrying on its inner end a suitable clamping device to which one of the wires of the electric circuit is connected. This slide, which is insulated from the trough, is made hollow, so as to receive the projecting end of the rod or other bar to be welded, which bar is held in the clamping device, and a suitable length projects beyond said clamping device. The slide is opened at its inner end so that water can circulate in the interior thereof. Another clamping device is fitted to a bracket on the opposite side of the box and holds the other part of the rod to be welded, the other wire of the circuit being connected thereto. A screwed spindle is attached to the outer end of the slide and passed through a screw-threaded hole in a bracket projecting from the side of the trough, so that, by suitably revolving the screwed spindle, the slide, and so one rod, can be advanced towards the other rod. Claims: The method described of electric welding consisting in immersing articles to be welded in water, heating them electrically, and pressing them together to form a weld. The apparatus for welding metals electrically combined and arranged substantially as described.—No. 15,455. September 30th, 1890. 6*d*.

CHEMISTRY.

MANUFACTURE OF BORAX.—*The Borax Company, Limited, London.*—The process embraced by this invention consists first of a preliminary purification of borate of lime, obtained by one or more washings of the ore in a solution containing carbonate of soda in a quantity equivalent to the sulphate of lime to be eliminated. The liquid is then drawn off, and carries with it the sulphate of soda that has been produced, leaving a mixture of borate and of carbonate of lime. To this purified mass a quantity of carbonate of soda necessary to convert the borate of lime into a basic borate of soda is added, and the mass diluted just sufficiently to enable it to be poured; secondly, it is introduced into an air-tight metallic recipient, capable of supporting a pressure of several atmospheres, which is then connected with a boiler. The steam throws the mass into violent agitation, the pressure, and in consequence the temperature, rises rapidly, and all the borate of lime is rapidly converted into a basic borate of soda and carbonate of lime. The contents of the recipient, whose density is about 60° Bé., are then forced into a vat, where the amount of boracic acid necessary to convert the basic borate of soda into borax is added, and in which they are mixed with the mother liquors of preceding crystallisation of borax. Claims: (1) In a process for manufacturing borax from borates of lime and boracite, the preliminary purification of the borate and elimination of the foreign matters and salts which accompany it, and more particularly of the sulphate of lime, as described; (2) the treatment of borate of lime at a high pressure, as described. —No. 2526. February 17th, 1890. 6*d*.

MISCELLANEOUS.

RAMRODS FOR ORDNANCE.—*T. H. Howard, Charlton, & J. M. Lapping, East Greenwich.*—The inventor's object is to provide a joint, by means of which the several parts of the ramrods or sponging rods of large ordnance may be readily and speedily jointed. For this purpose the inventor forms on one end of one of the parts a T-shaped metal head adapted to pass into a socket on the end of the other part of the rod, and when slightly turned the projecting portions of the T part pass over suitable ledges in the female part. If desired, a spring or sliding catch or bolt in one part may pass into a hole or recess in the other part, so preventing the rotation of one in the other when in use; or the two parts of the joint may be inclined on the faces which come together, so that, when turned one on the other, the two parts will jam tightly together. Claims: Ram or sponging rods for ordnance constructed in two or more lengths, the one length preferably having a T-shaped head, and the other a corresponding opening for the reception of the T head, which parts, when turned, will lock or jam together, and having a spring catch or bolt to prevent rotation thereof, substantially as described.—No. 948. January 18th, 1890. 6*d*.

SHIP SIGNALLING APPARATUS.—*M. Chadburn, Liverpool.*—The accompanying illustrations are of a receiving apparatus, constructed according to this invention, and for the purpose of receiving orders from the bridge, Fig. 1 being a part front elevation, Fig. 2 a side sectional elevation, and Fig. 3 details. Running in a frame-work A is a spindle B, actuated by means of a wheel B¹ and a chain or other means from the bridge. Loose on the end of B is a sleeve C (Fig. 3), carrying on its outer end the pointer D, working over a dial E, and on its inner end a toothed segment F on the upper surface of which a wheel F¹ is pressed by a spring F². This sleeve can revolve around B, subjected, however, to the limit of the slot C¹ in the former, in which works a pin in the latter. Two toothed wheels G G¹ are also carried on B, and actuate by means of bell-crank levers H H¹ two pairs of spring strikers I I¹, so causing them to strike the gong J. In action, when the shaft B is rotated by the actuation of the wheel B¹ from the transmitter, one of the teeth of the wheel G or G¹, as the case may be, actuates the short vertical end H² of the bell crank H or H¹, and draws one of the hammers down, and as soon as such tooth passes over or leaves such end H² the hammer is released and strikes the gong; then on the further stroke of the shaft, that is in its latter portion, the other

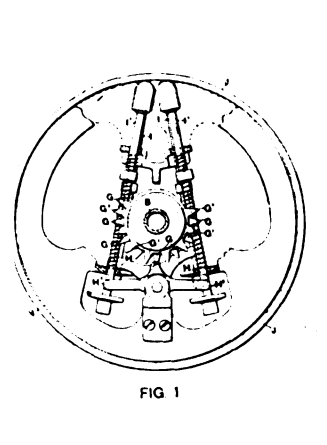


FIG 1

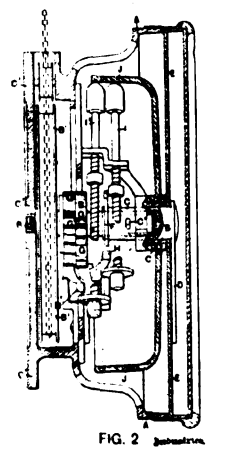


FIG. 2

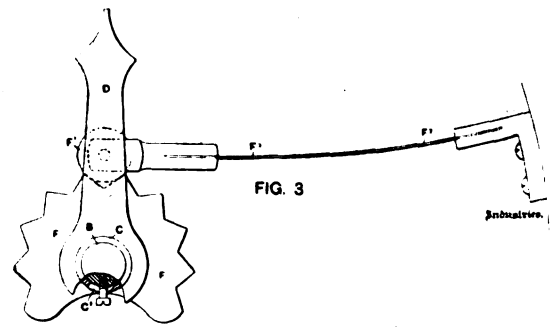


FIG. 3

toothed wheel comes into action with the other bell crank, and it is similarly worked, and the gong is sounded simultaneously—or nearly so—as the pointer moves into its correct and central position over the order on the dial it is intended to move it to, this latter movement of the pointer being effected automatically by means of the roller pressing on the toothed segment. Should, however, through mechanical defects or causes, the wheel B not receive from the transmitter enough movement, on some occasions, to cause the gong to be sounded as the pointer moves to its central position over the order to which it is intended to be moved, the sound given by the hammer first actuated will have called attention to the change of order. Six claims are made.—No. 1143. January 22nd, 1890. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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THE WEST HIGHLAND RAILWAY.

MESSRS. FORMANS & MACCALL, GLASGOW, ENGINEERS; MESSRS. LUCAS & AIRD, LONDON, CONTRACTORS.

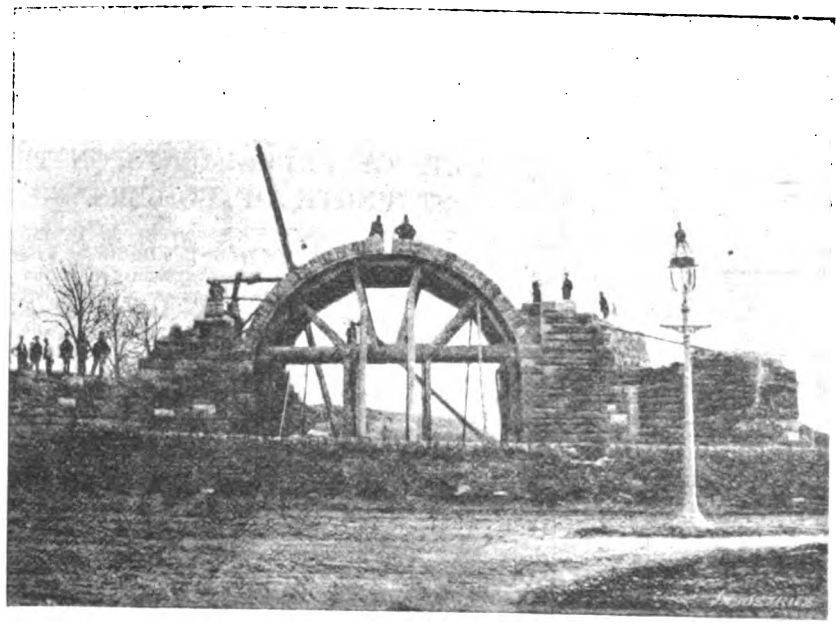


FIG. 5.—BRIDGE OVER PRIVATE ROAD AT 53 CHAINS.



FIG. 6.—HELENSBURGH CUTTING: SOUTHERN ENTRANCE.

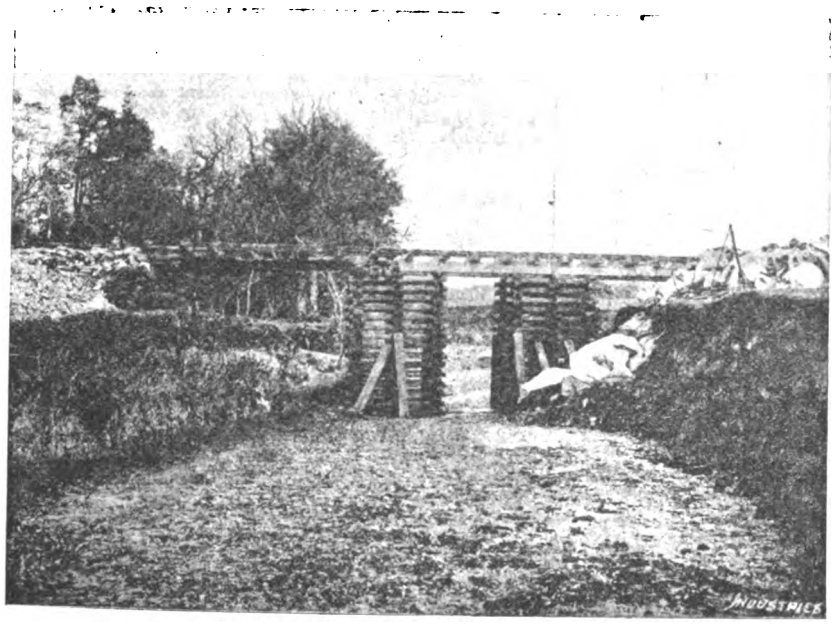


FIG. 7.—TEMPORARY BRIDGE NEAR ARDENCAPLE BURN.

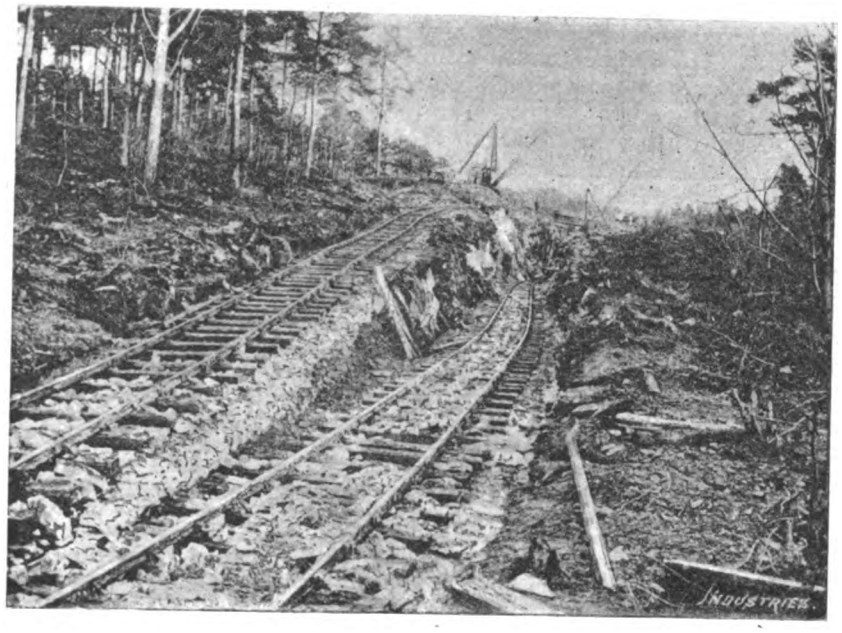


FIG. 8.—ROW CUTTING: NORTH END, LOOKING SOUTH.

THE WEST HIGHLAND RAILWAY.

II.

THE railway now under construction between Helensburgh on the Clyde and Fort William received some general notice in our recent article (see *Industries*, Vol. X., page 12), when we gave the most salient features of this important undertaking, and dwelt more particularly with the section extending from Crianlarich to some four miles beyond Tyndrum, illustrating our description by views portraying the most interesting and characteristic works being carried out at this point.

In the present notice we pass to the most southern section of the railway under consideration—viz., the portion from Helensburgh to about two miles beyond Whistlefield—and give a series of views extending from the commencement of the line to about the middle of this section, leaving the remainder to be dealt with in later issues. The line, as already stated, commences at Craigendoran, near Helensburgh, where it forms a continuation of the North British Railway, and, running up the eastern end of Helensburgh, reaches the high ground at the back of the town, and, taking a curve westward, skirts the northern boundary of that pleasant watering place. The line then passes along the hillside to Gareloch Head through pleasantly wooded and highly picturesque country, affording at every point charming views of the Gare Loch, with the beautiful peninsula of Rosneath on the opposite shore. The loch is never lost sight of until Whistlefield is reached.

Considering in detail the leading features of the first portion of this section, which form the subject of this notice, the line commences in bank to the east of Craigendoran Station; Drumfork Burn is then passed, a 7ft. culvert being provided for the passage of the burn, and the Dumbarton Road is crossed by a girder bridge, 35ft. on the square, the span on the skew being about 55ft., the angle being 39°. The line, still in bank, crosses a private road leading to an adjoining mansion-house by a masonry arch bridge, having a span of 30ft. (see Fig. 5). A diversion of the private road is being carried out at this point. The bank is well advanced towards the Dumbarton Road, whilst the arch bridge already mentioned, and which occurs at 53 chains, has made good progress, the arch being turned and the lining walls practically completed. The bridge has been built from stone quarried near its site, and presents a handsome and massive appearance. The bank already referred to, as extending from the commencement of the line to about two chains beyond this bridge, is about $\frac{7}{8}$th of a mile in length, and has a maximum height of about 30ft. A small cutting of soft material, some two chains in length, is then passed, which is completed, and the line again runs into bank up to 1 mile 20 chains, the greatest depth of this bank being about 20ft. At 1 mile 24 chains a steel girder bridge carries the old Luss Road over the railway, being approached on either side by raised banks. The cutting at this point is a small one, and calls for no special remark beyond the fact of its completion.

At 1 mile 36 chains the large cutting commences, which forms one of the leading features of the section now under consideration. This cutting extends for nearly a mile—viz., from 1 mile 34 chains to 2 miles 23 chains—and is crossed by several bridges, &c., which may be briefly enumerated. At 1 mile 48 chains a fly-over bridge, 30ft. wide, carries a private road over the railway, whilst at 1 mile 54 chains a water trough, constructed of steel, carries a stream over the line, whilst at 1 mile 72 chains a culvert carries the burn there met with under the railway, a siphon being also built to convey water to the mill lade.

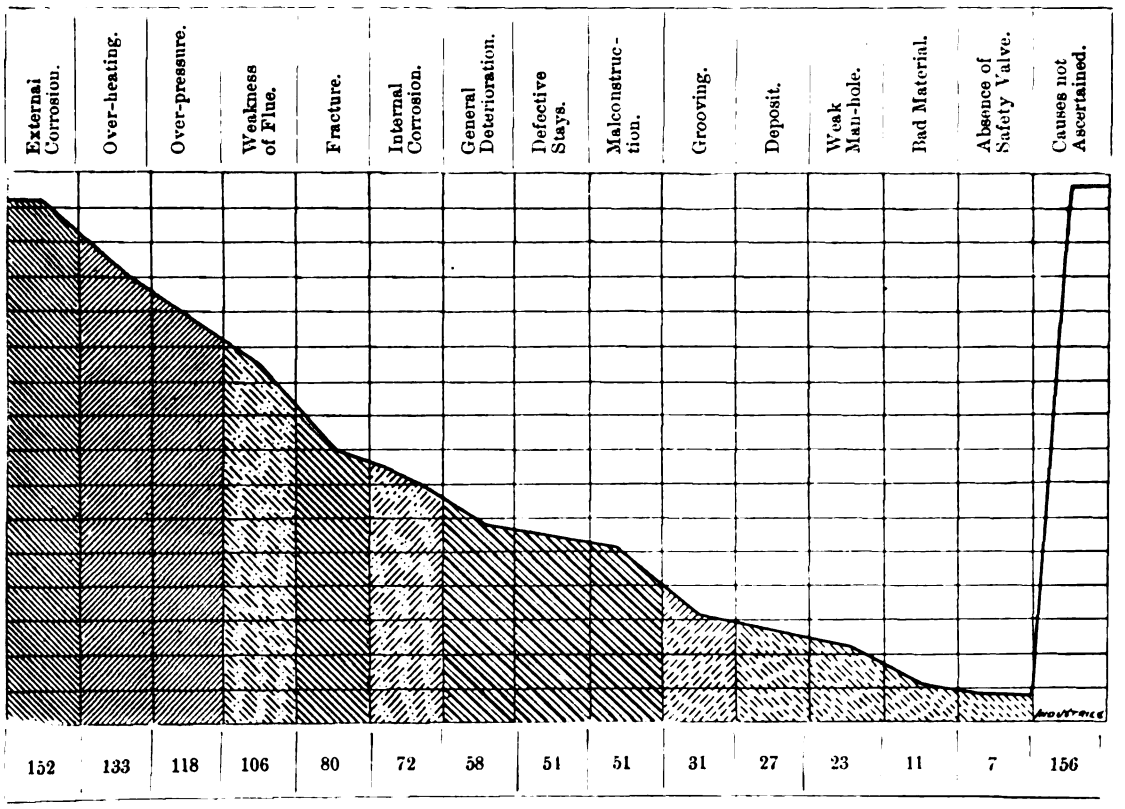
The Helensburgh goods and passenger stations are also placed at this point in cutting, and considerably increase the amount of material to be excavated, and the following bridges span the cutting towards its northern end:—At 2 miles 20 chains a steel girder bridge carries the Luss Road across the railway, being 40ft. in width and having a span of 30ft.; at 2 miles 9 chains a foot-bridge, in connection with the Helensburgh passenger station, is carried across the line, and several accommodation roads, forming one road 60ft. in width, on the south side of the railway; whilst at 2 miles 9 chains a public sewer is met with, and, being lowered, is duly carried under the line.

This important cutting is being entered in three sections (Fig. 6 showing the southern entrance) the

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DIAGRAM SHOWING THE CAUSES OF BOILER EXPLOSIONS.

By B. H. Thwaite, A.M.Inst.C.E., F.C.S.



Number of Explosions from the Causes Enumerated Above.

material met with being rock covered by a thick bed of soft material. The rock is being dealt with by blasting and quarrying. The Helensburgh cutting extends, as already stated, for about a mile, and has a maximum depth of over 40ft., whilst the total quantity requiring to be excavated, including that to be removed to form the site of the Helensburgh passenger and goods stations, is estimated as about 160,000 cubic yards. Work is being vigorously maintained on all three sections of this important cutting, and the excavation is well advanced.

The finished permanent way, we may remark, which runs up to this point, as the completed portions of the line, here joins an overland route, passing along the edge of the cutting, this temporary road being laid with the material to be subsequently employed in the permanent way, and consisting of 75lb. steel rails and 36lb. chairs, service line being one of the smoothiest and most carefully laid it has fallen to our lot to travel over; and, by freedom from casualties, has doubtless already amply repaid the care bestowed in its construction.

Returning to the termination of the great Helensburgh cutting, which extends 2 miles 23 chains, we pass to a short bank running to 2 miles 32 chains, and 45ft. in height, over a 4ft. culvert; a bridge, 30ft. span, passing under the railway at 2 miles 29 chains. A small cutting then follows, and at 2 miles 60 chains a bridge of 30ft. span occurs, together with a 3ft. culvert, provided for the passage of the Ardencaple Burn. Fig. 7 illustrates the temporary bridge provided at this point for the passage of the overland route, and is illustrated as portraying a type of construction occurring on this section. The view readily explains itself, the piers being composed of creosoted sleepers stacked in cross-layers. This bridge is succeeded by a shallow cutting; then various minor banks and cuttings alternate up to 3 miles 34 chains, where a 3ft. culvert has been built, and one chain further on—viz., at 3 miles 35 chains—the important Row cutting commences, running out at 3 miles 75 chains. This cutting, which forms the other leading feature of the length now under consideration, is entirely through rock, and is being entered, like that at Helensburgh, in three sections. Air-compressing plant has been erected at the northern end of the cutting, and rock drills are employed at all points. Row Station occurs in this cutting.

Fig. 8 illustrates the Row cutting. A bank succeeds this cutting, and passes over a culvert carrying the Row water-pipes, an accommodation bridge occurring at 4 miles 6 chains. This is followed by a small cutting, and then bank again occurs, extending from 4 miles 11 chains to 4 miles 23 chains, and 70ft. in height.

The girder bridges referred to in the foregoing description call for no special notice. Steel has been used throughout in their construction, and an average ultimate tensile strength of about 30 tons per square inch has been specified; whilst we are informed the maximum stress to which they can be subjected under any possible circumstances of severe loading does not exceed 6 tons per square inch. The girder work has been entrusted to Messrs. Findlay & Co., of Motherwell, the material being rolled in the district.

Cement concrete is being employed in bridges, &c., having a proportion of 5 to 1. The earth slopes throughout the undertaking are made 1½ to 1, whilst the rock is being cut to a slope of ¼ to 1. A considerable length of permanent way is already laid on this portion of the first section.

The contractors' headquarters are at Helensburgh, and a commodious depôt has also been established on this section near Helensburgh. Huts for the accommodation of the navvies employed on the undertaking are scattered at intervals along the line, in connection with which it may be mentioned that a large number of crofters from Skye and the other outer islands have been attracted to the line by the prospect of lucrative employment.

GRAPHICAL VIEW OF THE CAUSES OF BOILER EXPLOSIONS.

The above diagram, showing graphically the causes of boiler explosions as regards land boilers, is based upon an analysis of available reports of boiler explosions over a series of years. It was prepared by Mr. B. H. Thwaite for his lecture on steam generators delivered a short time back at the Yorkshire College Textile Society. The diagram shows in a striking manner that the causes are divisible into the following categories:—

1st,	Through the influence of	thermic action.
2nd,	„	„	chemical action.
3rd,	„	„	physical action.
4th,	„	„	structural defects.
5th,	„	„	defective supervision.

The diagram also shows clearly the necessity of using a form of steam generator not liable to corrosive effects, and points to the desirability of care being exercised in thoroughly draining the foundations of steam generators of the Lancashire and Cornish type, because by capillary attraction the water ascends through the flue walls until it reaches the shell plates of the boiler, and local corrosive action is at once set up, which continues insidiously destroying the safety margin of the plates. The action is probably accelerated by the alternate effects of dampness and the contact of heated gases, resulting from the stoppage of the boilers each week end. This diagram might with advantage be placed in the hands of all those who are responsible for the safety of steam boilers.

RESULTS OF EXPERIMENTS ON THE STRENGTH OF BOILERS.*

Last year the author brought before this Institution an argument intended to show that the present system of calculating the strength of boilers is erroneous, and proposed a new method. Since then he has made a series of experiments on the subject, the results of which he now desires to place before the Institution.

His previous argument was that it was unnecessary to make a boiler as strong as if it were an endless ring, and that the resistance, due to the connection between shell and ends, should be added to the circumferential resistance of the shell, in order to get the true strength of the structure. If this were true, the strength of boilers, especially of the marine type, would not be, as hitherto assumed, independent of their length, but would depend as much on their length as on their diameter. To test this, he made three small cylinders (see Figs. 1, 2, and 3, page 244) of equal diameter, thickness of plate, &c., differing only in length, and tested them to destruction by water pressure. Each of these drums was made of a sheet of $\frac{7}{16}$in. steel plate rolled to a circle of 26in. diameter, with one longitudinal single riveted joint. The ends were flanged outwards and riveted to strong end plates which were very strongly stayed, longitudinal and end joints were single riveted, pitch of rivets 1¼in., diameter of rivets ½in., diameter of holes $\frac{7}{16}$in., all drilled in place; percentage of plate in line of rivet holes, 55 per cent. of solid plate. The riveted joint was adopted because the only other alternative that occurred was a welded seam, and the author considered that a known weakness was better than an unknown strength. The single riveted joint was adopted, in order to keep the pitch of rivets small, and give the thin plate a chance of being water-tight with ordinary caulking. The end attachment was made in the style shown, to keep all the rivets outside, and avoid the necessity for any hand holes in end or shell.

Experiments.

Model No. 1.—The working pressure of all these models being, according to standard rule, 80lb., Model No. 1 was, after completion, tested and made tight to a test pressure of 160lb. before any measurements were taken. Five circles were then drawn round the shell as shown dotted in Fig. 1. These were marked off at the points *a*, *b*, &c., in order that the extension of joint might be observed separately from the extension of solid plate. Measurements were taken from *a* to *b* across the joint by a pair of compasses, and from *b* to *a* round the shell by a steel tape. Pressure was raised by means of a small hand test pump. Measurements of joint and plate were taken at various pressures, and are given in Table I., the pressure being reduced to 0 from time to time. Up to 600lb. pressure the model was not seriously strained; the leakage looked considerable, but the amount could not have been great, as an occasional stroke of the hand pump was sufficient to keep the pressure constant for a considerable time while all the measurements were made and checked and recorded. As the pressure rose above this, the leakage increased rapidly, and not more than 630lb. could be got with the hand pump. At this pressure the joint was evidently strained, but in other respects the model was not appreciably altered. The experiment was then stopped, the joints and rivets were all caulked and the model was carried into the boiler shop and connected to the hydraulic service pipes. Pressure was raised to 700lb. by a pair of steam pumps, but this could not be increased owing to leakage. Two other pumps were then coupled on, but were still unable to increase the pressure, the model still remaining not seriously damaged. A connection was then made with the accumulator, and the pressure rose to 730lb.; the form of the model visibly altered, and again the leakage overpowered the whole supply of water. The form taken by the model is shown by the dotted line in Fig. 1, which shows a decided hump near to each end and a slight hollow in between.

Model No. 2.—Was tested in much the same manner as No. 1. The leakage overpowered the hand pump at 550lb. pressure; joints and rivets were then caulked and model connected to hydraulic service pipes. In this case four pumps were discharging into the accumulator, and the pressure was admitted from thence to model. Pressure was allowed to increase gradually till it reached 680lb.; the model then visibly changed form, and the leakage overpowered the water supply. The form taken is shown in Fig. 2, which closely resembles that of No. 1.

Model No. 3.—This model had only three lines drawn on it, and had not been tested previous to the experiments; it was therefore thought advisable to caulk up some slight leaks which showed themselves at 250lb. pressure. This was done; the pressure was then increased by the hand pump to 550lb., when the leakage balanced the supply of water. The model was then caulked all over and connected to the accumulator. The pressure was raised quickly to 800lb.; at that pressure the joint broke with a loud report. The form taken by the model is shown in Fig. 3, the two outer curves showing the form taken by the plate all round the circle, except in the immediate region of the joint, where the barrelling is most pronounced, as shown by the curve at centre of Fig. 3. A view of the ends of the models is given in Fig. 4.

All the facts and figures observed during the experiments are given in Tables I. to V. and in the illustrations. But facts and

* Paper read by Mr. J. C. Spence before the North-East Coast Institution of Engineers and Shipbuilders, on the 20th ult.

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EXPERIMENTS ON THE STRENGTH OF BOILERS.

TABLE I.—Model No. 1. 26in. Diameter, 44in. Long.

Pressure per Square Inch on Model.	—	Extension of Joint at the Points marked in Fig. 1.					Extension of Plate at the Circles marked in Fig. 1.					Remarks.
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
	Original length = ..	In. $3\frac{55}{64}$	In. $3\frac{55}{64}$	In. $3\frac{55}{64}$	In. $3\frac{56}{64}$	In. $3\frac{56}{64}$	Steel tape 6ft. $7\frac{5}{32}$in. used for all circles.					
Lb. 100	With pressure on ...	0	0	$-\frac{1}{64}$	0	0	In. 0	In. 0	In. 0	In. 0	In. 0	Pressure applied by a small hand pump up to 630lb.
	Do. off ...	0	0	0	0	0	0	0	0	0	0	
200	Do. on ...	0	0	$-\frac{1}{64}$	0	0	0	0	$\frac{1}{32}$	0	0	Joint commenced to "weep" at 200lb., at line 4.
	Do. off ...	0	0	0	0	0	0	0	0	0	0	
250	Do. on ...	0	$-\frac{1}{64}$	$-\frac{1}{64}$	0	0	0	0	$\frac{1}{32}$	0	0	"Weeping" at same place, but no increase.
	Do. off ...	0	0	$-\frac{2}{64}$	0	0	0	0	0	0	0	
300	Do. on ..	0	$-\frac{2}{64}$	0	0	0	0	0	$\frac{1}{32}$	0	0	Do., do., also at 1 rivet in bottom flange.
	Do. off ...											
350	Do. on ...	0	$-\frac{2}{64}$	$\frac{1}{64}$	0	0	0	0	$\frac{1}{32}$	0	$\frac{1}{32}$	Do., do. do.
	Do. off ...											
400	Do. on ...	0	$-\frac{1}{64}$	$\frac{1}{64}$	0	0	0	0	$\frac{1}{32}$	0	$\frac{1}{32}$	"Weeping" at same place, but no increase, also at 1 rivet in bottom flange; battens tried on cylinder, which was found to be quite straight.
	Do. off ..											
450	Do. on ...	$\frac{1}{64}$	$-\frac{1}{64}$	$\frac{1}{64}$	0	0	0	0	$\frac{1}{32}$	0	$\frac{1}{32}$	Leaking at several points in longitudinal joint and several rivets in flanges.
	Do. off ...											
500	Do. on ...	$\frac{1}{64}$	$-\frac{1}{64}$	$\frac{2}{64}$	0	0	0	0	$\frac{3}{64}$	0	$\frac{1}{32}$	Leakage increasing.
	Do. off ...											
550	Do. on ...	$\frac{1}{64}$	$-\frac{1}{64}$	$\frac{2}{64}$	$\frac{1}{64}$	0	0	0	$\frac{1}{16}$	0	$\frac{1}{16}$	Do., cylinder still straight by batten.
	Do. off ...											
600	Do. on ...	$\frac{1}{64}$	$\frac{1}{64}$	$\frac{3}{64}$	$\frac{3}{64}$	0	0	0	$\frac{1}{16}$	0	$\frac{1}{16}$	Leaking heavily.
	Do. off ...	0	0	$\frac{2}{64}$	$\frac{1}{64}$	0	0	0	0	0	0	
630	Do. on ...	0	—	$\frac{3}{64}$	—	$\frac{4}{64}$	0	—	$\frac{1}{16}$	—	$\frac{1}{16}$	Leakage from joint was greater than hand pump could overcome; form of model unaltered.
	Do. off ...	0	0	$\frac{2}{64}$	$\frac{2}{64}$	$-\frac{1}{64}$						
730	Do. on ...	Model was caulked all over and connected to the hydraulic service pipes in boiler shop. Measurements could not be taken on account of leakage.					—	—	—	—	—	Model bulged near the ends at 730lb. Pressure was maintained at that for some time, but could not be increased.
	Do. off ...	$\frac{3}{64}$	$\frac{6}{64}$	$\frac{9}{64}$	$\frac{8}{64}$	$\frac{1}{64}$	$1\frac{5}{64}$	$1\frac{39}{64}$	$1\frac{33}{64}$	$1\frac{41}{64}$	$1\frac{23}{64}$	

figures are of little use and may be very misleading until the laws which govern them are understood. And if the author could give a clear and definite explanation of the results of his experiments, he would feel that he had done some service; but he fears that he may have only succeeded in unsettling established principles without being able to offer anything definite in their place. Although he has not been able to deduce a clear relation between pressure and strain, yet, as he has given a good deal of attention to this problem, and made some steps towards its solution, he has recorded the partial solution worked out by him. As the arguments are too speculative to affect practical work he has given them in an Appendix (which we hope to publish in our next issue); and he now only proposes to notice a few facts, to prove that there is a problem to solve, and attempt to extract some practical guidance from these experiments.

In the first place he would like to call attention to the points that appeared to him to be most significant. No. 1 was the first model tested, and he was surprised to find that the first measurable alteration was a contraction at the joints. This remarkable result is not easily reconciled with the theory that the shell was subject to a uniform tension and to no other strain. He had searched through many records of tests to find if this was unusual, but could find very little directly bearing on it. Some few facts pointed to a similar action in other cases, but they were too indirect for quoting. The next point worthy of notice is the very high pressure, 730lb. to the inch, sustained by this model. On the endless ring hypothesis the elastic limit of the joint would correspond to a pressure of 328lb.; that of solid plate with a pressure of 596lb. Those who are practically familiar with the sudden and rapid elongation which occurs when steel of this character reaches its elastic limit will probably agree that, in this experiment, that limit had not been reached (at any rate in the plate) till the pressure was about 700lb., and had not been much passed at 730lb. Another curious fact was, that the joint, except by leakage, did not appear to have suffered more than the solid plate. Fig. 5 shows the form of the model at the place where it was most strained. It will be seen that this is very nearly circular, and should be compared with Fig. 6, which shows the form of Model No. 3, in which the joint and the plate near the point show signs of much greater distress than the rest of the plate. Seeing that the joint has only 55 per cent. of the strength of the plate against circumferential tension, this behaviour suggests the idea that plate and joint were not bulged by circumferential tension, but by a radial strain acting normally to the circumference. The most striking result is the fact that the form finally assumed was rather hollow in the centre. Uniform circumferential tension would, one would expect, produce a straight line, or one rather arched like that of Fig. 3, as the effect of ends would gradually diminish. Even a strain normal to the circumference which bulged up the points A and B (see Fig. 1) would, if acting alone, also lift up the line between A and B and keep it parallel. The form exhibited here seems then to indicate a distribution of strain in the shell in which the strain increases as the distance from the centre increases.

The question at once arises—Is this behaviour singular or in accordance with general law? The writer has not been able to find much evidence bearing directly on this point, but on looking through tables of boiler explosions, it will be noted that a large proportion have given way at the end seams. The experiments made last year by Mr. Scott, at Greenock, afford the most beautiful illustration of this curious phemomenon. It will be noticed that the short cylinder, No. 3, has hogged, while the longer ones, No. 1 and No. 2, have sagged at the centre. Now, if we look at Fig. 7, which is laid down from the dimensions given by Mr. Scott, and shows the form assumed by his experimental boiler at a pressure of 580lb., you will see that each of the short cylinders between the seams have hogged, but that the cylinder, as a whole, is much less stretched at the centre than at the ends. This form, strange as it may appear, is therefore not exceptional; it reappears in Model No. 2, but not in No. 3. No. 3 was the second model tested. Judging from its behaviour under pressures obtained by the hand pump it appeared to be decidedly weaker than No. 1; still, it stood 10 per cent. more than the ultimate strength of joint without serious damage. When connected to accumulator the pressure was raised very quickly. So far as the eye could detect the form of the model remained unaltered till near the point of rupture, the bulging of the shell and the bursting of the joint being nearly simultaneous, as far as he could judge. In this case the joint and the plate near the joint were evidently more strained than the rest of the plate. The radius at the joint was about 14¾in., and if it were true that the strain on the joint was radius by pressure, then this joint must have ruptured at a strain about 77 per cent. greater than its calculated strength. Model No. 2 appeared to be intermediate in strength between No. 1 and No. 3. It showed that the form assumed by No. 1 was not the result of accident, but of some general law. The results, being intermediate between 1 and 3, serve as a general confirmation of both.

The writer thinks he has now brought forward sufficient evidence to prove that the strength of cylindrical boilers is still an unsolved problem. And he repeats, what he has formerly stated before this Institution, that a true solution of the problem will apply equally to boiler shells subject to internal and to flues subject to external pressure. The generally accepted theory which treats boiler shells as endless rings cannot be right, and is not even an approximation to the truth in these experiments. The theory proposed by the author last year cannot be right, or No. 3 model would have stood nearly twice the pressure of No. 1, and Nos. 1 and 2 would not have yielded near the end joint, but at these joints. Neither of these theories can therefore be true, they both contain an element of truth and an element of error. The first theory appears to be nearly right in making the strength

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EXPERIMENTS ON THE STRENGTH OF BOILERS.

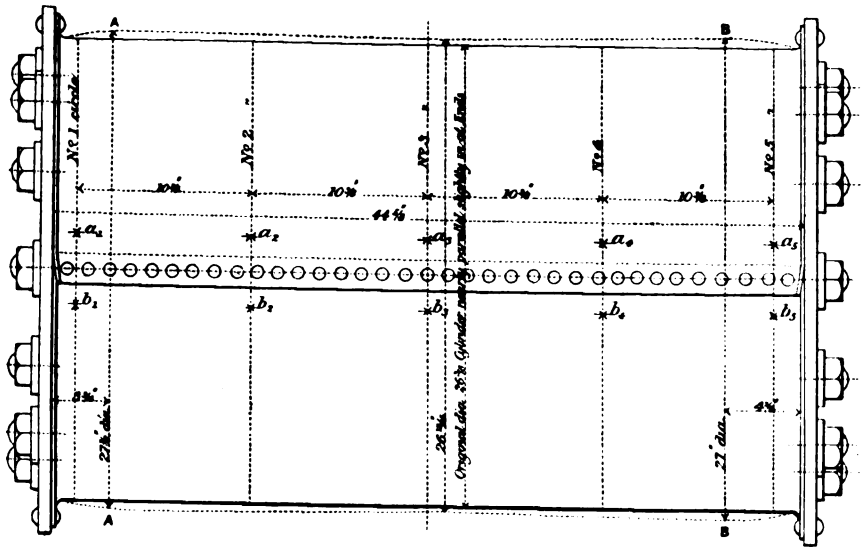


FIG. 1.

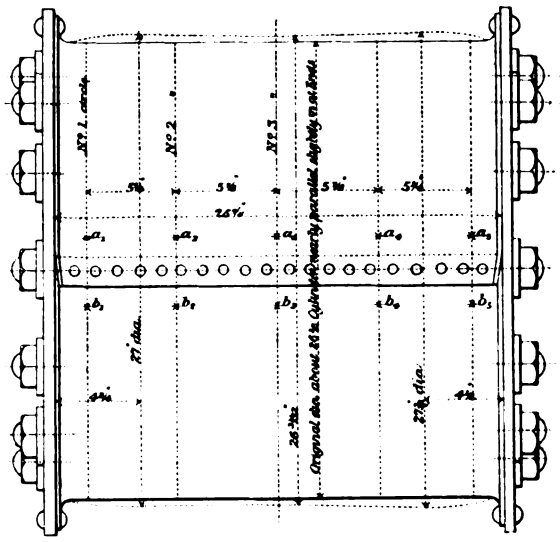


FIG. 2.

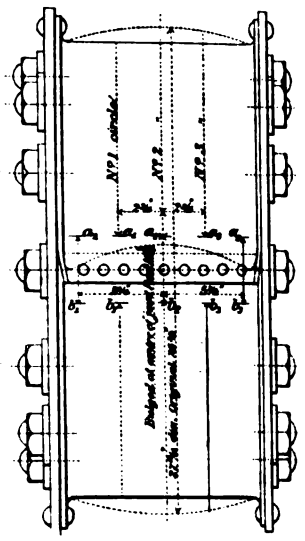


FIG. 3.

TABLE II.—MODEL NO. 2. 26IN. DIAMETER, 26IN. LONG.

Pressure per Square Inch in Model.	—	Extension of Joint at Points marked in Fig. 2.					Extension of Plate at Circles marked in Fig. 2.					Remarks.
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
	Original length = . .	In. $3\frac{1}{4}$	In. $3\frac{3}{4}$	In. $3\frac{3}{4}$	In. $3\frac{3}{4}$	In. $3\frac{1}{4}$	Steel tape 6ft. $7\frac{1}{16}$in. used for all circles.					Pressure applied by hand pump to 550lb.
Lb. 300	With pressure on ...	0	0	0	0	0	In. 0	In. 0	In. $\frac{1}{16}$	In. 0	In. 0	Joint commencing to "weep."
	Do. off ...	0	0	0	0	0	0	0	0	0	0	
400	Do. on ...	0	0	0	0	0	0	0	$\frac{1}{32}$	0	0	Joint leaking slightly.
	Do. off ...	0	0	0	0	0	0	0	0	0	0	
500	Do. on ...	0	$\frac{1}{64}$	$\frac{1}{64}$	$\frac{1}{64}$	0	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	Slight leakage from ends and longitudinal seams.
	Do. off ...	0	$1\frac{1}{32}$	$1\frac{1}{32}$	$1\frac{1}{32}$	0	0	0	0	0	0	
550	Do. on ...	0	$\frac{3}{64}$	$\frac{5}{64}$	$\frac{5}{64}$	$\frac{1}{64}$	$\frac{5}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{32}$	$\frac{1}{8}$	Leakage greatest near ends of longitudinal seams, hardly any at centre, cylinder straight by batten, and showing no visible alteration in form.
	Do. off ...	0	$\frac{2}{64}$	$\frac{4}{64}$	$\frac{4}{64}$	$\frac{1}{64}$	$\frac{1}{16}$	$\frac{1}{64}$	0	0	$\frac{1}{32}$	
	Pressure could not be increased by the hand pump. The model was caulked all over and connected to the hydraulic service pipes in boiler shop.											
450	.....	Joint commenced to leak.										
550	.....	Joint leaking all along joint.										
680	With pressure on ...	Could not be measured on account of leakage.....										At 680lb. model bulged out near the ends. This pressure was maintained for some time, but could not be increased.
	Do. off ..	In. $\frac{1}{16}$	In. $\frac{2}{16}$	In. $\frac{3}{16}$	In. $\frac{9}{32}$	In. $\frac{1}{16}$	In. $1\frac{5}{8}$	In. $2\frac{3}{32}$	In. $1\frac{3}{16}$	In. $1\frac{5}{16}$	In. $1\frac{1}{32}$	

of boilers depend on a ratio between diameter and thickness. The second theory, which assumes that the strain on the ends is not a small factor to be neglected, is confirmed by the evidence of straining near the ends. If these ends had been closed by a relatively weak tube plate full of holes instead of by these strong plates, it is the author's opinion that the weak tube plates would have yielded before the plate bulged, and he cannot believe that the original straight lines of these cylinders can have altered to either of the forms, shown in Figs. 1 and 2, or Fig. 3, without being stretched longitudinally; or that they could stretch longitudinally without overcoming a great resistance, which should be added to the resistance of plate to circumferential stretching. If then the errors could be eliminated, and the truth contained in these two theories combined, a true theory might be evolved from the process. The writer does not think this question can be settled by mathematics, but a few experiments made in a systematic manner would probably show, quite near enough for all practical work, what pressure can safely be used in any given boiler.

It is the writer's opinion that the experiments already made are sufficient to justify some alteration in our practice. All the models referred to stood a pressure of more than 540lb. with the small hand test pump. It cannot be far wrong to assume that this pressure had not strained them beyond their elastic limit. It would, therefore, be perfectly safe to make the test pressure for these two-thirds of 540lb. = 360lb., and the working pressure one-half of that, say 180lb. According to current practice the working pressure is only 80lb., and if 180lb. is quite safe, then in this case our rules are wrong to the extent of 125 per cent. If, as he believes, all those models yielded by bulging the solid plate and not by tearing the joint, then it follows that they would not have been stronger if the joints had been, as in boiler work they generally are, over 80 per cent. of the strength of the solid plate instead of only 55 per cent. With a joint of over 80 per cent. the working pressure would be about 120lb. according to present practice; if 180lb. is a safe pressure, then in such a case the error in the present rules is 50 per cent. The working pressure of these models, if calculated by the current rules, only substituting the strength of solid plate for that of joint, is about 150lb. This is still below the working pressure deduced from experiment, and, he believes, that it would now be quite safe to take the strength of solid plate as our basis instead of the joint, to keep other constants unaltered, and arrange our riveting with a view to tightness and caulking, without any regard to percentage of strength, provided that percentage was not reduced below 55. This would mean that with the same thickness of shell plates, the pressure might be increased 25 per cent., or that the same pressure might be carried with the thickness of shell plates reduced 20 per cent. This he considers a result of some importance, and future experiments may show that still further reductions might be safely made.

From a practical point of view there can be no question that, with the large boilers and high pressures now general, any reduction in thickness of shell plates which does not involve a reduction in the factor of safety is a benefit. If an inch plate is enough for strength, then, for many practical reasons, that plate is better than a plate $1\frac{1}{4}$in. thick. This, of course, does not apply to all sizes and pressures. No one would think of using $\frac{7}{8}$in. plate for a steam dome, for instance; a much thicker plate would be used for other reasons, entirely apart from the question of strength. Still, it is well to know what are the requirements of strength. Although they are by no means the only requirements which affect our designs, they always form a factor in the case about which it is better to know the truth than to be contented with an error. He regrets that he is not in a position to make a more exhaustive set of experiments, for he believes that there is a rich vein of discovery in this line. These experiments seem to prove that our present rules may be wrong to an extent anything between 50 and 125 per cent. It also seems to him that our rules as to boiler flues are very absurd. It is not possible

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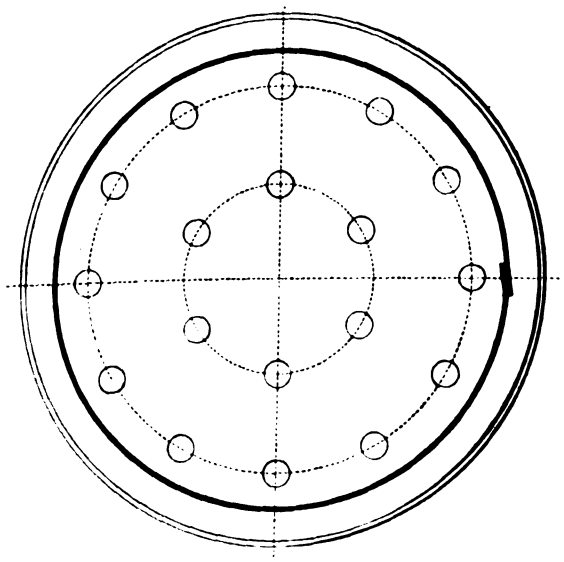


FIG. 4.

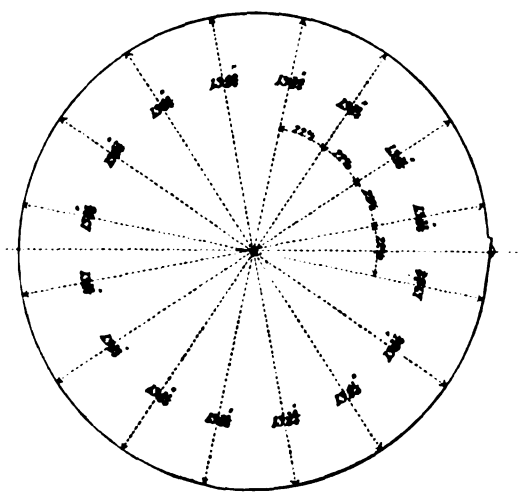


FIG. 5.

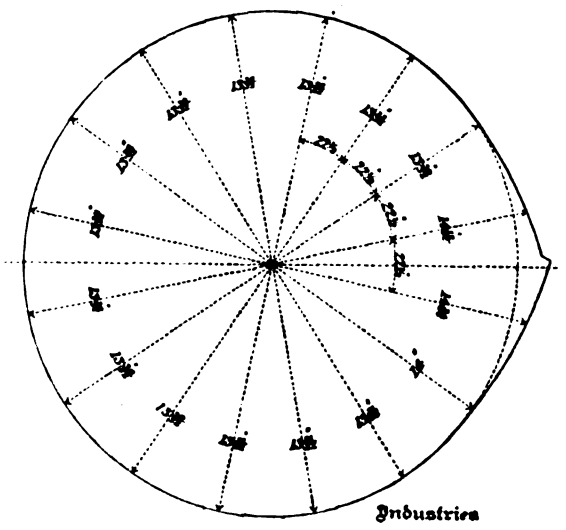


FIG. 6.

TABLE III.—MODEL NO. 3. 26IN. DIAMETER, 13IN. LONG.

Pressure Per Square Inch in Model.	—	Extension of Joint at Points Marked in Fig. 3.			Extension of Plate at Circles Marked in Fig. 3.			—
		No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	
	Original length =	In. 3 3/4	In. 3 3/4	In. 3 3/4	Steel tape 6ft. 7 1/16 in. used for all.			
lb. 150	With pressure on	0	0	0	In. 0	In. 0	In. 0	Pressure raised by hand pump to 550lb.
	Do. off	0	0	0	0	0	0	
300	Do. on	0	0	0	0	0	0	Commenced to leak in centre and near end.
	Do. off	0	0	0	0	0	0	Leak caulked.
400	Do. on	0	3/64	0	1/16	1/16	1/16	Joint leaking considerably. Caulked.
	Do. off	0	1/64	0	0	0	0	
500	Do. on	1/64	4/64	1/64	1/8	1/8	3/32	Commenced to leak, 350
	Do. off	1/64	4/64	1/64	1/32	1/32	0	
550	Do. on	3/64	6/64	1/64	5/16	5/16	11/64	Tried by batten. No alteration in form could be seen.
	Do. off	1/64	5/64	1/64	3/4	11/64	5/32	
	Pressure could not be increased by hand pump. Model was caulked all over and connected to hydraulic service pipe. The pressure from the accumulator was allowed to come on it at once.							
800	With pressure on	joint	burst	—	—	—	—	Plate bulged and joint burst, tearing plate through at centre rivet holes.
	Do. off	—	1	—	—	3 5/8	—	

TABLE IV. (SEE FIG. 8).

Strain.	Corresponding Pressure on Endless Ring, 26in. Diameter.	PERMANENT SET.		—
		Joint, 3in.	Plate, 14in.	
2 tons	Per Sq. In. 46lb.	In. 0	0	Load was applied in 2-ton increments.
4 ,,	92 ,,	0	0	Measurements were taken after the load had been applied and taken off.
6 ,,	138 ,,	0	0	Plate and joint were measured from pop marks shown in sketch.
8 ,,	184 ,,	0	0	
10 ,,	230 ,,	1/128	0	
12 ,,	276 ,,	1/64	0	
14 ,,	322 ,,	2/64	0	
16 ,,	368 ,,	3/64	0	
18 ,,	414 ,,	3/64	0	
20 ,,	460 ,,	3 1/64	0	
22 ,,	506 ,,	5/64	0	
24 ,,	552 ,,	Broke through joint.	0	24 tons broke the joint and 22 tons did not break it; the exact breaking load would therefore be between 22 and 24 tons.

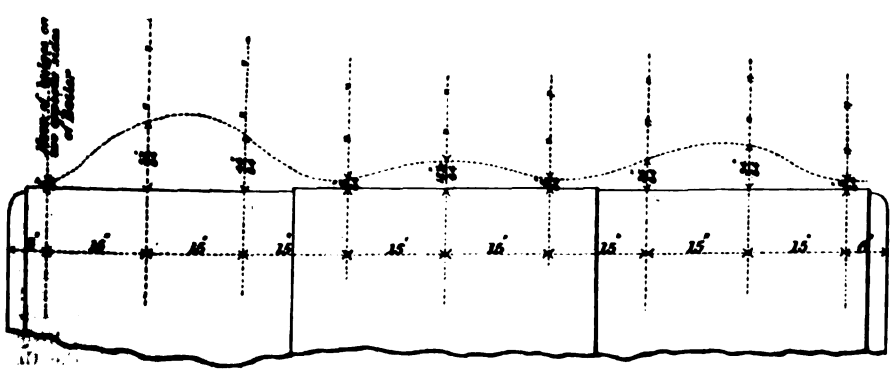


FIG. 7.—PART OF SHELL OF MR. SCOTT'S BOILER.

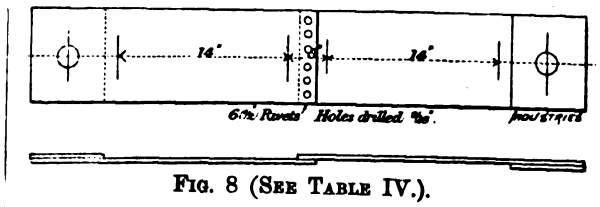


FIG. 8 (SEE TABLE IV.).

that their strength can vary inversely as their length; it is quite impossible that it can vary as the square of their thickness.

Before concluding, he wishes to record his thanks to Mr. Alexander Taylor for sharing the expense of these experiments; and to Messrs. Nichol, Sanders, and Walliker, for making and recording the measurements given in these tables; to Mr. Burrell for the tests of plates and joints. He has also to thank his employers, Messrs. the Tyne Boiler Works Company, Limited, for the use of their plant and machinery free of charge.

(To be continued.)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 10th March, 1891.

Iron.—The state of the iron market last week, as regards the number of transactions, showed marked signs of improvement. At the same time prices remained low. Best bars were at 124s. 6d., joists 125s., and plates 156s. the ton; castings and old rails were quoted at the prices of the previous week. The prospect of an amelioration in the state of affairs continues to be good, and doubtless a change for the better will take place in the course of the next few weeks, as most of the Paris workshops have as many orders on hand as they can execute. The only drawbacks are that some of the contracts have been taken at a very low estimate for the material, which will necessitate the most advantageous terms possible being made with the producers. Moreover, steel is taking the place of iron in bridgework and other structures, thus causing transactions to be made on some other market than that of Paris. The Minister of War is about to solicit tenders for constructions at Varenne (Seine-et-Marne) to the extent of 1,000,000fr. The Société Cail have a large contract for sheds for the Roumanian Government, but most of the iron used therein will be brought into France from abroad. In the provinces business seems to be steadily improving. The shipbuilding yards at Nantes (the Chantiers de la Loire) are fully occupied, having amongst other orders on hand a despatch boat for the brother of the Czar of Russia, and a large iron sailing vessel. The Compagnie Transatlantique has been transformed into a limited company, with a capital of 8,000,000fr. The new company proposes to extend the works and to occupy itself with the construction of guns, locomotives, and engineering work in general, as well as shipbuilding. In the Ardennes the manufacturers of iron work for railways, the founders, and bolt makers are all fully occupied; also in the Haute-Marne district the steel wire trade is well employed, but in this, as elsewhere, a further improvement in the situation depends more on the price of fuel becoming lower than on the market prices of iron being raised.

Coal.—The coal market continues very firm. The deficit caused in stocks by the late cold weather is not yet made good. It is reported that one or two mining companies have engaged more than three-quarters of their output in advance for the year 1891.

Copper, Tin, Lead, and Zinc.—Best Chilian copper in bars was quoted at £58 5s. per ton, ordinary Chilian copper at £56 5s., and "best selected" at £60 7s. per ton. There has been a slight fall in the prices of both Billiton and Detroit tin during the past week. The following were the quotations at the end of last week:—Banca, £98 10s.; Billiton, £96 10s.; and Detroit, £95 10s. the ton. The lead market was, if anything, rather firmer, with unchanged prices. Zinc has increased in value, quotations being from 4s. to 8s. per ton in excess of the prices of the previous week.

Electrical Tramway.—The Municipal Council of Lyons have granted the concession for a line of electrical tramways between the Dombes and Perrache railway stations in that town to the Compagnie Lyonnaise des Tramways et Chemins de Fer.

A New War Vessel.—A new ironclad ram of the "Lazare-Carnot" type is about to be ordered. She is to be built of steel, and will measure 355ft. 9in. between perpendiculars, and 367ft. 4in. over all. She will be provided with three screw propellers, one of which will be placed at the stem, so as to assist in manœuvring. The armament is to consist of two 30-centimetre bow and stern chasers in closed turrets, two pieces of 27 centimetres in the waist, and four turrets with coupled guns of 14 centimetres; also a large number of Hotchkiss fast-firing guns and four torpedo tubes.

BERLIN, 9th March, 1891.

The Berlin Chamber of Commerce.—The Chamber of Commerce of Berlin has decided to found an institution which shall have for its object the providing of funds to send young merchants and engineers into foreign countries to improve their knowledge and promote German industrial interests. The various Chambers of Commerce are to be canvassed to support this plan. Bremen and Hamburg are of opinion that local societies would be better than a national institution.

Railway Passenger Fares.—The "Verein zur Beförderung des Gewerbefleisses" held its monthly meeting on the 2nd inst. One of the subjects of discussion was the proposals of the Government with respect to alterations in the passenger fares on the State Railways. Since the introduction of the "zone tariff" in Hungary, there has been a movement in Germany, which gradually increases in importance, to bring about a reduction of passenger fares, and a large association has been formed for the purpose of collecting statistics and influencing the authorities in this direction. The railways in Germany being, with few exceptions, either the property or under the management of the State, an alteration in existing systems is very difficult to attain, but it is evident that the Government see that some reform is necessary, as they have appointed a meeting of their chief railway officials for the 24th inst. The Government propose to reduce the fares of the first, second, and third class by about one farthing per mile, and to withdraw all reductions on return tickets and circular tours, and to abolish the "fourth class." The fourth class is simply a luggage van provided with small windows, and is largely made use of by peasants. These persons will be compelled to travel in the third class, and the proposed alterations will thus on the whole mean an increase rather than a reduction in the fares.

VIENNA, 9th March, 1891.

The Iron Market.—During the past fortnight prices have somewhat risen in the iron market, and the increase of prices was maintained at the end of last week. Now that the weather has become much warmer activity in the building trade has been increased, and the sorts of iron and steel used in building operations have been much inquired for. On the other hand, iron sheets, especially galvanised sheets, have suffered a considerable reduction, and the syndicate has lowered the prices by 15fl. per ton. By far the greater portion of the iron produced here is used by the railway companies. The companies feel the necessity of adding to their rolling stock in order to cope with the continually increasing traffic, and many new railways are being constructed. As regards the supply of rolling stock, the Austrian-Hungarian State Railway Company has recently ordered in Vienna six locomotives with tenders. In Hungary during the past year 500 kilometres of new lines have been completed, and the same length of lines is at present under construction. In Austria 150 kilometres of new lines have been opened for public use, and nearly 500 kilometres of lines are now being constructed. It has been calculated that on an average 2,750 men would complete 1 kilometre of line per day. The machine works and iron foundry company of Messrs. Ganz, in Budapest, held their general meeting the week before last. The yearly balance sheet showed the net earning to be 859,943fl. The total receipts of the five works of the company amounted to 12,000,000fl. The company will pay a dividend of 75fl., which is at the rate of about 20 per cent.

Electrical Engineering.—The formation of the General Austrian Electricity Company afforded good evidence of the confidence of capitalists in this branch of industry. 17,820 shares were placed on the market, and more than twenty times as many were subscribed for. The shares have a nominal value of 200fl., and were issued at 230fl. without any fluctuation. When the International Electricity Company was founded two years ago, its shares with a nominal value of 200fl., were subscribed for some hundred times over, and were issued at 240fl., the present quotation being 260fl. The latter company was founded by Messrs. Ganz & Co. and by the Union Bank, and although Messrs. Siemens & Halske and the Anglo-Austrian Bank, who are the founders of the General Austrian Electricity Company, deserve quite as much confidence from the public, the last issue of electrical shares shows that they have not obtained it.

Mercury Mines in Carniola.—During the past year 1,220 persons were employed in the mercury mines in Carniola, and the output of mercury amounted to 73,395 tons, of which the value was 850,000fl. Of the total amount, 92·6 per cent. was produced by the State mines in Idria, and the remainder at the St. Anna mines. Of metallic mercury there was an output of 528 tons in Idria. The average price of mercury per ton was 2,700fl.

BRUSSELS, 10th March, 1891.

The Iron Market.—There is a complete want of activity in the iron market. There are some large orders, but they are not sufficient to keep all the works fully employed. The supply of orders has slackened, and the closing of rolling mills and the blowing down of blast furnaces is already talked of. There is, however, an order for 200 waggons for the Government of the Netherlands, which has been given to the Dyle Company, and an order for weighing machines and signalling apparatus to Messrs. Divoire, of Malines. An order for staples and bolts has been given to the manufactories of Seneffe, and an important contract has been agreed upon at Salonica which will bring large orders on the market. Prices are as follow:—Iron No. 1, 125fr.; No. 2, 132·50fr.; No. 3, 140fr., delivered at Belgian railway stations; joists, 125fr.; angle iron, 132fr.; iron sheets No. 2, 150fr.; No. 3, 170fr.; No. 4, 240fr.; rails, 125fr.; pig iron (Luxembourg), 55fr. to 56fr.; red short iron, 48fr.; special quality, 58fr.

The Coal Market.—The condition of the market is uncertain. Prices are maintained, but it is thought probable that sellers will have to make reductions during the present month. Business is therefore restricted to present needs. There are rumours of strikes and of other events which would have an important effect on the market. The Belgian State Railways invite tenders for the supply of 11,000 tons of brown coal or patent fuel for the use of steamers at Ostend. The manufacture of coke still gives rise to much discussion. Its price has been maintained at 18fr. by the syndicate of owners of ovens. Statistics show that the importation of black coal from Germany into Belgium amounted to 64,490 tons during the month of January, as compared with 57,000 tons in the same month of last year. This increase has been caused through the high prices of Belgian coals. The import from England has fallen from 94,000 to 27,000 tons, and the import from France has diminished by 8,000 tons. The total reduction from 193,800 tons to 114,270 tons only serves to point out the scarcity of coal in Belgium during the first months of last year. The diminution is the less remarkable because English coal could not be imported during the closing of the Schelde. As regards exports, Germany has taken 6,100 tons during January, as against 11,500 tons in January of last year, and France 313,790 tons, as against 257,000 tons. The total export of coal from Belgium amounted to 358,829 tons, as against 300,900 tons. The import of double coke amounted to 9,927 tons, as against 4,270 tons the previous year, and the exports to 84,931 tons, as against 109,000 tons. The diminution in the export shows an important decrease in the output.

DÜSSELDORF, 10th March, 1891.

The Iron Market.—This market is quiet. The export business is suffering from the high rates of the raw material and the taxes caused by the social laws.

The Coal Market.—During the past week a circular has been issued by the Minister of Commerce, Mr. von Berlepsch, to the Boards of Trade, in which the administrators of the Westphalian coal pits were charged with improperly neglecting their old contracts in order to carry out new contracts at higher prices. As the real cause of recent irregularities in the supply of coal was the deficiency of waggons, and a want of precaution on the part of the State Railways, deep indignation prevails amongst the coal owners against the Government, which, in the first place, neglected its duties, and then made grave charges against coal owners. In order to answer these charges Mr. Fencke, of Essen, the President of the Westphalian Coal Owners' Association, who is also president of the directorate of Mr. Krupp's works, has called upon Mr. von Berlepsch in Berlin, and has obtained a withdrawal of those charges. A declaration has unanimously been made on the part both of the Westphalian Coal Owners' Association and of Mr. von Berlepsch, who is the chief surveyor of the royal mines in the Saar district, concerning the eight hours shift. It says that the shift below the surface is to last eight hours, not including the time for going up and down. During this week there will be a general meeting of all the German coal owners in Berlin for the same purpose. The eight hours shift was one of the demands of the miners, but the opinion prevails that they will not enter upon a general strike. If there should be a strike, it will be only a partial one. Notwithstanding this opinion, there are many who are collecting stores of coals for all contingencies, and not only the railway companies in the eastern provinces, but also important consumers in the western districts, have completed their stores. Amongst others, Mr. Fried. Krupp has just laid down a store of 5,000 tons of English coal in Duisburg. The coal market is very strong, and prices are rising. Smelting coke is at 160 marks, and blast furnace coke at 133 marks.

German Railway Waggon Manufactories.—These manufactories, of which there are twenty-two, are capable of turning out 3,680 passenger carriages and 24,200 goods waggons in one year.

Coal Mining.—Important extensions of the workings in the royal coal mines of the Saarbruck district have been already begun, and will be carried out during the years 1891 and 1892. Eight different sets of workings are to be provided with the newest machinery for increasing the output. In this district complete plants for draining five of the mines, chiefly at deep levels, are being laid down. Several new sets of ventilating machinery are being erected. Electric lighting is to be brought into operation in many cases in the higher levels.

Prussian Railways.—The sum of 145,337,500 marks is to be spent by the Prussian railways during the ensuing year, as follows:—

Construction of new railways...	36 008,000	marks
Widening of existing lines	26,305,500	,,
Enlargement of railway stations	29,427,000	,,
Rolling stock	53,800,000	
Total.....	145,537,500	marks.

AMSTERDAM, 9th March, 1891.

Coal in Sumatra.—The Dutch Indian Government has finally decided to work the extensive Ombilien coalfields in Sumatra itself, and not by granting a concession to private enterprise. It will also construct a railway from the coalfields to the nearest point on the coast for the transport of the output.

Steamers.—Messrs. Meyer & Co., steamship owners and agents for Holt's Company at Amsterdam, propose to commence a line of steamships with the Dutch East Indies, for which purpose they intend to enter into negotiations with the Government for the conveyance of mails, Indian produce, and Dutch Indian officials. In consequence of the attacks which the Ministry had to suffer in the Lower Chamber of the States-General regarding the shipbuilding contracts with the Royal Engine Factory in Amsterdam, the Government has decided to take away from the undertaking, now in liquidation, the contracts for the building of the monitor class ship "Reinier Claeszen," and of the turtle-back ironclad "Wilhelmina der Nederlanden." Both these warships are to be finished in the Government Shipbuilding Yard, and contracts will be made with other firms for the necessary boilers and engines.

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FIRE AT ROZENDAAL.—The Java Sugar Factory, at Rozendaal, has been entirely destroyed by fire. The buildings, the machinery, and the sugar in course of treatment were all insured, chiefly with English fire insurance companies.

COMPETING STEAMSHIP COMPANIES IN THE ATLANTIC.—The competing steamship companies of Germany, Belgium, and Holland, whose vessels trade in the Atlantic, have come to an agreement whereby the cutting of rates will be stopped. The Hamburg and Bremen Companies have consequently raised their steerage rates by 10s., whilst the Red Star Line Company of Antwerp and the Netherland American Steamship Company of Rotterdam announce their intention of increasing those rates by 15s. a head.

VEGETAL BUTTER.—The Dutch Vegetal Butter Company at Amsterdam, having opened its factory, has now commenced to bring its vegetal butter to market. It is manufactured by the system of Dr. Schlinck, already applied at the only other factory in Heidelberg, and claims to be a pure and wholesome butter substitute, especially in cooking. It is what its name implies, a fatty substance which resembles butter, but contains no fat. It consists only of combinations of vegetal oils extracted from cocoanuts and other plants or fruits which contain oil. Vegetal butter wants an addition of salt when used, as, unlike margarine, no salt is added during manufacture. The retail price of this preparation is 8d. a pound.

STOCKHOLM, 7TH MARCH, 1891.

TRAMWAYS AT GOTHENBURG.—The profits of the Gothenburg Tramways Company, Limited, during the latter half of 1890 amounted to £6,315 12s. 6d., and the expenses to £5,198 17s. 11d. It is proposed to issue 6 per cent. debentures to the amount of £6,000. This sum will be partly used in buying more cars, so as to enable the company to carry on the large traffic anticipated during this summer on account of the show. It is proposed to pay a dividend of 4 per cent. per annum, which requires £1,050.

EXTENSION OF YSTAD HARBOUR.—It is proposed to extend the Ystad Harbour in order to meet the increasing demand for accommodation which the opening of the North Sea-Baltic Canal is likely to bring about. It is intended to be used also as a harbour of refuge.

NEW BEET SUGAR FACTORY.—The beet sugar industry in Sweden is continually being extended, and the erection of a new manufactory at Kristianstad is now being discussed. The project was favourably regarded at a large and influential meeting at Kristianstad, and a committee was formed for the purpose of advancing the plan. At a meeting, at Malmö, last week, of representatives of the various beet sugar manufactories in Skane, the price of beets was fixed at 1·85kr. for autumn and 2·10kr. for winter delivery per 100kgr., which is the same price as has been paid during the last few years. There appears to be some risk of over-production.

CHRISTIANIA, 7TH MARCH, 1891.

THE TRAMWAYS QUESTION.—The question of the extension of the Christiania tramways has been under consideration for a long time, and the adoption of electricity as a motive power has been suggested. The corporation has now appointed a committee to deal with the matter. Various concessions have been applied for during the last two or three years, but it has been found impossible to reconcile the conflicting interests of the applicants. The authorities are adverse to the introduction of steam trams, and seem to favour the accumulator system. Overhead wires are thought to entail various risks which should be avoided.

NEW RAILWAY MATERIAL.—The various Norwegian railways are to have a considerable amount of new material, both rolling stock and machine tools. It having been urged that home manufacturers ought to have the preference as to the delivery of locomotives, tenders were invited from some Norwegian makers, but these proved 15, 20, and 40 per cent. higher than offers from Scotland, and were not accepted.

NEW SEWING NEEDLE MANUFACTORY.—The firm of Messrs. Mustad & Sons, at Gjörik, are extending their works by the erection of a manufactory for sewing needles. Several English workmen have already arrived.

TELEGRAPH INSTRUMENTS OF NORWEGIAN MANUFACTURE.—The well-known firm of Messrs. A. I. Kragh has again delivered a number of Morse telegraph instruments for the State Telegraphs Department, which show good workmanship. In addition to these a similar order is being carried out for the State railways.

COPENHAGEN, 7TH MARCH, 1891.

THE COPENHAGEN FREE HARBOUR.—The proceedings in Parliament with reference to this important measure are now so far advanced that it is hoped the Bill will be eventually passed during the present session.

THE BURMEISTER AND WAIN SHIPBUILDING AND ENGINEERING COMPANY.—The balance-sheet of this company for last year shows that the gross profits were 801,690kr. for work done, and 50,461kr. profit on slip rent, 11,287kr. being carried forward from the previous year. The expenses were 398,948kr. The net profits amount to 464,613kr. The shareholders get 6½ per cent., or 130kr. per share, which amounts to 325,000kr. The buildings at Christianshavn are estimated to be worth 1,660,599kr., the shipbuilding establishment at Refshole 2,959,332kr., and the machinery 2,133,078kr. The share capital is 5,000,000kr.

MADRID, 9TH MARCH, 1891.

FRENCH AND SPANISH COINAGE.—Since the 1st inst., French gold coins of 20 and 10 francs and Spanish gold coins of 20 and 10 pesetas will circulate indifferently in both countries. This interchange of coinage will facilitate transactions between the two countries. If the metrical system had existed in England at the time when railways were first being developed in Spain it is probable that the bulk of the Spanish railways would have been in the hands of English capitalists and contractors.

BRANCH RAILWAY LINES.—A law to facilitate the construction of branch lines of narrow gauge railways will probably be passed by the Cortes at an early date. No less than from 6,000 to 7,000 miles of such railways are projected, and a fair rate of interest has been guaranteed.

INCIO IRON MINES.—A report has been circulated in the daily press of Galicia that some iron ore mines have been discovered in the province of Orense. The ores are stated to be of the finest quality, and are said to amount to 66 millions of tons, which is a larger quantity than is supposed to remain in the Bilbao mines. No reliance on the truth of this report is entertained at present by engineers of repute in the province. The owner of the concession is said to have extensive commercial relations with England. As the affair is of doubtful success, it is likely that much consideration will be given to it before any definite action is taken. Many iron mines in Spain have shown ores of rich and excellent quality at the surface, whilst the ores at a small depth below the surface have turned out to be of inferior quality.

MAIL CONTRACT FOR THE CANARY ISLANDS.—A contract has been offered by the Government for the carriage of mails twice a month between Spain and the Canary Islands. The steamers are to be of 650 tons, and to have a minimum speed of twelve miles per hour. A subvention of £1,000 is to be granted for the whole voyage. The traffic, independent of the mails, is comparatively small and irregular, but may possibly increase. No offer having been made at first, tenders have been again invited.

TENDERS FOR A NEW CRUISER.—The Spanish Government invites tenders for a new cruiser of 9,000 tons. The conditions of tender have been so modified on this occasion that foreign shipbuilders will be able to compete. Spanish tenders are, however, to be compared with foreign ones as if they were 12 per cent. lower than the sum actually stated, and this clause is certainly adverse to foreign tenders. It seems likely that the "Astilleros del Nervion" Company will get the order, and the difference of 12 per cent. should make the contract a profitable one. Sir Charles Palmer was for some time connected with this company, but it was reported lately that he had retired from it.

ROME, 9TH MARCH, 1891.

THE FOREIGN TRADE OF ITALY IN 1890.—The Government returns show that the imports and exports during last year compare unfavourably with those of 1889, as may be seen from the following figures:—

	1890.		1889.		Difference.
Imports ...	£52,663,443	...	£55,646,169	...	£2,982,736
Exports ...	35,030,426	...	38,025,830	...	2,995,404

It is to be noted that there has been an increase in the importation of raw cotton, and a decrease in the importations of cotton yarns and textiles, which shows that this branch of the Italian industries is steadily advancing. The importation of ores, metals, and manufactured articles in 1890 amounted to £6,736,500, and in 1889 to £7,792,227. This difference also shows the progress made in this branch of industry during recent years. There is a decrease in the importation of pig iron, a large quantity being now manufactured in the country. The same is to be said about raw iron and steel. There has also been a large decrease in the importation of locomotives, weaving machinery, and railway waggons. This decrease is due to a decrease in the demand, as well as to the increased capacity of the Italian engineering works. The exports for the same materials show an increase of £533,000, which is mainly due to iron ores, lead and copper ores, iron plates, copper ingots, bars, and sheets, mercury, and guns.

MARINE ENGINEERING.—Messrs. Ancaldo & Co., of Sampierdorno, have fitted three large steamers of the Navigazione Generale Italiana with new triple-expansion engines, of 5,000 indicated horse-power, with a boiler pressure of 110lb. per square inch. These engines are of the usual marine type, with three inverted vertical cylinders, the diameters of which are 0·94m. for high pressure, 1·55m. for medium pressure, and 2·50m. for low pressure. The stroke of the pistons is 1·52m. The steam is generated by four large double-fronted boilers, each of which has six furnaces. The steamers with the new engines have been recently tried, and have been found very satisfactory, giving 74 to 75 revolutions of the propeller, with 6,000 indicated horse-power, and at a speed of 11½ miles per hour.

NEW YORK, 28TH FEBRUARY, 1891.

THE LATE MR. JOHN WILEY.—Mr. John Wiley, of the great publishing house of John Wiley & Sons, of New York, died at East Orange, N.J., on the 21st ult. Mr. Wiley was born in Flatbush, L.I., in 1808. At the age of seventeen he went into business with his father, a publisher in New York. Subsequently the firm became Wiley & Putnam, the latter being George Haven Putnam, then John Wiley, and, later, John Wiley & Sons. The house is widely known in the line of scientific publishing. On its list will be found the names of many eminent scientific writers of recent years.

THE BAY CITY INDUSTRIAL WORKS.—The Industrial Works of Bay City, Michigan, has recently shipped to the Union Pacific a steel car mounting two 15-ton capacity very complete cranes, which will be used at Salt Lake City, Utah, in wrecking and construction work. The Lehigh Valley is erecting one of its 20-ton steel transfer cranes at Jersey City, N.J., and the Michigan Central has just started a powerful travelling crane at the Jackson (Mich.) shops, built by this company. Among other recent shipments have been a standard steam shovel to the Mexican Central, at Tampico, Mexico, a pile driver to the Sioux City and Northern, and two steam jib cranes, steel construction, and of 10 and 25 tons capacity, to the E. P. Allis Company, Milwaukee, Wisconsin. For this latter company a very powerful and complete steam track crane is also under construction. This crane will propel itself, lift at different speeds, vary the radius of its jib, and slew its load through a complete circle, all with its own power. In addition a 10-ton power travelling crane for the new plant of the Marinette Iron Works, at Duluth, Minn., is nearly completed at the shops, and there is in process of construction one of the portable rail-sawing outfits for the Chicago and Grand Trunk. This consists of a steel car, boiler, and high-speed engine, cutting-off saw, double drill, hydraulic straightener, and the machinery for properly handling the rail in all of its movements. Another ponderous piece of machinery is a steel car some 48ft. long, upon which is being mounted at each end a 20-ton steam crane and boiler, each complete within itself and entirely independent of the other. This outfit for the Philadelphia and Reading is intended for use at wrecks and for other purposes, and will be one of the most powerful yet constructed in this country. Two electric transfer tables, each 70ft. long, are being built, one for the new Cheyenne shops of the Union Pacific, and the other for the Denver Union Railway and Terminal Company. The Industrial Works, besides just finishing a considerable amount of special machinery for the East Tennesse, Virginia, and Georgia Railroad, is engaged upon a large contract for dredging machinery, to be used upon Government work on the Great Lakes, and several pile drivers, steam shovels, and other tools.

PHILADELPHIA, 27TH FEBRUARY, 1891.

PETROLEUM EXPORTS.—The petroleum stills of the Philadelphia refineries at the beginning of 1890 had a capacity of about 43,000 barrels, and by the transfer to Point Breeze of the stills of the Chester Oil Refinery and the Globe Refinery, and by the regular increase in capacity, this has been increased about 20,000 barrels during the last year. The plant necessary for the shipment of petroleum has also been proportionally increased. The Philadelphia pipe line of the National Trust Company, which has a daily capacity of 9,000 barrels, is being taxed to its utmost, and the new Southern line, which has now been running a week, is sending in 1,500 barrels a day. The total storage capacity has been greatly increased during the year, and now exceeds 1,000,000 barrels. The rapid improvement of the facilities for doing business here promises to secure to Philadelphia a large share of the export petroleum trade of the country.

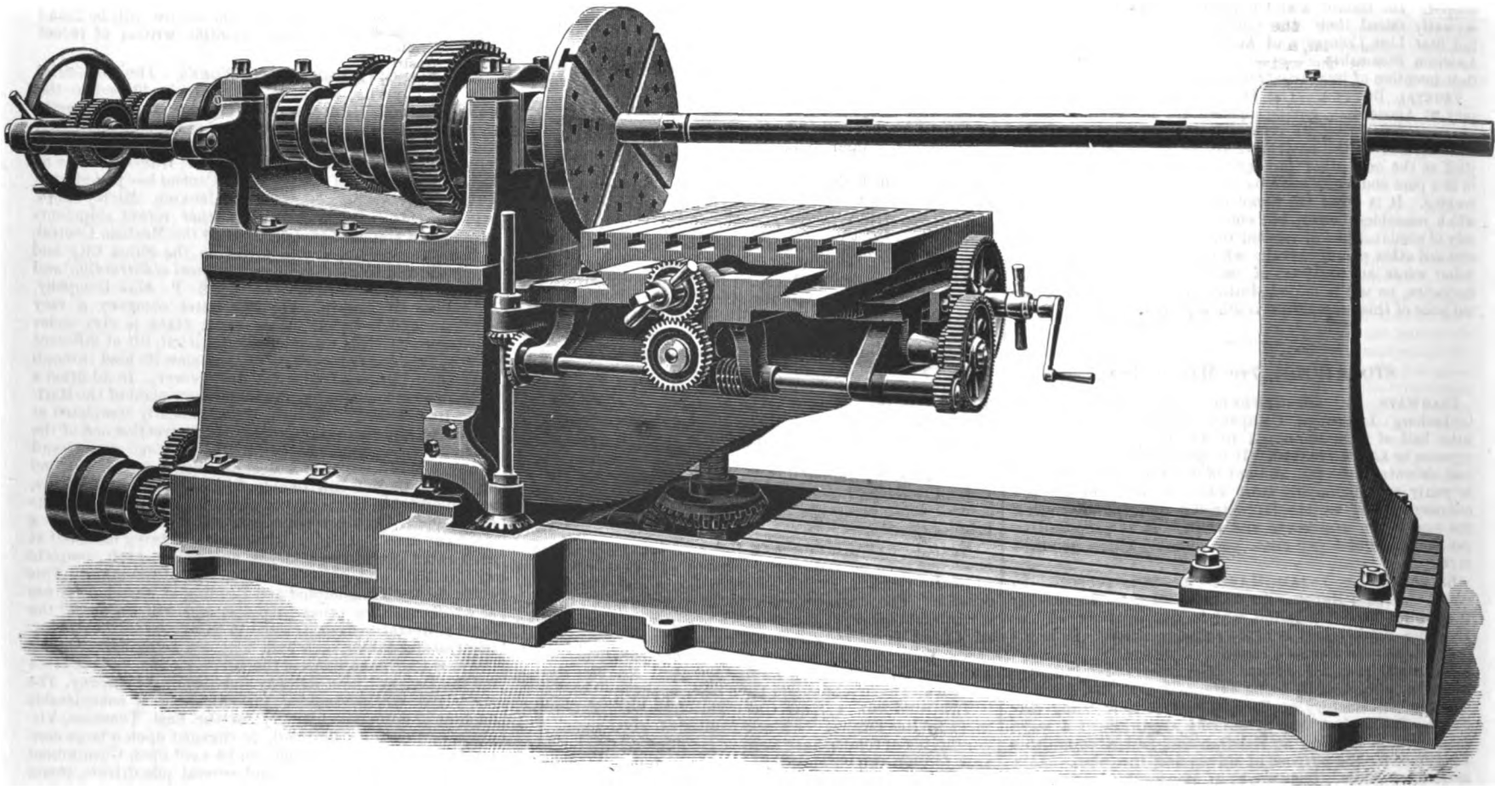
THE ILLINOIS STEEL COMPANY.—The business of the Illinois Steel Company, which recently increased its capital stock from $25,000,000 to $50,000,000, during the last year turned out 720,000 tons of pig iron, 36,000 tons spiegel, 733,000 tons of ingots, 509,000 tons of rails, 80,000 tons of billets, 54,500 tons of rods, and 70,000 tons of beams, angles, and merchant steel and iron. The receipts of raw material were 3,642,660 tons, of which about 20 per cent. was received by water, and the balance by rail. The company shipped 928,769 tons of finished product by rail, using 209,421 railroad cars for the year's shipments. The wages paid out during the year aggregated $6,863,416 to 9,648 employés.

PENNSYLVANIA RAILROAD.—The trouble between the men and officials of the Pennsylvania road are still unsettled, and every attempt is being made to have matters arranged amicably. The officials of the road insist, however, that the condition of the company's business will not allow an advance in wages, and the men seem equally determined that their demands shall be met. The leading members of all the societies among the employés have been assembling in Pittsburgh for several days, and a meeting of Council of the Federated Order of Railway Trainmen, which will be held in a few days, will probably decide whether there shall be a general strike or not. On the Western lines about 90 per cent. of all the men are members of the various organisations, while on the Eastern lines there are about 75 per cent. A strike will only be ordered as a last resort, and even then the company will receive four days' notice of the intended action.

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IMPROVED HORIZONTAL BORING AND CHUCK LATHE.

CONSTRUCTED BY THE NORTHERN ENGINEERING COMPANY, LIMITED, HALIFAX.



GENERAL VIEW.

BORING AND CHUCK LATHE.

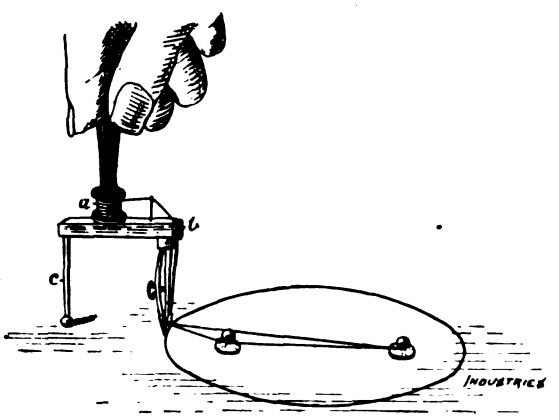
THE lathe shown above is designed so that when large castings are to be operated upon they can be placed upon the foundation plate. The fast headstock is arranged with a steel spindle enclosed in a cast-iron barrel, and is fitted with self-acting feed motion, with three changes of speed, giving a traverse of 20in. to the boring bar, the outer end of which is supported by a strong standard. A quick withdraw motion is secured by a hand-wheel at the end of headstock. The machine will admit 18in. from centre of boring bar to top of table at its lowest position. The table has a transverse traverse of 24in. and a longitudinal traverse of 6in., or of 10in. when the face-plate is not in use, and this can be further increased by removing the wheels at the top of the knee-bracket. The vertical, transverse, and longitudinal motions of table are self-acting. The makers are the orthern Engineering Company, Limited, Halifax.

THE INSTITUTE OF MARINE ENGINEERS.

A MEETING of this Institute was held on the 3rd inst., and presided over by Mr. F. W. Wymer, when the discussion on the paper entitled "Application of Zinc in Boilers" was resumed. In opening the proceedings Mr. Green gave a supplement to his paper in reply to the discussion of the previous evening. In the discussion, zinc in contact with the boiler plates was advocated, not only in the water but in the steam spaces. It was mentioned that the use of kerosene and white zinc had been found a good preventative to corrosion when the steam spaces affected are painted with the mixture. It was remarked that the weight of zinc required in practice is about 4lb. to 5lb. per square foot of grate surface. Some references were made to the use of zinc in the form of electrogens and zynkara, and experiences were detailed showing where the results from the former had not proved so satisfactory as from the metallic contact with ordinary zinc plates. The author replied in detail to the various points raised in the discussion.

A SIMPLE ELLIPTOGRAPH.

THE accompanying illustration represents a neat and useful little instrument for drawing figures of elliptical form, which has been patented by Mr. C. E. Egner, of Asarum, Karlshaum, Sweden. The principle of the instrument is based upon the well-known method of drawing an ellipse by means of a pencil and a thread whose ends are fixed at its two foci. The instrument consists essentially of a pen or pencil fixed at right angles to a small horizontal bar, at the other end of which is similarly provided a leg *c* with a ball point which acts as a



rest. On the top of the bar a vertical handle, with a small reel *a* (containing a double thread) at its lower end, is mounted. This is revolved in order to lengthen or shorten the thread to suit the size of ellipse to be drawn. The thread passes down practically to the point of the pen or pencil, and is held secure by the small thumb-screw *b* (shown). The ball-headed pins are pressed into the paper at the foci of the required ellipse. The thread is placed around them, and the curve is then completed in the usual way. The instrument is provided with pen and pencil, legs and pins, and is neatly arranged in a small case. The combined set can be obtained from Mr. C. I. Lundstrom, 17, Fleminggt, Stockholm.

LEEDS ASSOCIATION OF ENGINEERS.

AT a meeting of this Association, held in the Chemical Lecture Theatre of the Yorkshire College on the 26th ult., Professor Smithells delivered a lecture on "Rust." He remarked that if they were to do anything on the subject of rust, they must begin by studying the conditions under which rust was formed, getting to know as much as possible about the phenomenon itself. The question was, Was it the chemist or engineer that was to tackle the problem? The answer in this case, as in so many others, was that the two must work together; they must combine theory and practice. His object would be mainly to take the chemist's attitude, and to explain to them the chemistry of rust, and to hint at one or two ways in which attempts had been made to obviate its formation. Rust, of course, was more or less a general phenomenon. It was not restricted to iron, but was most noticeable in the case of iron because iron was the most abundantly used metal, because the rust of iron formed rapidly, because it assumed a scaly character, because of its colour, and because of the fact that rust was a thing that appeared to grow in the case of iron, and it did not grow so rapidly, if at all, in the case of other metals. Most metals, of course, did rust. They knew they could not expose the bright surface of copper or zinc without the surface becoming dim. These metals might, therefore, be said to rust in their respective ways, but the rusting was very slight as compared with iron, which was the most susceptible to rust. Iron rust was found to consist of three elements—iron, oxygen, and hydrogen. That rust did contain water could be shown by the simplest experiments. That rusts were oxides they could easily prove, because they could produce rust by burning metals in oxygen alone, hence there could be no other element present, but the way that might appeal to them would be by getting the metal back again from the rust, and the oxygen as well. The lecturer demonstrated this by experiments with iron rust. The experiment he had done, he remarked, was a very suggestive one, because in getting the iron back from the rust in that particular operation he had done what had to be done so often in the process of soldering. They knew that before they could unite two pieces of metal by solder they must use a flux. The reason was that the two metals might be

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covered with a thin film of rust, and the solder would not adhere to these two unclean surfaces. What was the cause of iron rust? They all knew that rusting was favoured by the presence of the air, and by the presence of moisture, but they wanted to know which of these two was the active agent, whether both were necessary, and whether anything else took part in the process. They wanted to know why rusting went on so rapidly and at different points, and how it was affected by the different composition and qualities of the metal, and by impurities in the metal, in the air, or in the water. Professor Smithells then showed some specimens of iron in jars, which he had been preparing for some time. One was a piece of iron in dry oxygen, and he explained that that would not cause the iron to rust. Next he showed a piece of iron which had been sealed up in water for some days, remarking that it was found that when they excluded air and other gases from the water no action took place, and a second conclusion was that water alone would not affect iron. The next question was—Would air and water together affect iron? That experiment had been tried, and it had been shown that, wherever action had taken place at all, the action had been exceedingly insignificant, and the question arose—What was it that was absent and that caused the rust? The one ingredient which was present in one of the jars, and was not present in the cases he had shown, was carbonic acid gas. Carbonic acid gas existed in the atmosphere to a small extent, and it was this gas in the air that was all-important in the operation of rusting. Pure air, pure water, pure carbonic acid would not act singly upon iron; pure water and pure air would not act together upon iron, carbonic acid and air would not act upon iron, but when they had carbonic acid, water, and air together, they got rust. It was carbonic acid that really set up the rust action, and when it was formed the carbonic acid was liberated and attacked the layers beneath. That was why rust had got the property of travelling inwards How could they prevent this action of rusting? There were many things which had been tried. They might paint the iron, and if they observed certain precautions they might have an effective method. One precaution was that the metal must be perfectly clean. A spot of rust embedded below a coat of paint would often break out of itself. Then there was the method of covering the iron with oils and tarry matters. There was also the process of galvanising iron; the process of enamelling, which was very useful for small articles, but the enamel was apt to chip off; and there was the Bower-Barff process, which was worked at Keighley, and which was an admirable process. Alluding to boilers, he said that by putting soda into them not only did they correct acidity of the water, but they introduced something which would absorb the carbonic acid gas, and prevent it acting in a rusting capacity.

SHIPBUILDING NOTES.

On the 7th inst. the s.s. "Blenheim," which has been built by Messrs. Wm. Gray & Co., Limited, for Messrs. Wilson & Corner, of Whitby, had her trial trip. She is 295ft. in length, 38ft. 10in. broad, and 22ft. 10in. deep, and takes Lloyd's highest class. The Central Marine Engine Works of Messrs. Wm. Gray & Co. have supplied the engines, which are of the triple-expansion type, having cylinders 22in., 35in., and 59in. diameter, with a stroke of 39in. There are two large steel boilers, working at a pressure of 160lb. per square inch. The performance of the ship and her machinery was highly satisfactory.

On the 9th inst. the s.s. "Acanthus" was launched by Messrs. Alexander Stephen & Sons, Linthouse. The steamer has been built to the order of Mr. J. B. Murray, Glasgow. The tonnage of the vessel is 3,000, and the dimensions are:—Length, 310ft.; breadth, 42ft.; and depth, 25½ft. The main framing is extra heavy, and the hull is divided by longitudinal intercostals. The holds are unobstructed by beams, and are thus suitable for bulky cargo. The engines are of triple-expansion type, with cylinders of 23in., 37in. and 59in. respectively.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, March 13th, at 7.30 p.m. Students' meeting. Paper to be read: "The Lanarkshire and Ayrshire Railways," by Mr. W. A. P. Tait.

Society of Arts.—Friday, March 13th, at 4.30 p.m. Lecture on "The Science of Colour," by Captain Abney, F.R.S.

Royal Institution.—Saturday, March 14th, at 3 p.m. Lecture V., on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

Manchester Association of Engineers.—Saturday, March 14th, at 7 p.m. Paper to be read: "The Construction of Self-adjusting Bearings," by Mr. E. G. Constantine.

NEXT WEEK.

Society of Chemical Industry.—Monday, March 16th, at 8 p.m. Papers to be read: "Observations Made in the Working of Vitriol Chambers," by Mr. W. Crowder; "The Chemistry of Whiskey and Allied Products," by Mr. A. H. Allen.

Society of Arts.—Monday, March 16th, at 8 p.m. Cantor Lecture II., on "Photographic Chemistry," by Professor R. Meldola, F.R.S. Tuesday, March 17th, at 8 p.m. Lecture on "Recent Development of Tasmanian Industries," by Sir Edward N. C. Braddon, K.C.M.G. Wednesday, March 18th, at 8 p.m. "Harbours, Natural and Artificial," by Mr. F. H. Cheesewright.

Institution of Civil Engineers.—Tuesday, March 17th, at 8 p.m. Adjourned discussion upon Mr. J. T. Harrison's paper "On the Subterranean Water in the Chalk Formation of the Upper Thames."

Owens College Union Engineering Society.—Tuesday, March 17th, at 7 p.m. Paper to be read: "The Blowing Room," by Mr. I. Goëtz.

Royal Victoria Hall.—Tuesday, March 17th. Paper on "Thunderstorms," by Mr. A. W. Clayden.

Royal Meteorological Society.—Wednesday, March 18th, at 7 p.m. Paper to be read: "A Contribution to the History of Rain Gauges," by Mr. G. J. Symons, F.R.S.

Newcastle-upon-Tyne Association of Students Inst.C.E.—Wednesday, March 18th, at 8 p.m. Paper to be read: "The Railway Bridge over the River Tyne at Wylam," by Mr. W. G. Laws, M.Inst.C.E.

Institution of Mechanical Engineers.—Thursday, March 19th, and Friday, March 20th, at 7.30 p.m. Papers to be read and discussed: "Fourth Report of the Research Committee on Friction: Experiments on the Friction of a Pivot Bearing"; "On Recent Trials of Rock Drills," by Mr. E. H. Carbutt and Mr. H. Davey.

Royal Institution.—Thursday, March 19th, at 3 p.m. Lecture on "Modern Chemistry in Relation to Sanitation," by Professor C. Meymott Tidy.

Chemical Society.—Thursday, March 19th, at 8 p.m. Papers to be read: "The Molecular Refraction and Dispersion of Various Substances," by Dr. J. H. Gladstone, F.R.S.; "Contributions to our Knowledge of the Aconite Alkaloids. Part I. The Crystalline Alkaloid of Aconitum Nepellus," by Professor Dunstan and Dr. W. H. Ince; "The Crystallographic Character of Aconitine from Aconitum Nepellus," by Mr. A. E. Sutton.

PRICES CURRENT, 11th March, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 17 6	.....	7 7 6	London.
„ Angles	7 0 0	.....	7 10 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 0 0	„
„ Ship and Girder			7 0 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.		40/6 Cash.
Scotch Warrants, m/n		44/10½ „
Hematite Warrants, m/n		49/4½ „
Stocks in Stores. Scotch	540,607—Dec. for week	5,179 Tons.
Middlesbro'	126,088—Inc. „	1,863 „
Hematite	197,876—Dec. „	6,650 „

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	...	.....	...	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	„ „
Calder	65/-	.....	59/-	„ „
Carnbrae ex Store	48/-	.....	48/-	„ „
Eglinton „	48/-	.....	47/6	„ „
G.M.B. „	45/3	.....	45/-	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	67/6	57/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£25	0	0	to	25	5	0
Copper: British Cakes and Ingots	56	10	0	„	57	0	0
„ Chili Bars, G.O.B.'s	51	2	6	„	51	7	6
„ Other sorts, G.M.B.'s (equal to Chili Bars)	51	2	6	„	51	7	6
„ Manufactured (strong)	65	0	0		.....		
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	90	2	6	„	90	10	0
„ Australian	90	10	0	„	91	0	0
„ English Ingots	94	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues inactive, with small business. Published statistics show a decrease in stocks during February of about 1,560 tons. Owing to the slack demand, values of raw copper are receding, Chili bars to-day being quoted £51 2s. 6d. to £51 7s. 6d. cash, with good trade reported. Manufactured steady at £65, "strong."

Tin: Without change, the fluctuations during the past week having been within very narrow limits.

Lead: Quiet; values unchanged.

Spelter keeps very firm, and is scarce.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6¼
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 8½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 15 0	—	.....
„ Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	25 0 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	10 15 0	—	.....
„ Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 0 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 9	—	.....
„ (50/90 %)	„	0 3 7	—	.....
Copper Sulphate	ton	17 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	25 10 0	—	.....
„ Brown „	„	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 10 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
„ White	„	0 3 6	—	.....
Salts: Epsom { Bags	ton	3 0 0	—	.....
Epsom { Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 10 0	—	.....
„ Recovered	„	7 5 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	11 2 6	—	.....
„ „ { „ 60%)	„	9 17 6	—	.....
„ „ { Cream 60%)	„	9 10 0	—	.....
„ Crystals	„	8 3 0	—	.....
„ Bicarbonate	„	7 10 0	—	.....
„ Hyposulphite	„	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 8	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Business has continued quiet since our last, and there is very little of interest to report. Sulphate of copper is in better request for shipment, and prices have advanced slightly. Green copperas is now more freely offered. Acetates of lime are steady, but little business doing. Borax is firm, and is expected to advance.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	36 0 0
„ Ceylon	„	28 10 0
Cottonseed	„	19 10 0
Cod	„	23 0 0
Lard	„	33 10 0
Linseed	„	21 12 6
Olive, Spanish	„	43 0 0
Palm, Lagos	„	25 10 0
Rapeseed: English	„	29 5 0
Seal: Pale	„	26 0 0
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	21 0 0
Turpentine	„	1 9 0
Coal	per cwt.	.....
Petroleum (Refined)	per gal.	0 0 5¾
Spirit	„	0 0 7

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HOME INDUSTRIES.

LONDON, 12th March, 1891.

THE MONEY MARKET.—The slight stringency in the money market has quite worn off, and rates are again easy, and seem likely to become more so. The outward drain of gold has ceased for the time, and the Bank's stock is growing in strength. On the Stock Exchange dulness still prevails. There is no business to speak of, and in no quarter, except perhaps among silver securities, is there indication of improvement. Home railways are quiet, and Americans are drooping and neglected. Much attention has been concentrated on the Canadian railroads, owing to the recent elections in the Dominion, and the failure of the Opposition to oust the Government has told favourably on Canadian Pacifics. Grand Trunks have suffered severely through the company identifying itself with the United States party in Canada. Among foreign securities Argentines have been depressed, owing to the revival of financial troubles at Buenos Ayres, which has not been counterbalanced by the conclusion of the coupon-finding arrangements. Mining and miscellaneous shares have exhibited no striking feature.

THE GREAT NORTHERN TELEGRAPH COMPANY.—The traffic returns of this company show that the receipts in February, 1891, were £20,800. The total receipts from January 1st to February 28th were £41,600, the receipts for the corresponding months of 1890 and 1891 being £39,400 and £42,000.

THE REGISTRATION OF BOILERS.—A Bill has been introduced into Parliament to ensure the periodical examination and registration of steam boilers throughout the United Kingdom by competent "lay inspectors." The owners of boilers are to be held responsible for the competency of the inspectors, whom they may select. The certificate, which is to be valid for a period not exceeding thirteen months, will state that the condition, construction, and fittings, as well as the setting, general equipment, and surroundings, of the boiler admit of its being worked at a certain pressure for a definite period. The lay inspectors' certificates are to be sent to the Board of Trade, who will issue licences to the owners. The Bill will not require any expenditure of public money, as the expenses connected with the examination and registration of boilers are to be paid for by the owners. Owners of boilers are to be liable to a fine of £1 per day for using boilers which are not licensed and numbered, and a fine of £5 per day may be exacted from owners after a failure to comply with regulations has been notified by the registrar.

THE IMPERIAL INSTITUTE.—On the 5th inst. a meeting of the Organising Committee of the Imperial Institute was held at Marlborough House. There were present—the Prince of Wales, K.G., President (in the chair), Lord Herschell (Chairman of the Organising Committee), Sir Lowthian Bell (Vice-Chairman), and a large number of members of the Committee. Sir Frederick Abel, organising secretary, and Sir Somers Vine, assistant secretary, were in attendance. The progress of the building operations having been duly reported, the draft scheme of constitution, prepared by a special sub-committee, together with regulations for the admission of Fellows to the privileges of the Institute when opened, were considered in detail, and finally approved and confirmed for submission to the Privy Council, as required by the charter of incorporation.

INTERNATIONAL CONGRESS OF HYGIENE.—The Seventh International Congress of Hygiene and Demography will be held in London from August 10th to the 17th. The subject to be discussed by the Congress is that of Section VI., "Architecture in Relation to Hygiene," and deals with (i.) "The Laying out and Extension of Towns; (ii.) "Buildings." All communications relative to this section should be addressed to Mr. E. Turner, 246, Regent Street, W., whilst letters relating to the general business of the Congress should be addressed to the Hon. Secretary-General, 20, Hanover Square, W.

THE EDUCATION CODE AND THE DECIMAL SYSTEM.—A deputation from the Decimal Association last June presented a memorial to the School Board for London, praying that the metric system should be taught in the Fifth Standard, and that decimal fractions should be taught in the Fourth Standard at latest. After due consideration the Board petitioned the Education Department to make the necessary provision in the new Code, and this was subsequently supported by thirty-seven other School Boards. On reference to the Code, it will be seen that the Education Department has inserted the provision desired, the following foot-note having been appended to Schedule I.:—"The scholars in Standards V., VI., and VII. should know the principle of the metric system, and be able to explain the advantages to be gained from uniformity in the method of forming multiples and sub-multiples of the unit. As a preparation for this it will be useful to give in Standard IV. elementary lessons on the notation of decimal fractions."

THE IRON AND STEEL INSTITUTE.—On the 11th inst. a committee of members of this Institute entertained Dr. Raymond, the Secretary of the American Institute of Mining Engineers, at dinner at the Grosvenor Club, New Bond Street, W. In connection with the trip of the Iron and Steel Institute to the United States last year, Dr. Raymond will be long and gratefully remembered on this side for his courtesy, and for the active part which he took in making that trip a great success.

MORLEY MEMORIAL COLLEGE FOR WORKING MEN AND WOMEN.—Scholarships have been offered to those students who pass the best examinations in astronomy, electricity, chemistry, descriptive geometry, and machine drawing in order to enable them to spend some time during the August vacation in attending the summer classes, which have been specially arranged at Oxford and Cambridge for University Extension students.

MANCHESTER, 12th March, 1891.

THE SHIP CANAL.—At a special meeting of the Manchester City Council the recommendations of the special committee appointed to inquire into the desirability of rendering aid to the Ship Canal Company was received. After some discussion, the Council unanimously agreed to the recommendations of the committee, and the Mayor and Sir J. J. Harwood left for London to forward the interests of the proposed Bill. There is a very unanimous feeling in the district with reference to this matter, and a demand for the formation of a public trust to acquire and manage the business is finding many supporters.

TECHNICAL SCHOOL.—A rather novel departure is being made in Oldham. The Mutual Cotton Class in that town, which consisted of an association of overlookers and managers who periodically met to discuss matters of trade interest, resolved a short time ago to start a movement in favour of technical training. They have accordingly taken rooms which they have fitted up, and in which a complete series of machines for spinning cotton have been erected. It is intended that the overlookers, who are by their occupation confined to one department, shall, under the guidance of their fellows in other departments, acquire a knowledge of the method of working the machines with which they are not so well acquainted. The mutual character of the undertaking is to be carefully preserved, and the discussion of practical points is to be continued as hitherto. Already this association, now styled the Oldham Technical School Classes, has done a great deal of useful work, and its value will be largely increased in the immediate future.

THE ENGINEERING TRADES.—There are several signs of a diminished amount of trade, but it is difficult to say whether it is only temporary or permanent. Most makers have plenty of work on hand to keep them going for some months, but in the meantime there is not so much new business coming in. The boiler-making and engine-building departments are fully occupied, and in machine tools the demand has not yet fallen away, orders for new tools having been given out recently. In textile machinery there is as yet a large amount of work being done, and in this branch there is not likely to be much slackness for some months. There is, however, a much worse tone among spinners than there was, and it is not likely that many new mills will be projected for some time to come. In most quarters there is a hopeful spirit shown, and both from home and abroad there are a few orders of considerable magnitude. Coppersmiths have not been so busy during the early months of this year as they were previously, and the weight of manufactured copper going into use is not very great at present. Among miscellaneous machines it may be mentioned that the Theisen condenser, which is made by the Union Engineering Company, is being utilised in one or two places where a supply of water is scarce.

THE LINEN AND JUTE TRADES.—This has been another quiet week, and the situation becomes positively discouraging. Everything seems to be against both manufacturers and shippers. The home demand is decidedly poor, and there is really no branch upon which sellers can rely. It is difficult to see how, under existing conditions, full employment can be afforded to so many looms as were running last year. The South American outlets for trade do not improve, but seem to become worse. The Canadian market is in a poor condition, and the dry goods trade of the Dominion has been adversely affected by the elections and by the fact that farmers are not making their usual purchases. For the United States there is a fair general trade in linens and unions. The Australian and Cape markets, however, are unsatisfactory, and if producers had to depend on these markets for the disposal of their cloth there would not be many looms running. Sales of jute fancy goods are maintained. The demand for articles of this description has for some time been a growing one, and Dundee has secured very good orders from this district, and will probably continue to do so. There is no change of importance in the linen thread trade, which keeps steady. Messrs. Ainsworth are making alterations in their agency here.

GLASGOW, 12th March, 1891.

SHIPBUILDING.—The Inman liner "City of Paris" has arrived at Glasgow for the purpose of having a new set of engines fitted by the builders, Messrs. J. & G. Thomson, Clydebank. At present the vessel lies at Yorkhill Wharf, where Messrs. Howden & Co. are completing the fitting of the boilers with their system of forced draught, the work having been begun at Liverpool while the "City of Paris" was lying there. The vessel steamed from Liverpool to Glasgow propelled by a single engine, the other having been destroyed by the accident which befell the ship last year.—Messrs. Caird & Co., Greenock, have contracted to build two steamers, of 4,500 tons each, for the Dutch Transatlantic Company, for whom the same builders have already built two steamers.—The Greenock Steamship Company are about to establish a line of steamers from Glasgow to Adelaide, Melbourne, Sydney, Newcastle, and Brisbane. Messrs. Caird & Co. are to build a new steamer for this line. The Greenock Steamship Company, Limited, has declared a dividend for the half-year of 5 per cent., with a bonus of 2½ per cent., making in all 12½ per cent. for the year.

SCOTTISH RAILWAYS.—The phenomenal fall in Scottish railway stock, which was due partly to the prospective loss in dividend and increase in working expenses caused by the strike, and partly to the likelihood of traffic returns being affected seriously by the falling off in general trade, has been, for the time at all events, checked. The fall in North British Ordinary and Preference Stocks has been most marked. North British Ordinary has lost £7 3s. 9d. during the course of the last account from the 23rd ult. to the 9th inst. North British Ordinary Preference has lost £8 6s. 3d., while Caledonian has lost £5 5s.; Preferred, £1 10s.; and Deferred, £3 10s. The combined stocks of the North British stood on 6th October, 1890, before the prospect of a strike assumed definite shape, at £137¾; on the 9th inst. they stood at £107½, a fall of about 30 per cent. of the par value. The slight check in the fall is due to the desire on the part of "bears" to cover their sales. Yet the North British Preference Stock has continued to fall. On the 10th inst. it stood at 65⅛. The dividend falls to be declared this afternoon.

CARRIAGE OF PETROLEUM.—The answer given by the Home Secretary to a question put in the House of Commons in reference to the transport and storage of petroleum seems to indicate a disposition on the part of the Government to prohibit the employment of wooden barrels for its storage and transport. The result of any such prohibition would entail the expenditure of a large amount of capital in iron drums, since at present the trade is carried on almost entirely by means of wooden barrels.

ENGINEERING.—Messrs. Kincaid & Co., Limited, have just completed the fourth year of their existence as a joint stock concern. Last year they closed their account with a debit balance of about £500, but this year they have recovered this loss, provided for various contingencies, and have declared a dividend of 10 per cent.

(From our own Correspondents.)

LIVERPOOL, 11th March, 1891.

THE TIMBER TRADE.—The trade during the past month has been very quiet, with no improvement in prices, the stocks being too heavy. There has been a fair consumption of yellow pine waney, but square has not been in demand; the stock of 541,000ft. is more than the trade at present requires. There is little or no inquiry for red pine, and the stock is ample. There is a large stock of New Brunswick and Nova Scotia deals, although the import has been small; prices have not improved in consequence. The stock of oak is heavy with no imports; the consumption is small and the prices unchanged. The arrivals of oak waggon planks have been large, but the deliveries have been larger. The stock is light. First-class planks of suitable scantling command good prices, with an upward tendency. The demand for United States and Quebec walnut has been steady, and the prices at the quays have ranged from 3s. 4d. to 4s. 6d. per cubic foot. There is not much demand for elm, only 3,000ft. going into consumption as compared with 10,000ft. the same month last year. The stock of ash is heavy and the deliveries small. The auction sales of mahogany and other furniture woods were well attended, and satisfactory prices were realised.

TECHNICAL EDUCATION.—In connection with this subject Professor Hele Shaw, M.Inst.C.E., recently read a paper on "The Education of an Engineer" before the Liverpool Engineering Society. In the course of his paper the author stated that a committee of the council of the Society had been appointed to watch the disposal of such funds as might be devoted by the Liverpool City Council to engineering education under the Technical Instruction Act

LEEDS, 11th March, 1891.

THE IRON AND STEEL TRADES.—Business generally is still very quiet, but ironfounders are well employed, as a large amount of construction work is going on. The forges, as a rule, are not running full time, and difficulty is experienced in obtaining orders to fill the place of old contracts which were taken at better prices than at present prevail. As regards the steel trade business is perhaps more brisk than in the iron industry, though prices are kept down, owing to competition from the Continent, especially in girders. For two or three years engineers and machine makers have been kept very busy, but the depression is now making itself felt, and the new orders are not sufficient to replace present deliveries. In regard to the locomotive trade, however, Messrs. Kitson have lately received an order for forty engines from the Midland Railway Company. There is a feeling in some quarters that relief ought to be given by the coal owners, as the prices of fuel are little less than when iron was nearly 20s. a ton higher. The Leeds Forge Company will pay a dividend for the year 1890 at the rate of 8 per cent. on the ordinary and 7 per cent. on the preference shares.

THE COAL TRADE.—There seems to be less briskness in the coal trade, and at some pits stocks are accumulating. Prices remain unchanged.

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SHEFFIELD, 11th March, 1891.

Iron and Steel.—The prices of manufactured iron and steel show a decided tendency to decline, and if the cost of fuel is reduced the prices of iron and steel will soon follow. The chief interest of this week has been in the receipt of further orders for rolling stock from the home railways. The Manchester, Sheffield, and Lincolnshire Company have placed with Messrs. Ashbury, of Manchester, an order for 660 waggons, of various types, including open and covered goods waggons, brake vans, and timber trucks. This order is an addition to the 500 heavy waggons now being built by Messrs. Ashbury for the company. The tyres, axles, and springs will be made in this district, and the ironwork by Messrs. Ashbury, who have special plant for this class of work. The Glasgow and South-Western Company have ordered 350 waggons from Messrs. Brown & Marshall. Most of the springs and tyres will be made by Messrs. Cammell.

Engineering Trades.—The engineering trades are well employed generally, but it is mainly of a special class. Messrs. Hawksley, Wild, & Co., of the Brightside Works, are turning out some fine boilers. Messrs. Ward & Rhodehouse are making a specialty of telescopic lifts, which are made from weldless steel tubes in a most satisfactory manner. File cutting machines are being exported largely to France and Germany.

Fuel.—There is little change in the market, and prices are high. Local collieries are fully employed. The Sheffield Gas Company have agreed to pay their usual dividend of 10 per cent. The company sell 15 to 16 candle-power gas at 2s. 4d. per thousand. A naphthalene deposit in the service pipes is causing much trouble. The capital account now stands at £654,396 6s. 9d. Last year the company sold 78,000 tons of coke. The staple trades of the town are fairly well employed, especially in work of the best class. Files are not selling well, but the agricultural implement trade is improving. The building trades are in a poor condition owing to the continuance of severe weather.

NORTH STAFFORDSHIRE, 11th March, 1891.

The Iron Trade.—A general curtailment of output is becoming an absolute necessity, and is being extensively carried out, as, owing to the enhanced cost of raw materials, and the disadvantage at which this district is placed in consequence of its landlocked position, present prices of finished material and the crude metal involve manufacturers in a heavy loss. Pig iron is being sold at 42s. 6d. per ton for forge purposes, and common bars are being offered at £6 per ton delivered at Liverpool or port of equal facility.

Trent and Mersey Canal.—On the assurance of the general manager of the North Staffordshire Railway Company that it was proposed to widen this canal throughout the route from Stoke-on-Trent to its junction with the Manchester Ship Canal, the opposition of the local Chamber of Commerce to the railway company's scheme, which was regarded as inadequate, has been withdrawn.

BIRMINGHAM, 11th March, 1891.

General.—There is practically no improvement in the state of trade in this district. New orders in most industries are scarce, though many works are still fairly well employed on old contracts. The bedstead trade is, perhaps, a little brisker, and safe makers have a good many orders in hand. Tube works are busy, and some of the leading makers have good orders for gas cylinders for railway carriages. Cart and carriage axle makers report a fair demand. Makers of light brass castings are not well employed. Coal and coke continue high in price, and ironmasters find it difficult to make profits; notwithstanding this, the prices of manufactured iron seem to be declining a little. Bridge and girder builders are getting a considerable quantity of their material from Cleveland, as the low prices in that district enable them at the present time to bear the cost of carriage and still buy cheaper than from the local works.

Limited Companies.—Messrs. Muntz's Metal Company pay on the ordinary shares a dividend of 7½ per cent. for the half-year ending December 31st last, making 10 per cent. for the year; also a bonus of 5 per cent. on ordinary and a dividend of 5 per cent. on preference shares for the year. Messrs. Allday's & Onion's Pneumatic Engineering Company's annual meeting was held on the 9th inst., and the report of the directors was adopted. The dividend is 10 per cent. on ordinary shares and 5 per cent. on preference, £7,000 being placed to a reserve fund.

LEICESTER, 11th March, 1891.

Wool Spinning and Yarn Trades.—There is little variation in the condition of the local wool market. Prices remain very firm indeed at late rates. Though there is a lack of animation in the market, there is a fairly large consumption, but users buy only for present wants. Bristol wool fair, this week, is regarded as fixing the price of English wool, and many users are postponing their operations till this is over. Spinners are only moderately busy, and the output is rather restricted. There is plenty of new business offered, but prices are so unremunerative that spinners refuse to enter into contracts unless at an advance which is seldom obtainable.

Hosiery Trade.—There is a slow but steady improvement in this industry. For the time of the year there is a fairly good amount of business, and some good contracts have been taken both for home trade and for export. Fancy hosiers are becoming busier. As stocks are low, and buyers are disposed to operate, there is a very cheerful prospect of good trade in the coming season.

SWANSEA, 11th March, 1891.

Tinplates.—The Manufacturers' Association has discussed a proposal for combination in view of the new American tariff. The idea, which meets with general favour, is to reduce as much as possible the stocks in the United States, so that the industry in South Wales may not suffer too sudden and severe a relapse when the tariff comes into operation. Since, however, the falling off in American orders is regarded as an inevitable consequence in the not far distant future, the associated masters have decided to send out men to Ceylon, Japan, and China to teach the natives how to pack tea in tinplate boxes. This endeavour if successful must give a great impulse to the tinplate trade.—At a recent sale, after a keen competition, the Midland Works were sold to Mr. Thomas Bowen, of the Morriston Tinplate Company, at the reserve price of £10,000.—It is interesting to note that the value of tinplates and sheets exported during the first two months of the present year amounts to £1,180,962, as compared with £875,701 during the same period last year. The weights of the said exports, are for the two periods named, 72,322 cwt. and 56,734 cwt. respectively.

CARDIFF, 11th March, 1891.

Iron and Steel.—There is no improvement in the manufactured iron and steel trades, and the outlook is worse than before. Steel bars for tinplate making, which have been the principal article on which steel works have relied lately, do not seem in such demand, on account of the feeling amongst tinplate makers that the McKinley tariff will press heavily on their trade. One furnace at Rhymney has been turned on to spiegel iron. The iron ore market is dull. Rubio ore of first quality is quoted at 13s. 6d. to 13s. 9d. c.i.f. Cardiff or Newport; second quality, 13s. to 13s. 3d.

Coal and Coke.—Shipping operations have been partially suspended on account of the snowstorm, which has also had the natural effect of reducing chartering transactions and sales. There is, however, a fair prospect for the summer months, judging from the number of inquiries for large quantities during the past few days. With the exception of small steam coal, quotations for all descriptions are firm at recent quotations. Steam coal (large) realises:—No. 1 quality, 14s. 6d. to 15s. 3d.; No. 2, 13s. 9d. to 14s. 3d.; No. 3, 13s. 3d. to 13s. 6d.; and No. 4, 12s. 6d. to 13s. Small steam, 5s. 3d. to 5s. 5d. The inquiry for coke is limited, furnace being offered at 20s. to 21s.; foundry, 23s. to 24s.; special foundry, 26s. to 27s. 6d. The supply of Pitwood is largely in excess of the demand, owing to heavy imports and low freights.

BARROW-IN-FURNESS, 11th March, 1891.

Hematite.—A quieter tone is again shown in the hematite pig iron trade this week, and only a very small amount of business has been done. Prices have dwindled down to 49s. 6d. for hematite warrants net cash, and makers are asking 52s. per ton for parcels of mixed numbers of Bessemer iron net f.o.b. Makers cannot produce iron at a less figure than this whilst the cost of raw material remains at its present quotation. Stocks have been diminished this week to the extent of 6,110 tons, and now stand at 199,676 tons, compared with 380,000 tons on January 1st, 1890. Forty furnaces are in blast and thirty-six standing idle.

Steel.—There is no change to note in the steel trade, and the only department in which there is any prospect of good trade is the Siemens-Martin department. Shipbuilders are expected to place good orders for plates and angles, and the Barrow Steel Company have determined to double their output of plates by the erection of a light mill.

Iron Ore.—Although the demand remains very slow, and although raisers of ore are stocking at the pits, prices are maintained at 10s. 6d. to 11s. 6d. per ton, but cheaper rates are expected.

Shipping.—The export trade in pig iron and steel is still depressed. During the week the shipments amounted to 15,053 tons, compared with 22,524 tons in the corresponding week of last year, being a decrease of 7,471 tons. The exports up to date this year represent 159,334 tons, against 187,938 tons exported during the same period of 1890—a decrease on 1891 of 28,604 tons.

Barrow Hematite Steel Company.—The report of the directors of this company shows a net profit of £132,314 during the past year. Of this sum, £18,194 is to be applied in defraying special expenditure upon the furnaces, steel works, and mines, and £25,000 is placed to the reserve fund. £4,616 is carried forward, and the remainder will be applied in paying dividends on the preference and ordinary shares. The report states that the capital account of the steel works has been increased by £7,197 2s. 10d. This sum represents expenditure upon new compressing machinery, a new machine shop for dealing with steel castings, and a hot metal mixer, the latter being for the purpose of obtaining a more uniform quality of iron taken from the blast furnaces to the steel works.

Chemical Wood Pulp.—The Kellner-Partington Pulp Company, at Barrow, has accepted the tender of Mr. Peters, of Rochdale, for a large extension at the works at Barrow. It is proposed to make not only the pulp, but also special qualities of paper for which there is a great demand.

MIDDLESBROUGH, 11th March, 1891.

Pig Iron.—There was a very large attendance on 'Change yesterday, but the market was dull and the tone despondent. Scarcely an order or inquiry was reported, and the only sales or purchases were for early delivery. The inquiry from the Continent is disappointing, and the present weather will not improve matters. For the present the demand from Scotland is well kept up. Merchants generally quote 41s. per ton for prompt f.o.b. deliveries of No. 3 G.M.B., and makers have asked and in some cases realised that price, but buyers, as a rule, would not give more than 40s. 9d. Middlesbrough warrants are at 40s. 7½d. buyers, and 40s. 9d. sellers. Forge pig is a little weaker, as the re-lighting of the furnaces in Scotland will ultimately cause a lessened shipment of Cleveland forge to Scotch works. The price is quoted at about 40s. per ton. Grey iron is 40s., mottled 39s., and white 39s., but buyers offer 3d. below these prices. East coast hematite pig is 53s. per ton at furnaces for mixed numbers. The stock in Connal's stores on the 9th inst. was 125,921 tons, an increase of 1,353 tons on the previous week.

Manufactured Iron and Steel.—No change has taken place since last week. Manufacturers are still able to keep their mills in regular operation, and do not reduce their quotations. Common iron bars and ship plates are £5 12s. 6d. to £5 15s.; best bars, £6 2s. 6d.; boiler plates, £6 12s. 6d.; ship angles, £5 10s.; engineering angles, £5 12s. 6d.; steel ship plates, £6; steel angles, £5 17s. 6d.—all less 2½ per cent. discount. Steel rails are very dull, and may be obtained at from £5 12s. 6d. to £5 15s. net at works.

The Coke Trade.—Good blast furnace coke can be bought here at 15s. to 16s. per ton, and the price is tending downwards.

Shipments.—The shipments are very well kept up, considering the weather, and amount to 19,190 tons for this month up to the 9th inst. Of this 12,910 tons have gone to Scotland, 2,100 tons to England and Wales, 2,100 tons to Germany, and 1,505 tons to other countries.

NEWCASTLE, 10th March, 1891.

The Coal Trade.—The very sudden change in the weather has, as might be expected, greatly stimulated the demand for household coals, and prices have in consequence been somewhat strengthened. In some other departments of the local coal trade a tendency to improvement may be seen, but this is, perhaps, attributable to the unsettled state of the trade in Durham, resulting from the long-continued strike at the Silksworth Colliery. The output at most of the Northumberland collieries is quite up to the average, and full time is generally being worked. The shipments of coal and coke at Tyne Dock for the week ending the 7th inst. amounted to 102,731 tons, being a decrease as compared with the shipments in the corresponding week last year of 2,105 tons.

The Disputes in the Shipping Trade.—In the struggle between the Shipowners' Federation and the Seamen and Firemen's Union the former is rapidly gaining the upper hand. At a large meeting of union men held at South Shields on the 9th inst. it was decided to accept the Federation programme, which simply pledges the holder to proceed to sea in any vessel he may "sign" for, whether the other members of the crew belong to a seamen's union or not. The number of steamers laid up in the Tyne increases daily, and cannot now be less than 120, representing an aggregate tonnage of 150,000 tons.

Stoppage of Work.—A very heavy fall of snow, which took place on the 8th inst., has caused a general cessation of operations in outdoor employments, the shipbuilding industry included. The number of men laid idle in the district cannot be estimated at less than 20,000, and as the stoppage of work is likely to last for several days, the loss to the industrial and commercial sections of the community will be very serious.

Overtime in Engineering Shops.—A conference between representatives of the employers and the operatives in the local engineering trade was held in Newcastle on the 10th inst., the object being to discuss a claim put forward on behalf of the men in reference to the restriction of overtime. The result has not yet transpired, but it was expected that a basis of settlement would be agreed upon.

DUNDEE, 11th March, 1891.

Jute and Flax Trades.—Business in both branches of the Dundee trade continues quiet. In the jute branch it looks as if production were in excess of requirements. The demand from South American markets is greatly curtailed, and prices are with difficulty maintained. Advices from New York indicate a weaker market. Burlaps, 40in. 10½oz., are quoted at 5c. per yard, and light weights at 4 13/16c. per yard. The linen trade is steady. In flax considerable sales on contract are reported. The market for flax and tow yarns has been rather active. Makers of linens are fairly busy, but canvas continues dull.

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THE "KINGDON" INDUCTOR DYNAMO.

CONSTRUCTED BY MESSRS. WOODHOUSE & RAWSON UNITED, LIMITED, 88, QUEEN VICTORIA STREET, LONDON, E.C.

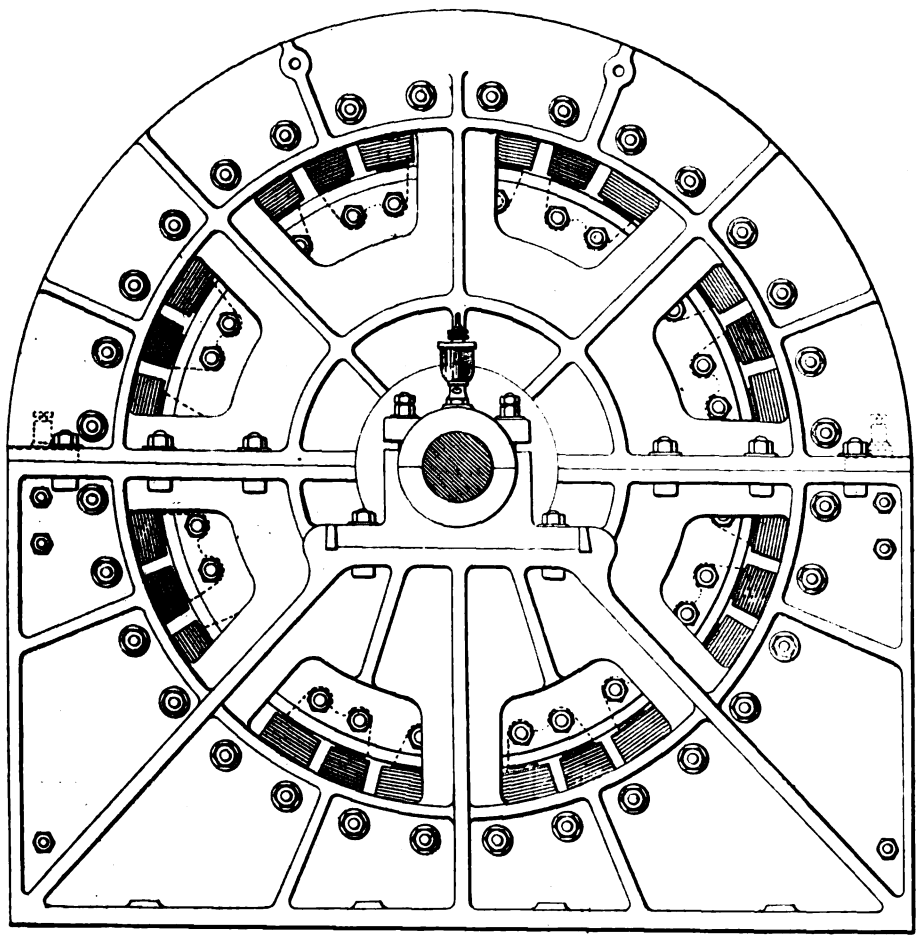


FIG. 1.—SIDE ELEVATION.

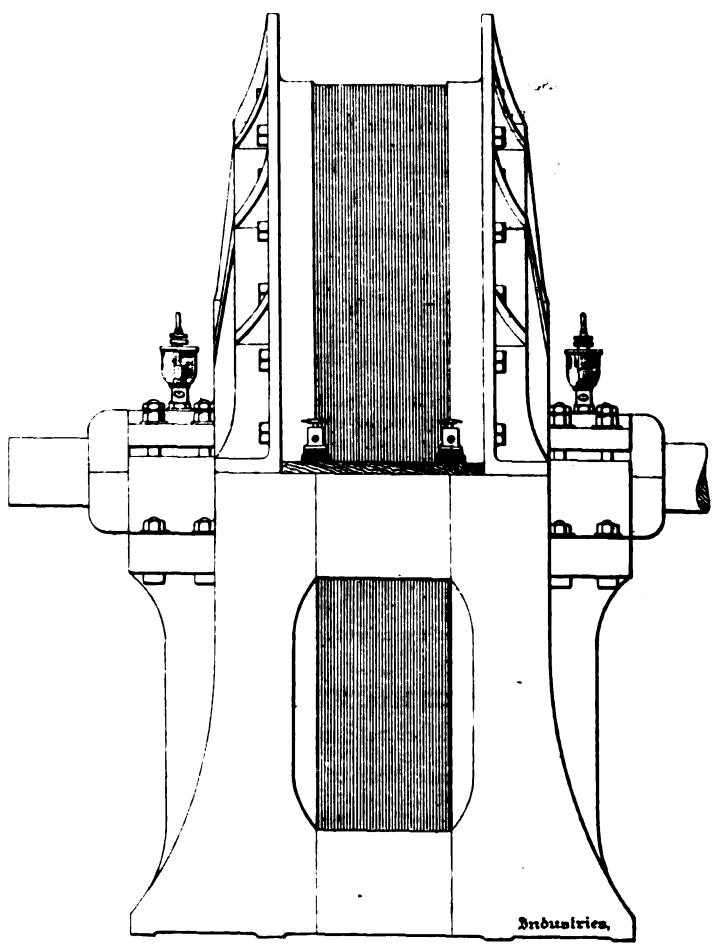


FIG. 2.—END ELEVATION.

THE "KINGDON" INDUCTOR DYNAMO.

THE illustrations given above (Figs. 1 and 2) represent one of the 70 unit alternating current dynamos designed by Mr. J. A. Kingdon for the central station at Woking. In this machine the coils, which correspond both to the armature coils and to the field magnet coils of an ordinary alternating current dynamo, are fixed, while the revolving wheel carries a number of

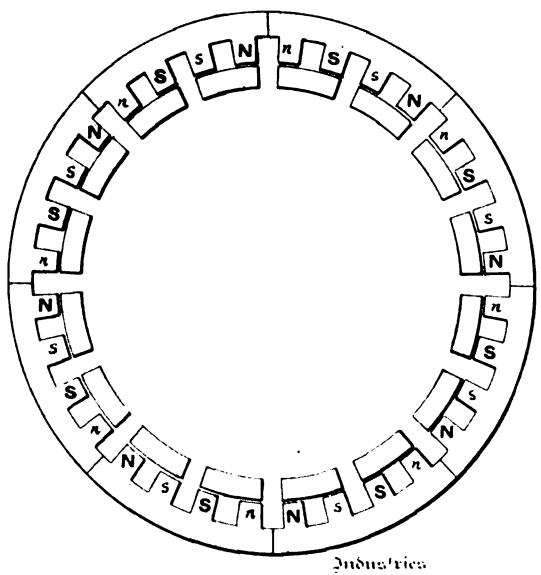


FIG. 3.

laminated masses of iron or inductors, which produce by their motion magnetic changes in the iron cores of the armature or secondary coils. The magnets of the dynamo are built up of a number of stamped iron plates, each plate being of the shape shown in Fig. 3, and having four projecting core pieces. These plates are bolted between two stout cast-iron frames, which also carry the pedestals. The machine is divided horizontally along the centre lines, so that the top can be lifted off and the wheel taken out. There are thirty-two magnet cores projecting from the magnet ring, and sixteen of these are fitted with the primary or exciting coils, and sixteen with the secondary coils in which the alternating current is generated, primary and secondary coils being placed alternately. In the diagram (Fig. 3) the poles marked N S N S are primary poles, and are magnetised by means of an exciter with the polarities indicated. The intermediate poles *n s n s* are the secondary poles, and have their magnetism constantly changed as the inductor wheel rotates. The number of inductors, which consist of a number of stamped iron plates bolted between two steel discs carried on a hub on the shaft, is sixteen, being equal to half the number of the magnet cores.

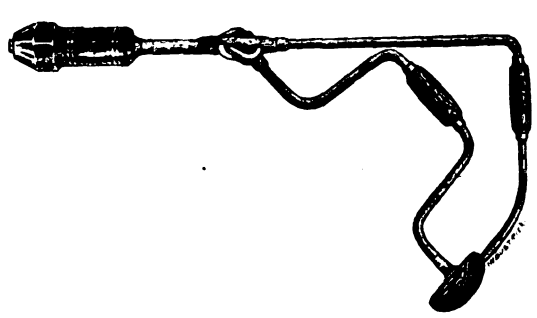
The action of the machine is as follows:—In the position of the wheel shown in Fig. 1 the secondary poles have the polarities indicated, being magnetised by the primary poles with which they are connected through the inductors. When the inductor wheel has rotated through one thirty-second of a complete revolution, the secondary poles will all have their polarities changed, being now magnetically connected through the inductors, each with the primary magnet on the other side. The inductor wheel thus acts as a magnetic commutator, and as it rotates continually changes the polarities of the secondary magnets. Alternating currents are accordingly generated in the coils wound on the secondary magnets. The polarity of the secondary magnets being changed thirty-two times during each complete revolution, the number of alternations per revolution is thirty-two, being equal to twice the number of the inductors, and being quite independent of the number of primary or secondary coils.

The dynamos at the Woking Central Station are coupled direct to triple-expansion engines running at about 260 revolutions per minute. The periodicity of the machines is therefore 70. Each machine is divided into halves, each half giving 15 amperes at 2,000 volts at the speed mentioned. Either the top half or the bottom half can be used alone or the two halves may be used together as one machine. When the load on a machine is less than 30,000 watts, one half only of the primary magnets are excited, and current is taken from the corresponding secondaries. The principal dimensions of the machine are:—Length, 6ft. 8in.; height, 6ft. 8in.; width, 3ft. 9in. The inductor wheel is 4ft. 6in. in diameter. The inductors measure 12in. by 8in. on the face. The magnets are 3in. long, and measure 12in. by 3in. on the face. The resistance of eight primary coils connected in series is 2·7 ohms, and of eight secondary coils 1·8 ohm. The total weight of the machines is about 7½ tons.

The Kingdon inductor dynamo is manufactured by Messrs. Woodhouse & Rawson United, Limited, of 88, Queen Victoria Street, E.C., at their heavy engineering works at Kidsgrove, near Crewe, where also the engines and boilers for the Woking Central Station were made.

THE "AMIDON" CORNER BRACE.

THE accompanying illustration represents a new corner brace made by Mr. C. H. Amidon, 1451, Niagara Street, Buffalo, New York State, intended for boring holes in corners, where the ordinary type of brace could not be used. As will be seen, the brace handle works at an angle with



the bit spindle by means of a Hooke's joint, the pressure being applied directly through the vertical arm instead of through the handle. The want of a simple brace of this description—particularly in electrical installation work—must have been long felt, and as the brace is equally adaptable for ordinary positions it should have an extended use. Our illustration is taken from the *Electrical Engineer* of New York.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 13TH MARCH, 1891.

RAILWAY WORKING EXPENDITURE AND RAILWAY RATES.

THERE are two items that give concern to every railway engineer, and which he is always endeavouring to bring under better control. The one, and the most important, of these is the item of labour; the second, which is hardly less important, is the price of materials. The average working expenditure per train-mile in the United Kingdom is about 2s. 6d., and of this amount probably fully 1s. 6d. is made up of the two items that have been named, leaving only 1s. to go towards the cost of fuel, general expenses, rates and taxes, and so forth. The recent labour disputes on the Midland and Scotch railways are likely to cause greater uneasiness in the future in reference to labour movements, but it would, perhaps, be unwise to attach too much importance to these circumstances, or to connect too closely the present unsettled condition of the labour market and the exceptional position of railway servants as regards long hours and low rates of wages. It is nevertheless evident that the railway companies themselves are by no means too easy about the matter, since they have attached special importance to the future relations of labour in the controversy they have lately had with the traders as to their maximum rates and charges, while they are preparing to insist on the same points with all the strength at their command in the inquiry that is about to be held on the Bills now before Parliament. So far as it is possible to glean the information from the somewhat defective returns embodied in the accounts of the railway companies, it would appear that the recent tendency of labour has been towards increased cheapness rather than towards a higher cost—taking for comparison a period of ten or twelve years. Whether this is due to any absolute decrease of the rate of wages, or to the working of longer hours by the individual, or to getting the functions of labour aided by mechanical auxiliaries so as to reduce the number of hands employed relatively to a given result, or whether all these and other causes combined have had something to do with the fact, we do not pretend to say with precision, but we give below a statement of the actual amounts paid for labour on the longest system in Great Britain—namely, the Great Western Railway—for the years 1877 and 1888:—

	1877.		1888.
Maintenance of way	£258,800	...	£229,600
Locomotive power running	277,200	...	356,900
Repairs and renewals	213,500	...	218,500
Carriages	56,000	...	95,500
Waggons	68,600	...	83,700
Traffic expenses	694,300	...	825,500
Totals	£1,568,400	...	£1,809,700
Train-miles run	25,709,200	...	31,708,500
Average wages per train-mile	1·26s.	...	1·16s.

Here, as between the two dates, we find an average reduction of about one-tenth of a shilling in the ascertainable amount paid for wages. The sums given above do not, however, include all the wages paid by the company, since there are many minor departments as to which no actual returns are available. The only thing that can be said is that, as the figures that have been adduced cover the greater part of the labour employed by the company, it is fair to assume that the remainder will follow the same tendency, and bring out a closely approximative result. And as with the Great Western, so, in all probability, with the other great lines of the United Kingdom, of which this particular system is fairly representative. Evidently, therefore, up to the end of 1888, the railway companies had not much reason to complain of the way in which they were effected by the general movement of the labour market, and this fact may be commended to the attention of the Labour Commission that has just been constituted, since no description of labour is more typical than that employed on our great railway lines. No doubt, since 1888, the cost of labour has increased as a general rule, but it has increased less in relation to railway working than it has done in relation to industrial operations generally, and it is not probable that the slight margin of increase that has undoubtedly taken place is likely to place the railway companies in a worse position in reference to the train-mile cost of labour than they occupied between 1873 and 1887.

The reduced cost of the materials that are used on a large scale in railway working has enabled the companies to show a remarkable economy over the period that has been selected for comparison. In this direction the companies have made more striking reductions than in any other. Comparing the returns of the same railway company for the same two years we find the following results:—

COST OF MATERIALS PURCHASED BY THE GREAT WESTERN RAILWAY.

For—	1877.		1888.
Maintenance of way	£413,556	...	£184,429
Repairs and Renewals—			
Of locomotives	131,536	...	141,145
Of carriages	54,030	...	72,270
Of waggons	78,985	...	77,754
Totals	£678,107	...	£475,598
Total train-miles run	25,709,200	...	31,708,500
Average per train-mile	6·31d.		3·60d.

The working out of a very simple problem in arithmetic will show that, if the company had expended the same amount per train-mile in 1888 that they did in 1877, the total sum paid for materials in the former year would have been £833,670 instead of £475,598, and this would apply, no doubt, with equal force to the other companies throughout the United Kingdom. The lower prices recently paid for railway materials have enabled the companies to have at their disposal a larger sum for improvements and alterations in other directions, but it is doubtful whether they have always wisely bestowed their surpluses thus obtained. But of the fact that the industries of the country have enormously benefited the railway companies by placing cheaper materials at their command, there cannot be any doubt whatever.

As the railway companies, in presenting their case before the Board of Trade, have made a good deal of the possible increase of expenditure entailed by the higher cost of labour and materials, it is well that the actual facts, as brought out in the above analyses, should be presented to Parliament. The railways of this country have paid relatively less for

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labour, for fuel, and for materials of construction during recent years (excluding 1889-90) than they have ever done before, and this should have enabled them, but for their extravagance in other directions, to have reduced their working costs all round. It is to the traders, whom they now wish to saddle with the burden of higher rates, that they primarily owe these notable advantages, and it is to be hoped that the traders will not fail to see that Parliament is made acquainted with the details of this part of their case. The time is now close at hand when the railway companies' charter must be settled one way or the other. The Board of Trade have submitted what they believe to be satisfactory and equitable schedules, and a classification, that are perhaps not perfect, but certainly much better than those proposed by the companies. The Board of Trade look to the traders to support the proposals which they have put forward, and the traders would be unwise if they neglected the opportunity.

THE NAVY AND BRITISH COMMERCE.

The debate in the House of Commons on the motion proposed by Sir J. Colomb on the growth of colonial sea commerce, and the consequent increase of British responsibilities, did not excite very much interest among the members—at least, if we are to judge from the small number which attended. The motion suggested that the growth of the sea commerce of the British colonies and dependencies, and of the war fleets of foreign Powers, render it desirable that the annual Navy Estimates presented to Parliament should in future be accompanied by a return showing the total number of warships of each class in commission, in reserve, and building, the annual aggregate revenue, the annual naval expenditure, the aggregate tonnage of the mercantile marine, and the approximate annual aggregate value of the sea-borne commerce of the British empire, and of each foreign Power possessing warships, and a further return showing the annual naval expenditure on sea-going forces, and the approximate annual value, exclusive of interchange with the United Kingdom, of the sea-borne commerce of British North America, British South Africa, British Australasia, and British India respectively. All this looks a rather innocent request for information, but the tone of the speech by which it was backed was decidedly alarmist, and intended to show that our naval arrangements were not kept up to the requirements of our rapidly extending commerce. As to the latter, Sir J. Colomb pointed out that the outlying empire —that was to say, the empire exclusive of the United Kingdom—showed a value of exports and imports in one year of £460,000,000, of which the interchange with the United Kingdom was only £187,000,000, and, therefore, the independent trade of the outlying empire was £273,000,000. We were approaching a period when the sea-borne commerce of the colonies would exceed that of the mother country, and for that reason Sir J. Colomb submitted that the information for which he asked should be attached to the annual Navy Estimates, so that the House and the country, responsible for this gigantic empire, and the safety of this gigantic sea business, should be able to judge whether the preparations were adequate, and whether the Government were taking the steps necessary to secure these interests.

The First Lord of the Admiralty agreed to grant the return in a modified and condensed form, but he could not assent to the motion as it stood, as he found that the longer the documents presented to Parliament the fewer members read them. He differed from Admiral Colomb in the opinion that increase of commerce necessarily meant increase of naval danger. We ought, he thought, to try to keep up our Navy so that it would maintain in every part of the world its fighting supremacy, and for that purpose the Navy should be independent of any assistance from the merchant cruisers. Having performed that duty, we ought to give the most adequate protection possible to our commerce, and in that task our merchant cruisers could, to a certain extent, be associated with the Navy, and it was on these lines that the Government were now working.

Although Sir William Harcourt may have exaggerated the assistance which would be received from neutral flags in time of war, still, on the whole, we think that his remarks were needed by those naval members of Parliament who seem to think it is necessary to be constantly trying to induce the increase of the already enormous expenditure of the country on naval and military defence. He pointed out that during the past two years Her Majesty's Government had brought in two measures, one called the Imperial Defence Act, and the other called the Naval Defence Act, which provided for an expenditure of £24,000,000, and in that they had not merely made a present provision, but had really mortgaged the resources of the future.

There is nothing worse for the Navy than periodical panics, and even the most severe critics of the Government in naval matters admit that at present there is no cause for alarm. They have during their tenure of office done much to strengthen the Navy, and they have gained the confidence of the country by the business-like way in which they have gone about it. Our advice has always been to go on steadily maintaining the power of the Navy, and to show that we are conscious of our strength, and thus do much to remove the causes of the periodical alarms to which we are subject. The modified returns which have been agreed to by the First Lord of the Admiralty will be useful in showing that the policy which is being pursued both in the Navy and the mercantile marine is as much as reasonable men will be inclined to demand.

THE PROPOSED FORTH AND CLYDE SHIP CANAL.

The proposed Forth and Clyde Ship Canal, which has now been before the public for a considerable time, and to which we have several times directed the attention of our readers, has again been somewhat prominently brought into notice by the motion made by Mr. Wilson, representing the South of Scotland Chamber at the recent meeting of the Associated Chambers of Commerce, held in London, to the effect "that, seeing the establishment of a ship canal connecting the Forth and Clyde would be of great advantage to commerce between the Continent of Europe and all ports on the west coast of Britain and countries beyond, and that it would at all times be of national value, this Association urges the appointment of a Royal Commission to inquire into the merits and cost of such an undertaking." Mr. Wilson gave a sketch of the advantages and of the financial and engineering questions connected with the canal. These we have referred to on previous occasions, and therefore need not repeat them here. We may mention, however, that a very interesting *brochure* on the subject, especially in its relation to the development of commerce, by Mr. J. Law Crawford, has just been published by Messrs. Maclaren & Sons, Glasgow and London, in which will be found a report by the engineers of the route of which he is a supporter, and in which the importance of such a canal in time of war, and its value in the development of international traffic, is fully dwelt upon. We may simply mention that the proposal is to construct a ship canal 29 miles 6 furlongs and 196 yards long, 26ft. deep, and 100ft. wide at the bottom, capable of bearing on its waters large ocean-going steamers and men-of-war, and extending in a direct line across the narrowest part of Britain, from Yoker on the Clyde to Grangemouth on the Forth. Mr. Crawford estimates the cost at £8,000,000, and the annual income at £600,000. The promoters of the scheme had, we think, every reason to be satisfied with the amount of support which it received from the Associated Chambers of Commerce. Mr. Esslemont, M.P., however, pointed out that it was doubtful whether it was advisable to press upon the Chamber the expediency at the present stage of appointing a Royal Commission, as it required some discussion, and was a matter of great interest, as to whether it was going to be a Government undertaking. If it was to be a Government undertaking no doubt a Royal Commission would readily suggest itself, but it was a question whether the scheme could be taken out of the arena of private enterprise, especially as the sanguine engineers might really demonstrate that this was a commercially sound undertaking, and, if that were so, capitalists would find the money for it without Government intervention. He therefore suggested that the matter be considered for another year, and then they would have more information to go upon. This view was supported by the President and Sir Michael Hicks-Beach. The latter pointed out that it was not his business to influence their decisions because of his official position, but without expressing any opinion upon the real subject at issue, whether it was a work of general national importance or not, he might say that he did not see how it would be possible to defend the suggestion of a Royal Commission unless it was a work of national importance. Obviously, if it were merely a work that could be carried out, like the Manchester Ship Canal, by private capitalists, they would form the best commission for themselves. He thought the matter had been by no means sufficiently considered in the country as yet to justify the decision that it was a work of such national importance that the Government should aid it, and if the Government should not aid it, he could conceive no reason for the appointment of a Royal Commission. Ultimately the resolution was adopted, with the omission of that part referring to the appointment of a Royal Commission.

EXPLOSION AT DIXON'S IRONWORKS, GLASGOW.

An explosion, attended by the loss of at least five lives and the destruction of a considerable quantity of plant, took place on Tuesday at the well-known ironworks of Messrs. Dixon, Glasgow. The works are situated near Gushetfaulds Station, one of the stations of the Caledonian Railway on the confines of Glasgow. About three years ago plant for the recovery of sulphate of ammonia from the gas employed in the smelting furnaces was erected by the firm. The plant was designed and supplied by Messrs. R. & A. Dempster, of Manchester, and was of capacity sufficient to deal with 60,000,000 to 70,000,000 cubic feet of gas per day. During the suspension of pig iron production the works were wholly idle. Only a few weeks ago the furnaces in the district began to be re-lighted, though only a fourth of the normal number had yet been set going. At Messrs. Dixon's, although several furnaces had been re-lighted, the apparatus for the recovery of ammonia was only on Tuesday being put into working order preparatory to its being used. The manager, the foreman engineer and his assistant, the two latter being brothers, along with several men, were engaged in the work when the explosion occurred, by which the manager, three engineers, and a workman were killed, others being more or less seriously injured. It appears that the works had been unused for about five months, and that air had been blown through them at intervals in order to secure that no gas remained in the condensers or in the scrubbers. The details are not yet fully obtainable. It is said by one witness that the gas had been turned on, and by another that it had not. That there must have been gas in the apparatus is, however, certain. The immediate seat of the explosion was a tower, one of a series of five about 150ft. high, and this tower was partially destroyed by the explosion, the upper half having been completely demolished. The men who were killed were found at the foot of the tower buried in the *débris*. The work of attempted rescue was attended with no little difficulty, since minor explosions occurred at intervals until the gas was exhausted.

THE LATE MR. J. L. STOTHERT.

Mr. John Lum Stothert, for more than thirty years the principal member of the firm of Messrs. Stothert & Pitt, of Bath, died on the 5th inst. His health had been failing for several years, but no immediate danger was anticipated two days previously to his death. Although he had relinquished for some time much of the active business of the firm, he retained to the last the chairmanship of the company. Mr. Stothert was a man of great energy, and shrewd practical common sense. He was a mechanical engineer of the old school, and the well-established reputation of his firm is due to the fact that he would tolerate no inferior workmanship. The reputation of the firm for cranes and for block-setting machinery for harbour works is well shown in the works at Jersey, Madras, Mandaree, Colombo, Tynemouth, Hartlepool, Douglas, and those going on now at Peterhead. During the Bath meeting of the British Association in 1888 Mr. Stothert worked indefatigably as one of the hon. secretaries. It says a great deal for Mr. Stothert's tact in the management of men, that during the thirty-five years in which he was engaged in business he never had a strike or any serious dispute with his workmen. Mr. Stothert was a devoted student of astronomy. He had a well-appointed observatory in his grounds. This, with a private little workshop, fitted with some of the best English and American tools, occupied his leisure movements. Mr. Stothert died in his sixty-third year.

CLYDE SHIPBUILDING FOR FEBRUARY.

With regard to new contracts, business was altogether much quieter than in the preceding month, the amount of tonnage secured being only 12,000 tons—a little more than half the aggregate output. The largest order was booked by Messrs. William Denny & Bros., Dumbarton, for a steamer 430ft. long and of 6,500 tons, for the dead meat trade of the New Zealand Shipping Company. The same firm also contracted to build three other steamers, each of about 200 tons. Orders aggregating 3,500 tons were placed with Messrs. Scott & Co., Greenock, which include two twin-screw and two single-screw steamers, for general trading purposes; and Messrs. Blackwood & Gordon, of Port Glasgow, were instructed to build a twin-screw steamer of 1,400 tons, for a London firm. The output of tonnage reached a total of 22,710 tons, and included eleven steamers, of 13,650 tons; five sailing vessels, of 8,310 tons;

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and five barges, of 750 tons. Considerably more than one-third of the total tonnage launched was built for German owners, and the principal steamer contributing to the month's output—the "Weimar"—was launched from the stocks of the Fairfield Shipbuilding Company, Govan, for the North German Lloyd of Bremen. The dimensions of this vessel are:—Length, 431ft.; breadth, 48ft.; depth, 33ft.; and tonnage, 5,400. Her engines are of the triple-expansion type, with three cylinders of 31in., 52in., and 83in. in diameter respectively, with a stroke of 54in. The high-pressure cylinder is fitted with a piston valve, while the medium and low pressure cylinders are each fitted with the ordinary double-ported slide valves. Two double-ended and two single-ended boilers are fitted to supply steam at a working pressure of 150lb. per square inch.

The third of the second-class twin-screw cruisers built by Messrs. J. & G. Thomson, of Clydebank, for the British Admiralty, was launched during the month. She is in every respect similar to her sister ships, "Thetis" and "Terpsichore," being 300ft. in length, 43ft. in extreme breadth, with a displacement of 3,400 tons on a mean draught of water of 16ft. 6in. The propelling machinery consists of two sets of triple-expansion engines, capable of developing 9,000 horse-power under forced draught, from which a speed of 20 knots is expected.

The following are the particulars of vessels launched during the month:—

SINGLE-SCREW STEAMERS.

"Esmeralda" (steel), 1,500 tons, built by Messrs. William Hamilton & Co., Port Glasgow, and fitted with triple-expansion engines by Messrs. Hutson & Corbett, Glasgow, for Messrs. A. Russell & Co., London.

"Gnat" (iron), trawler, 150 tons, 300 horse-power, built and engined by Messrs. Mackie & Thomson, Govan, for the North Sea fishing trade.

"Norman" (iron), 300 tons, built by Messrs. M'Gill & Co., Irvine, for Messrs. J. & G. M'Farlane, Glasgow.

"Premier" (steel), 200 tons, built by Messrs. S. M'Knight & Co., and fitted with compound surface-condensing engines by Mr. W. Kemp, Govan, for Mr. J. Wood, Halifax, Nova Scotia.

"Rover," sister ship to the "Gnat," by the same builders.

"Somerville," sister ship to the "Gnat," by the same builders.

"Sheik Borkhud" (steel), 400 tons, 500 horse-power, built and fitted with triple-expansion engines by Messrs. Scott & Co., Greenock, to the order of the Perim Coal Company.

"Weimar" (steel), 5,400 tons, built and fitted with triple-expansion engines by the Fairfield and Shipbuilding Company, Govan, to the order of the Norddeutscher Lloyd, Bremen.

Steel screw steamer, 1,500 tons, built by Messrs. Wm. Denny & Brothers, Dumbarton, and fitted with triple-expansion engines by Messrs. Denny & Co., for the Union Steamship Company, Dunedin.

TWIN-SCREW STEAMERS.

H.M.S. "Tribune" (steel), 3,400 tons, 9,000 horse-power, built and fitted with triple-expansion engines by Messrs. J. & G. Thomson, Clydebank, for the British Government.

Steel dredger, 500 tons, 500 horse-power, built and engined by Messrs. Wm. Simons & Co., Renfrew, to the order of the French Government.

SAILING VESSELS.

"Baroda" (steel), barque, of 1,350 tons, built by Messrs. Archibald McMillan & Sons, Dumbarton, to the order of Messrs. W. & J. Crawford, Greenock.

"Centurion" (steel), four-masted ship, of 1,700 tons, built by Messrs. Russell & Co., Port Glasgow, for Messrs. G. T. Soley & Co., Liverpool.

"Gowanbank" (steel), four-masted ship, of 2,200 tons, built by Messrs. Russell & Co., Port Glasgow, for Messrs. Andrew Weir & Co., Glasgow.

"Othmarschen" (steel), 1,700 tons, built by Messrs. Chas. Connell & Co., Scotstoun, for Hamburg owners.

"Pax" (steel), barque, of 1,360 tons, built by Messrs. Russell & Co., Port Glasgow, for Mr. J. H. Hastede, Elsfleth, Germany.

In addition to the above, Messrs. Murdoch & Murray, Port Glasgow, shipped five lighters, each of 150 tons, to Rio de Janeiro.

SYNOPSIS OF LAUNCHES.

	Steamers. No.	Tonnage.		Sailing Vessels. No.	Tonnage.
Great Britain	6	5,650	...	3	5,250
Germany	1	5,400	...	2	3,060
France	1	500	...	—	—
New Zealand	1	1,500	...	—	—
Nova Scotia	1	200	...	—	—
Arabia	1	400	...	—	—
Total	11	13,650	...	5	8,310

Letters to the Editor.

THE LONDON SMOKE AND FOG PLAGUE.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Your correspondent, "B.B.," in the opening part of his letter, adds an eloquent argument in favour of action in some way to remove the Smoke and Fog Plague of London. Those who have a highly nervous temperament undoubtedly suffer most from the devitalising influences of an ambient atmosphere, impregnated as it is with carbon atoms, carbon monoxide, sulphuric acid, &c., in combination with the vaporous results of organic exhalations.

The vitality and electric influences of the solar rays are practically destroyed by the non-conducting layers overhanging London, and thus the atmospheric oxidising influences (by which the organic suspended matter at the breathing level is rendered effete and harmless) are arrested, so that the fatal effects of fog and smoke are widened, and are thus difficult to calculate with precision, but the number of deaths and extent of disease attributable to the modern London plague must be sought for in other classes than the merely respiratory and even zymotic ones.

Your correspondent, "B.B.," asks a question which, I think, rather premature at present, as to the manner in which it is proposed to carry out the undertaking. This will probably be determined either by the London County Council or by the present Metropolitan Gas Directorate in combined union.

If the London County Council decide to promote the scheme, which is worthy of their attention in a greater and more urgent degree than is the proposal to acquire the London water supply undertakings, and would be far and away more lucrative, the ordinary Parliamentary procedure for obtaining the necessary borrowing powers would, of course, have to be followed.

If the Metropolitan Gas Directorate syndicate the scheme, they already have existing powers to carry out a great part of the work necessary. These powers could be extended to the required extent. There would of course be the usual opposition of vested interests; but if London is fairly unanimous the opposition would clear away like a smokeless mist before the sun. There would, I believe, be no difficulty in obtaining the necessary capital to carry out the undertaking. The actual money expenditure on Metropolitan and district gas undertakings is said to exceed 17 millions sterling, whereas my alternative project is estimated to cost 10¾ millions only.

If the Gas Directorate carry out the project, part of the existing generating plant and distributing arrangements would remain intact. At present the gas companies of the Metropolis deal with, say, ⅓th of the total annual weight of the fuel consumed in the Metropolis; the fuel gas project would require to deal with the ⅓th of the fuel now used in the solid form.

Although the thermic *raison d'être* of heating proposed by "R. S." is more adequate than the usual open grate system, I am quite sure that the majority of the London citizens will still cling to the Englishman's and Scotchman's hearth with its many episodes, so closely associated with our domestic history

> But a sight sae delightfu' I trow I ne'er spied,
> As the bonnie blythe blink o' my ain fireside.

Our hearths and cheery firesides are words that have a meaning too dear to be obliterated in our age.

> See, the fire is sinking low,
> Dusky red the embers glow.
> * * * *
> Every quivering tongue of flame
> Seems to murmur some great name.
> * * * *
> Then the flicker of the blaze
> Gleams on volumes of old days.
> * * * *
> Suddenly the flame sinks down;
> Sink the rumours of renown.

Mr. Armer in his letter points out the advantages that would accrue to the middle classes by the carrying out of the project; it would restore peace in many a household disturbed by incessant internal conflicts with servants, owing to the existing dirty and barbarous system of obtaining heat for domestic requirements. As Mr. Armer suggests, there is no reason why the large provincial towns adjoining the main pipe lines should not be fed with fuel gas and even lighting gas if required. It is simply a question of supply and demand; if there was sufficient demand to warrant the laying down of an extra pipe this could be done. As to the question of the main pipe line, consisting of three service mains of 5ft. diameter, calculation, and actual data of experience, show me there need be no difficulty, especially now that light and reliable mild steel plates at a low figure and economic electric welding are features easily obtained.

The residual nitrogenous recovery plant would produce the nitrogenous constituents, ammonia sulphates, in the centres of agriculture, and where wanted.

In reply to Dr. Bailey's important contribution to the discussion, his remarks as to the deadly character of the smoke plague should produce a lasting impression on all who read them, and clench with ponderous force the hygienic argument in favour of the project. It is sad to know that Manchester, the city of Dalton, Joule, and Whitworth, should be also afflicted with a plague even more deadly than that of London. I am quite sure that, if Dr. Bailey explains the meaning of the statistics he gives to Manchester men, some steps will be taken to carry out a scheme similar to that suggested for London. Once the City Council recognised the fact that the existence of an avoidable system which they control is fatal to life, they will endeavour to remove it, because they are morally just as responsible for deaths that occur from an avoidable and mischievous system, which they have power to control and alter, as are the owners of defective machinery that kills the workpeople. In the latter case legislation has brought in a measure of recompense, but there is no penalty for the evasion of municipal or civic duty.

Dr. Bailey states that the coalfields are nearer to Manchester than they are to London. This is quite true, but in the application to London there is an initial financial advantage of a greater margin of profit owing to the increased cost of carriage. This profit alone would justify the expenditure necessary to carry out the project. The cost of coal in London is about double that of Manchester, and if the project is to go through at all, it will be due principally to the fact that not only will its accomplishment abolish the black fog and smoke plague, but it will effect an enormous profit, by which much of the startling misery of East London might be relieved; besides, the architectural beauty of the London and Government buildings would be cleared from its mask of soot, and the rays of the sun could rest occasionally on the faces of London's almost countless citizens.

> But for the smoky Fog, the Sunbeam then would go
> Into the darkest places, all filled with want and woe,
> Until sad hearts look'd upwards—there would it brightly shine—
> Shine till they thought of heaven, their sweet home and thine.

I quite agree with the last paragraph in Dr. Bailey's letter to the effect, that no scheme, lacking in thoroughness and completeness of application, would be an adequate remedy for the evil.

Since writing the foregoing, other letters of more or less sympathetic criticism and support have appeared, and require answering. Some of them have already received attention by anticipation. In "F. G. D.'s" communication the part of his letter not already answered in the original articles is that referring to the amount to be paid for existing vested interests. This question of compensation has already been settled by the fate of the Bill to compensate publicans. Any existing trade or industry involving in its carrying on a national waste, and a standing injury or danger to the health of the neighbouring residents, can be justly suppressed, without compensation. Do the Government compensate the owners of industrial undertakings proved by the noxious vapours inspectors to be an insupportable nuisance? If this indictment is proved, the works are summarily stopped by injunction, and no compensation is allowed, and, therefore, I am fully justified in neglecting the compensation feature in my estimate of the cost of the pipe line project. "F. G. D." will observe that I do not propose the hot air from basement system of heating.

"D. H. N." gives an explanation of the exorbitant prices charged to the London poor for coal. Undoubtedly if the proposed project became *un fait accompli*, and the penny prepayment system was adopted, this would prove a great boon to the "submerged tenth," and to the denizens of the East End, and the occupation of the gang of "coal Shylocks" would be gone. "D. H. N." emphasises the fact that should not be forgotten by Londoners—viz., that the great profits earned by the gas departments in the Northern and Midland provincial towns go a long way towards meeting the annual cost of the other and sanitary departments, and if London is to have its sewage scheme enlarged, and this will cost, according to the engineer's estimate, £8,000,000 sterling and £80,000 a year for maintenance—and if the London water supply undertakings are also to be acquired by the London County Council—taxation in London will run up to a very seriously high figure unless such a project as that I propose is carried out, by which the London government would be enabled to secure an annual and considerable profit. The water supply department will only be able to cover its expenses, and the sewage scheme will be a dead financial loss and yearly outlay, so that Londoners had better commence to inquire who is going to "pay the piper."

In reply to Mr. Jesse Lovett's interesting communication, I do not doubt but that the project will eventually be carried out by some combination of the gas companies with the London County Council.

This might be effected as follows:—The present gas undertakings and distributing systems to be purchased right out by the London County Council for a figure to be determined on—say, £30,000,000—on the understanding that the London County Council bonds equal to this amount, and bearing the usual corporate rate of interest, should be accepted by the present shareholders of the gas companies as purchase money. The necessary additional capital—say, 10¾ millions—to be borrowed at the usual corporate rate of interest—say, 3 per cent.—to enable the complete project to be carried out. By this arrangement the whole of the gas undertakings and the complete carrying out of the project would be exceedingly simple, and its adoption would smash any opposition of vested interests.

It may be mentioned here that a low-priced heating gas would be a boon to the electric lighting companies for gas motor purposes. This would enable the central electric lighting stations to be more numerously and conveniently established, and thus reduce the loss of electric efficiency by conductor resistance and waste by leakage.

Mr. Lovett asks the pertinent question as to the calculated price per 1,000 cubic feet of the proposed cheap heating gas. This all depends upon the photometric and calorific value of the gas supplied. If a low luminous value of gas is produced it might be supplied to customers at prices varying from 1s. to 1s. 2d. per 1,000ft.; if 8-candle gas, from 1s. 3d. to 1s. 6d. per 1,000ft. might be charged, and of 12-candle gas, from 1s. 7d. to 1s. 11d. would be the probable cost. So much will depend upon the Government restrictions as to quality, that it is impossible to closely calculate and define the selling price of the fuel gas.

The objections raised in some quarters to the modern open gas fires are not justified. Given a cheaper gas and a higher gas pressure, there should be no difficulty in converting the present gas fires so as to radiate an average thermic value equal to an ordinary coal fire, which has an attribute of variable efficiency. With cheaper gas there will be no insuperable difficulty in increasing the heat producing and radiation area of the gas fire so as to compensate for the inferior local intensity. I should think Mr. T. Fletcher, or Messrs. G. Wright & Co., and others, with their experience, might demonstrate the possibility of this in a manner to satisfy the most exigent.

I fully appreciate the suggestion of Mr. Lovett that the plant should be, if not actually in duplicate, of such an approach to comprehensiveness of detail, that if one element should fail another can be immediately put on. He will also notice that the pipe line will be on the tripartite plan. This enables each generating station to have its own distributing main, and allows higher pressures to be established with less weight of metal thickness of conduits. Mr. Lovett considers that the railway and carters' interests would be met by Mr. Armer's proposed modification, but why perpetuate the costly and wasteful absurdity of carrying a material that can be made to travel in gaseous form? Just as foolishly perpetuate the old town pump and water-carts, instead of the present water distributing systems from watershed sources miles away from the place of consumption to where it is piped. Mr. Lovett's last paragraph, by logical incidence, shows that the financial proportions of the scheme would not throw it out of the area of practical application.

I fully concur in all that "B. B." states in his second letter.

The subject heading of this correspondence has recently been before both Houses of Legislature, and has been acknowledged by the Press to be the dark, if not the burning, question of the hour. It is proposed by Lord Campbell's Act to invade the

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sanctity of the Englishman's castle to remove or abate the smoke evil, but, as Lord Salisbury justly inferred, the law will become a dead letter, and prove worse than useless. Englishmen will endure the smoke fog rather than have their privacy encroached upon by officious smoke inspectors. No; let us couple legislative enactment with the production of a cheap fuel gas and its distribution to every house, compelling by this legislative enactment the general use of this cheap gas, or of a smokeless substitute, and then the demon smoke fog will be exorcised once for all.

Mr. James Knowles, of the *Nineteenth Century*, has proposed in the non-technical press a midway scheme alternative to that of mine. Mr. Benjamin Ward Richardson goes nearer in his suggestion to the scheme I have outlined. A technical contemporary infers that "the only true remedy is to draw the smoke from the chimney into specially constructed savers." I leave this latter proposal to the judgment of your readers. I confine myself to the remark that such a proposal can hardly have been made seriously. If it has been, calculations and chemical considerations will show it to be impracticable and absurd in the highest degree.

Yours, &c.,
B. H. Thwaite.

Liverpool, 9th March, 1891.

THE PRESENT POSITION OF THE ALKALI TRADE.

To the Editor of "Industries."

Sir,—May I beg a little more space in which again to refer to the above subject? And first let me ask readers to substitute "to" for "in" in lines 8, 10, and 13 of the third paragraph of my letter printed in your issue of the 27th ult.

In your foot-note to my last letter you quote an opinion that "the struggle between the older and newer processes is no longer doubtful," and you add: "The words 'newer processes' will, we take it, be quite clear to the mind of our correspondent." Will you allow me to say, without any equivocation or reserve, that to the best of my knowledge and belief the products which, as stated in my letter of the 25th ult., are the basis of the Leblanc alkali trade—viz., caustic soda, bleaching powder, chlorate of potash and sulphur—are not made commercially by any other "newer processes" than those worked by the United Alkali Company. In fact, if we leave out of account the old Sicilian sulphur trade and a very small quantity of caustic soda made from cryolite, it would be almost literally true to say they are not produced by any other processes, either new or old.

The expression "newer processes" in the quotation given can only refer to the ammonia soda process, the success of which (in this country at least) is so well known. But that process produces only soda ash, and not any of the above-named principal products of the Leblanc process. And to say that because the manufacture of soda ash by the ammonia soda process is more profitable than the production of caustic soda, bleaching powder, chlorate of potash, and sulphur by the Leblanc process, therefore those engaged in the latter industry should abandon it and adopt the more remunerative process, would be as illogical as to argue that because the smelting of copper is more profitable than the making of iron or steel, therefore iron and steel smelters should demolish their costly plant and enter the copper trade. Or, to carry the analogy a step further, it would be almost as absurd as to reason that because shipping pays (let us say) 15 per cent., while railways average only (say) 5 per cent., therefore railway companies should dispose of all their valuable property of every kind and invest the proceeds in steamships.

The world still needs bleaching powder, chlorate, &c., but does not require an unlimited supply of ammonia soda ash. If those engaged in producing the former could, by some stroke of magic, transfer their capital to the latter industry, that very transfer would entirely alter the relative positions of the two processes, so far as their profit-earning power is concerned, and the last state of the said capitalists would be worse than the first.

Yours, &c.,
M.

Newcastle-on-Tyne, 6th March, 1891.

[By a slip, which we regret, the word "process," in the brief note appended to our correspondent's last letter, was printed "processes." The "newer process," in the official report from which we quoted, refers, of course, to the ammonia soda process, and we admit, with our correspondent, that caustic soda, bleaching powder, chlorate, and sulphur are not at present made by it. Both processes are, however, primarily soda ash processes, and in this respect the ammonia soda has beaten its predecessor, and it could readily manufacture caustic soda if the Union gives it the opportunity. Our correspondent defends the Union on the ground that bleaching powder, chlorate, and sulphur are still needed by the world; but we have in our review for the year, and in our article, endeavoured to show that the world is not needing these things in the same sense as formerly. There is a tendency for bleaching powder to be replaced by caustic, by hydrogen peroxide, by ozone, and by bleaching products, made direct from magnesium and calcium chloride by electrolysis, not to speak of the patents of Solvay, Eschellmann, Weldon and Pechiney, Wilde and Rechler, Mond, and many others, which, although not worked commercially, would, no doubt, be attempted, if there was a belief in the lasting nature of the demand for bleaching powder or in the permanency of the Union. There is also a tendency for chlorate to be made at Stassfurt in combination with some one or other of these various processes, and there is a possibility of sulphur being produced by the Chance-Claus kiln from coal gas, as well as from alkali waste. It is these various indications of progress in alternating processes which induced us to state in our article that the Leblanc process as such was dying, and that the Union can only be a success by affiliating some or all of these, as they become successful.—Ed. *Industries.*]

MR. KAPP'S CANTOR LECTURE.

To the Editor of "Industries."

Sir,—In your issue of the 27th ult. the Secretary of the General Electric Power and Traction Company, Limited, at the request of his managing director, publishes a correspondence in which it is stated that the Tables IV. and V. of Cantor Lecture given by Mr. Kapp at the Society of Arts, on Monday, the 16th ult., are entirely misleading, &c.

Now Table IV. shows the cost of the equipment of the Barking Road line with half a dozen 52-passenger accumulator tramcars, carried out by the writer in the spring of 1889 for the Electric Traction Company, Limited, every item of which is accurate, and their details can be furnished, the amount being £6,191 16s. (see *Industries* of February 20th). The cars proper are not included in the table, as only those items connected with the running expenses are dealt with. To include the cars would add £1,200 to the total, making it £7,391 16s., which is, perhaps, not what is desired.

Table V. gives the running expenses for the full mileage of the line—*i.e.*, five cars in service running a total of 100,844 miles per annum, being 8·068d. per car-mile. This corresponds to the year ending June 30th, 1890 It is accurate. It must also be very nearly true, indeed, for the present time, since the five most important items—namely, batteries, wages at depôt, drivers, fuel, steam plant—remain unchanged, and these five items represent 88 per cent of the total. The life of the batteries is ten months, or 300 discharges up to present time. The cars have now been on the road twenty-one months, and are working with their second renewals. It is to be hoped that the K type plates may prove more durable; the end of present year will show their merits or demerits as compared with the ordinary type. It is to be observed that the 8d. per car-mile corresponds to the full mileage of 100,844 miles per annum, and that the wages at depôt are a fixed charge—£677 6s. a year.

The mileage run during the first half-year of 1890, under the charge of the writer, was 44,047 car-miles. The mileage run during the second half-year (the installation now becoming the property of the General Electric Power and Traction Company, Limited) was 33,794 car-miles, or a decrease in miles run, period for period, of 10,252. Is this a measure of the improvements? This low mileage runs up the proportion of shed wages from 1·612d. to 2·407d., making the car-mile run 8·861d., which is unpleasantly near to 9d.

I must remind Mr. Mackenzie that I left the Electric Traction Company, Limited, at the time of its liquidation, and was in no way connected with the company to which he is secretary.

Yours, &c.,
T. Frazer.

114, Broadway, Plaistow, London, E.,
5th March, 1891.

To the Editor of "Industries."

Sir,—I regret to be compelled again to trouble you upon this subject, but if Mr. Kapp intends to convey the impression, which I presume he does, that on his visit to the Edinburgh Exhibition he found Mr. Frazer acting as cicerone on behalf of this company, it is my duty to point out to Mr. Kapp that Mr. Frazer was never employed either by the old Traction Company or by this company in any capacity whatever at the Edinburgh Exhibition. The engineer in charge of our installation was Mr. Lloyd B. Parsons.

On the occasion of the inspection of the launches run by my company on the canal at Edinburgh, Mr. Frazer was, by our courtesy, a passenger on the boats like other members of the Institution of Electrical Engineers. I am, therefore, quite at a loss to understand how Mr. Kapp could have made such a mistake as to Mr. Frazer's position there. In all the Press reports of the visit of the Engineers on that occasion, I do not find any mention made of Mr. Frazer having acted in the capacity of cicerone. Mr. Frazer himself states in his published letter that he was in no way connected with my company.

I have to thank Mr. Kapp for his offer to publish the authorised figures of the Barking Road installation. When my Board think it advisable to do so I shall have no difficulty in bringing them before the public. The effort that is being made to prove that five cars cannot operate at the same cost as 300 is quite unnecessary. I would only add that in response to invitations from various tramway companies and corporations owning tram lines my company have been and are issuing tenders to electrically equip and maintain tram lines by the overhead, conduit, and accumulator systems. If electric traction by accumulators were more expensive than horse traction the North Metropolitan Tramways Company, who have now had something like two years' experience of the work of these cars, would not be, as they are at present, applying to Parliament for powers to extend the system at a capital outlay to themselves of £50,000.

Yours, &c.,
W. J. M. MacKenzie, Secretary.

The General Electric Power and Traction Company, Limited,
New Broad Street House, 35, New Broad Street,
London, E.C., 9th March, 1891.

Legal Proceedings.

Pinto *v.* Badman.

This was a case tried in the Court of Appeal in connection with a trade mark action tried by Mr. Justice Day and a special jury in the Court of Queen's Bench in January last, of which we gave our readers a report at the time (see *Industries*, Vol. X., page 112). It will be remembered that in the Court below the jury found a verdict upon two issues to the effect that the trade mark used by the defendant was a colourable imitation of the plaintiff's trade mark, and that the defendant had been guilty of fraudulently passing off as and for the goods of the plaintiffs goods which were not his. From that judgment the defendant appealed upon the ground, among others, that the plaintiff's trade mark had been improperly registered. The appeal was supported by Mr. J. Fletcher Moulton, Q.C., Mr. J. W. Willis Bund, and Mr. Herbert Reed. For the respondent-plaintiff in the Court below appeared Mr. Aston, Q.C., and Mr. McCall, Q.C.

For the appellant it was argued that the plaintiff had no registrable interest in the trade mark because he had acquired from his predecessors in title only a right to use the mark, and not the goodwill, of the business in connection with which the mark had been used. In proof of this reference was made to the deeds by means of which the plaintiff had deduced his title to the mark, and it was contended that these deeds amounted to an assignment of the mark "in gross"—that is to say, by itself, and not as a mere part of the goodwill of a business which was being sold. The deeds being drawn up in Spanish, and executed in Mexico, some difficulty was experienced by the Court in coming to any conclusion as to their effect, but eventually it was held that they conveyed, as has been said, no goodwill or business, but only an independent right to the use of the mark. This being so, it was held that the registration was bad, and that the plaintiff, therefore, was not entitled to maintain the action in which he had recovered judgment. The judgment was accordingly reversed and entered for the defendant, but without costs.

The principle embodied in this decision is of the very greatest importance in trade mark law, and should be constantly borne in mind in any transactions in which the transfer of rights to such marks is involved. It is in the public interest, and not in the interest of the parties, that the rule has been laid down that a trade mark shall not pass without the trade to which it is attached. The reason of this is plain enough. It is no doubt greatly to the interest of the owner of a trade mark that the public should recognise the brand as designating his goods, but it is so because and only because it is to the interest of the purchaser to be able by this means to identify the article which he is purchasing. Now, if the owner of a trade mark were at liberty to sell his mark while he retained his trade, it is clear that the public might be deceived by having the whole meaning of a known mark surreptitiously altered. This might not matter to the contracting parties, but it would amount to a fraud upon the public, and for the repression of such fraud the rule has been introduced. The present was a very striking case of its application. There was no evidence that the assignment was not perfectly valid. According to the law of Mexico—the country in which it had been executed—it was admitted in the fullest possible manner that the person originally entitled to the mark who had assigned it to the plaintiff had parted with his own rights, but nevertheless, as the title which the plaintiff set up affected the rights of the British public, it was held that the transaction and the registration founded upon it could not be supported in a British court of law. There seems no room for doubt that the judgment correctly expresses the law, and it must be taken therefore that in no circumstances will the courts be likely hereafter to depart from the strict principle which has been so emphatically asserted in the present case.

Books Received.

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Polytechnics or Technical and Recreative Institutes. A Paper read before the Society of Architects. By W. Howard Seth-Smith. London: Bradley T. Batsford.

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Lessons in Applied Mechanics. By JAS. H. COTTERILL and J. H. SLADE. London: Macmillan & Co.
The Valuation of Gas Works for Assessment. By THOS. NEWBIGGING, M.Inst.C.E. London: Walter King.
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An Elementary Course in Mechanical Drawing. Part. I. By ALEXANDER MACLAY, B.Sc., M.I.C.E. Manchester: The Technical Publishing Company, Limited.
Elementary Systematic Chemistry for the Use of Schools and Colleges. By WM. RAMSAY, Ph.D., F.R.S. London: J. & A. Churchill.
Histoire d'un Inventeur. Exposé des Découvertes et des Travaux de M. Gustave Trouvé dans le Domaine de l'Electricité. Par GEORGES BARRAL. Paris: Georges Carré.
Return of the Trade of the Swansea Harbour for the Year ending December 31st, 1890.
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The Design of Structures. A Practical Treatise on the Building of Bridges, Roofs, &c. By S. ANGLIN, C.E. London: Charles Griffin & Co.
Hazell's Annual for 1891. London: Hazell, Watson, & Viney, Limited.
Text-Book of the Steam Engine, with a Supplement on *Gas Engines*, and Part II., on *Heat Engines.* By T. M. GOODEVE, M.A. London: Crosby Lockwood & Son.
An Explanation of the Phonopore and of the Simplex Phonopore Telegraph. By C. LANGDON-DAVIES. London: Kegan Paul, Trench, Trübner, & Co., Limited.
Annali della Società degli Ingegneri e degli Architetti Italiani. Anno V., 1890. Fascicolo VI. December, 1890.
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Transactions of the Institution of Engineers and Shipbuilders in Scotland, January 27th, 1891, *Meeting.*
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THE FERRANTI ELECTRICITY METERS.

THE Ferranti meter, which we illustrate in Fig. 1, is a sort of "nonpolar," or "unipolar," or "one turn" motor. Ferranti, Faure, and others have converted the rotating conductor of the physics text-books into a commercial meter. Messrs. Ferranti have been indefatigable in attacking the difficulties of the apparatus. The essential principle of the meter is the measurement of the rotation of a bath of mercury, through which the current passes from the periphery to the centre after energising a magnetic field, the lines of force of which are at right angles to the radial direction of the current in the mercury. The speed of rotation is proportional to the current, and the movement is transmitted to the register by a fan which is mounted on a light spindle and immersed in the bath. The registering of the meters is as simple as their mechanism. The faces are marked with six dials—units, tens, hundreds, &c.—and the amount registered on these when divided by the constant stated in the instructions will give the number of Board of Trade units consumed. An important feature of the Ferranti meter is the extremely small power needed to work it, and the consequent absence of any appreciable drop in volts. There is only one moving part, and this is perfectly enclosed in a metal case, entirely outside the range of the defects to which a more open form must sooner or later be subject. It is unaffected by external influences; indeed, the correctness of the record is not impaired (as would be the case in some other direct-current forms) by a magnet being placed near it, as might be done by a dishonest consumer.

To overcome the initial friction an auxiliary shunt coil is provided, and is shown in Fig. 1 over the letter N. A resistance placed at the bottom of the case is in series with this. If the shunt current were strong enough, the meter would, of course, slowly revolve, but it is arranged so as to be just too weak to do this. A very small current through the main coils will, therefore, start the meter, whose readings are then proportional to the current. Figs. 2 and 3 are diagrams showing the method of ascertaning the constant of each instrument.

The following tests show the accuracy of the instruments:—Forty ampere alternate current mercury meter, shunted; started with three ampere; mean constant, 7·56 over twenty-fold range; variation—above 1·85 per cent., below 2·12 per cent. One hundred ampere direct current meter; starts with five amperes; mean constant, 2·838 over fifty-range; variation—above 1·3 per cent., below ·99 per cent. Ten ampere continuous current mercury meter, unshunted; started with two amperes; mean constant, 23·56 over twenty-fold range; variation—above 3·98 per cent., below 2·37 per cent.

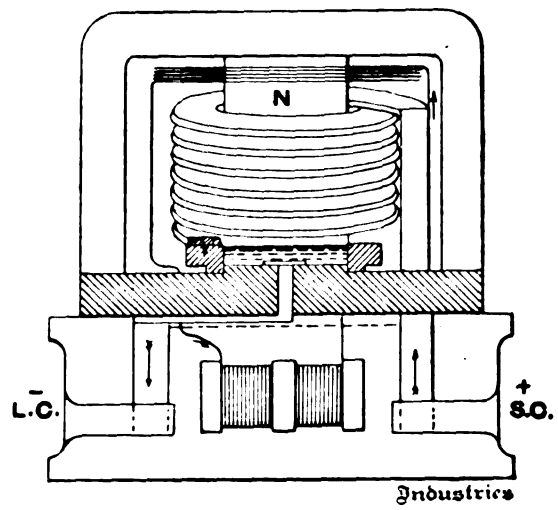


FIG. 1.

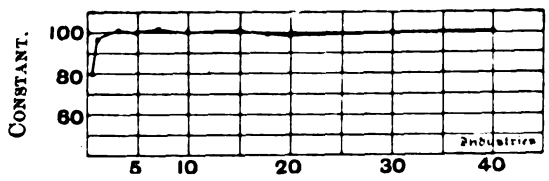


FIG. 2.—Curve showing performance of 40-ampere meter.

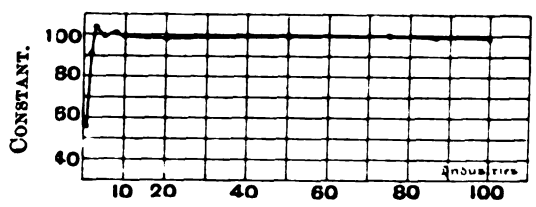


FIG. 3.—Curve showing performance of 100-ampere meter.

THE AMERICAN NATIONAL ELECTRIC LIGHT ASSOCIATION.

(*From our New York Correspondent.*)

THE last meeting of this Association was held at Providence, Rhode Island. The city of Providence is very favourably situated for the holding of a convention of this character, being on the direct line of travel between New York and Boston, 175 miles from the former and fifty miles from the latter. In point of numbers it was the largest gathering of the kind yet held, there being over 500 members and guests present. The proceedings were of unusual interest to the electrical profession at large by reason of its having been the occasion for the celebration of the decennial of the commercial application of electricity for lighting. The first session was held on the morning of February 17th. After introducing Mayor Smith, who officially welcomed the Association to the city, President Perry delivered his annual address, which was devoted to a general review of the past history of electrical development. The first business was the report of Chairman Brown on the copper tariff, who reported that by the McKinley Bill the duty on copper had been reduced to 20 per cent. of the former rate, and that the object of the Committee having therefore been accomplished, he asked for the formal discharge of the Committee, which was ordered.

A paper was then read by Mr. W. H. Markland, of the Pennsylvania Railroad, on "Electric Lighting as Applied to Steam Railroads." He said that the Pennsylvania Company had introduced electric lighting at its shops in Altoona in 1881, which was followed in 1885 by the installation of a plant for lighting the station sheds at the same place. This led to the consideration of the question whether the illumination of the yards by electricity could be successfully carried out with a view to reducing the damages arising from the breakage of cars and contents caused by handling the cars during the night. The problem was different from street lighting, as a brilliant light was not so necessary as even distribution. To accomplish this end the lamps in the Altoona yard were placed on 65ft. poles set 8ft. in the ground, so located as to illuminate switches and cross-overs where the yards were narrow. Where yards were wide and long the lamps were placed about 600ft. apart, a row on one side of the yard and a row in a broad alley that was wisely left between tracks near the opposite side of the yards, the lights of the two rows being zig-zagged to prevent shadows and better diffuse the light. This plan does not make a brilliant light at any one point, it being possible, but difficult, to read fine print. The result was something of a moonlight effect, and very good in practice. A clear globe was found objectionable on account of the shadows thrown by the side arms. A lower-half ground globe was found preferable, it being better to lose a little light than to have shadows. This system enabled the car inspectors to perform their duties more satisfactorily, and there was a decrease in the amount of pilferage from the cars, while the breakage of cars and contents was but little in excess of that which occurred in the daytime. The arc lights were of great assistance in shifting cars, as the trainmen are enabled to see the tracks and the position of cars nearly as well at night as by day on account of the light shining on the rails. Also in coupling and dropping cars the men are able to gauge the distances with sufficient accuracy to avoid jar or danger. The switchmen in the towers are also able to tell when a car passes over the switch. Experience has proved that the arc lamp is much superior to the incandescent for shed lighting. With incandescents the necessary volume of light is costly to maintain, and the bulbs soon become dirty from steam and smoke, or require considerable labour to keep clean. The arc lamp is very satisfactory for freight transfer stations, as the men are enabled to see the marks readily, while the foreman can keep watch of his men. One 2,000 nominal candle-power arc lamp to about 1,500 square feet of floor space will generally suffice for a freight transfer station where the lamps are zig-zagged. Where stations are narrow more light per square foot should be allowed. On a platform 10ft. wide one light every 60ft. gives good illumination. The author doubted if the arc lamp could compete with gas so far as cost was concerned, yet, considering the saving in labour and from pilferage, he believed electric lights more than paid for themselves. He believed also that the men worked much more cheerfully and with better results where the light was bright and cheerful. In the new Altoona shops of the company 100,000ft. of floor space is lighted exclusively by electricity, not a foot of gas pipe being run in the buildings. All the travelling cranes are also operated by electricity.

A paper on "Distribution of Steam from a Central Station," by Mr. F. H. Prentiss, was read by Judge Armstrong in the absence of the author. It was devoted to the problem of the utilisation of exhaust steam for heating purposes by underground pipes leading from electric light stations. From the paper and discussion it appeared that this practice had proved financially successful in many instances.

The morning session on February 18th was devoted exclusively to memorial exercises in commemoration of electrical advances during the past decade. During the afternoon session Dr. Louis Bell, Chairman of the Committee, submitted a preliminary report on "Rating the Candle-power of Incandescent Lamps." The simplest method of classification the Committee believed to be was by the watts consumed; the actual power for which the consumer pays, but with a specification as to candle power to limit the efficiency of the lamp to a practical value—that is, a value that will not, on the one hand, produce an inordinate waste of energy, or, on the other hand, force the lamp far above its proper candle-power, and consequently burn it out rapidly. The Committee was emphatically of the opinion that the mean horizontal candle-power should be specified, taking the average of the horizontal illumination in all azimuths. The largest variation from this standard should not exceed 1 candle-power on either side of 16. Without specifying the efficiency, the Committee suggested that a lamp giving over 15 and not over 17 mean horizontal candle-power on a consumption of less than 60 and not less than 55 watts represents the average conditions of central station practice better than any other type of lamp that could be readily found. Several difficulties are encountered in determining the mean horizontal candle-power upon which the standard lamp is to be based. There is, however, one way of determining it—that is, by spinning the lamp about an axis as it is being tested. If a lamp be mounted in a rotating socket and spun rapidly about its own axis, the mean horizontal candle-power can be obtained at once if the velocity of rotation rises to about

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300 or 400 turns per minute. This process is used in at least one lamp factory with uniform and unvaried success.

A paper was afterwards read by Professor Elihu Thomson, on "The Electric Arc and its Use in Lighting." In the early years of the growth of arc lighting, said the author, the effects obtained were not of the best. Unsteadiness was the rule, and it required much persistent effort to discover the causes and find the remedy. The prominent defects were, and are still, hissing, sputtering, flaming, and general unsteadiness. Hissing or frying comes, of course, with too short an arc, and may be connected with too vigorous vaporisation. They may also be due to a carbon of too coarse grain. Sputtering may arise from impurities in the carbons, and flaming from too long arcs from impure carbons, or from carbons insufficiently baked and containing unexpelled gases. Running an arc at a length between the long arc condition and the short arc condition may cause great unsteadiness of light. There is, in fact, a critical point in the length below which there is a considerable fall of luminosity and a drop of nearly one-third of potential. As an arc lengthens by consumption of its carbons beginning below this critical point, great unsteadiness will be manifest on arriving at the critical state, and a little longer arc brings about a sudden and marked increase of potential, of illumination, and of steadiness. Any observer may easily detect these conditions without special effort. Another important matter in relation to carbons is that the size of section or diameter must be proportioned to the current used. Where attempts have been made to prolong the hours of burning of a carbon by enlarging its diameter beyond certain limits, they have resulted in injury to the character and distribution of the light. Large diameters of carbon may burn too blunt to let the light out between them. Likewise, where attempts have been made to prolong the hours of use by employing a harder or denser carbon than before, it has frequently been found that a sacrifice of light has been incurred, rendering the results much less satisfactory. The fall of resistance with increase of current has an important bearing on the construction of dynamos for arc lighting and the running of lamps on constant potential or incandescent circuits.

The remainder of the afternoon session was devoted to the hearing and consideration of the Report of the Committee on Legislation.

The morning session on February 19th was opened with the reading of a paper by Mr. Caryl D. Haskins descriptive of the "Ferranti System" as installed in London. It was confined chiefly to the machinery used at the earlier stages of the work, the author having severed his connection with Mr. Ferranti some time since.

A paper was afterwards read by Mr. T. Carpenter Smith, on "The Distribution and Care of Alternating Currents," in which he said that the majority of accidents which have occurred from overhead wires have been due to poor construction.

During the afternoon and closing session of the convention, an address was delivered by Mr. Edward Weston, "On Electrical Measuring Instruments, and their Methods of Use and Care." The following officers were elected to serve for the ensuing term:—President, C. R. Huntley, Buffalo, N.Y.; first Vice-President, James I. Ayer, St. Louis, Mo.; second Vice-President, M. J. Francisco, Rutland, Vt. It was voted that the August meeting be held in Montreal, Canada, the exact date to be fixed by the Executive Committee. In accordance with the practice at the more recent of the preceding conventions, an electrical exhibition was established in a separate hall, at which all descriptions of electrical machinery and supplies were exhibited.

THE PHYSICAL SOCIETY.

At a meeting of this Society, on the 27th ult., Professor W. E. Ayrton, F.R.S., being in the chair, a paper, entitled "Proof of the Generality of Certain Formulæ Published for a Special Case by Mr. Blakesley: Tests of a Transformer," was read by Professor W. E. Ayrton, F.R.S., and Mr. J. F. Taylor.

The authors said that in 1888 Mr. Blakesley published a number of formulæ relating to the measurement of power, &c., in alternating current circuits by means of electro-dynamometers, one of which had its two coils independent and placed in different circuits. These formulæ were deduced on certain assumptions, the chief ones being that the currents and magnetisations varied harmonically, and that the magnetic stress in the iron was proportional to the ampere turns. The present paper shows that the above assumptions are not necessary to the truth of the resulting formulæ. To take the case of a transformer, let alternating current ammeters be placed in the primary and secondary circuits, and a direct reading "split dynamometer" have a coil in each circuit. Let D_p, D_s, and D_{ps} be the respective readings of these instruments, then whatever be the law of variation of the currents,

$$D_p = \sqrt{\frac{1}{T}\int_0^T A_p^2\,dt}$$

$$D_s = \sqrt{\frac{1}{T}\int_0^T A_s^2\,dt}$$

$$\text{and } D_{ps} = \sqrt{\frac{1}{T}\int_0^T A_p A_s\,dt}$$

where A_p and A_s are the values of the primary and secondary currents at any instant, and T the time of one complete alternation.

If i be the total induction in the core, P and S the numbers of turns of wire on the primary and secondary respectively, V_p and V_s the terminal pressures, p the resistance of the primary coil, and s the resistance of the whole secondary circuit, then the following equations hold at any instant:—

$$V_p = pA_p + P\frac{di}{dt}$$

$$\frac{di}{dt} = \frac{s}{S}A_s$$

Therefore $V_p = pA_p + \frac{P}{S}sA_s$.

Multiplying both sides by A_p we get $A_pV_p = pA_p^2 + \frac{P}{S}sA_pA_s$, and integrating from $t = 0$ to $t = T$, and taking the mean—

$$\frac{1}{T}\int_0^T A_pV_p\,dt = \frac{p}{T}\int_0^T A_p^2dt + \frac{P}{S}\frac{s}{T}\int_0^T A_pA_s dt;$$

or watts in primary $= pD_p^2 + \frac{P}{S}sD_{ps}$, quite independent of the laws of variation of A and V.

The power lost in heating the iron core was also shown to be $s\left(\frac{P}{S}D_{ps} - D_p^2\right)$.

Other formulæ, such as that given by Mr. Blakesley expressing the primary volts in terms of the dynamometer readings, are shown to be true generally.

On the subject of transformer magnetisations, the authors state that it is desirable not to speak merely of the ampere turns, but also of the self-induction, for they have reason to believe that the magnetising value of an ampere turn varies. Defining the self-induction of the secondary by the equation $L_s = \frac{dN}{dA_s}$, N being the total flux through the secondary, they show geometrically (assuming harmonic variations) that if $L\rho$ diminishes, the efficiency increases, and at the same time the phase angle θ between the primary and secondary currents, and the magnetic lag ϕ, decrease. On comparing this theoretical deduction with the results of experiment they find a good agreement, as will be seen from the following table:—

Frequency.	Efficiency.	$L\rho$	θ	ϕ
160	96·3 %	·0017	113°	0° 24′
160	92 %	·0368	169°	18° 24′
160	85·4 %	·1241	174·6°	45° 36′

Similar results were obtained in different sets of experiments. It was also noticed that as the secondary current is increased, the efficiency rises to a maximum, and then diminishes, whilst $L\rho$, θ, and ϕ diminish and then rise again; the current which gives the maximum efficiency coinciding almost exactly with that which gives minimum values to $L\rho$, θ, and ϕ. The methods employed in making the tests are described in the paper, and the formulæ used in working out the results are there demonstrated. Amongst the facts deducible from the experiments are the following:—

1. With constant frequency, the ratios $\frac{V_s}{V_p}$ and $\frac{D_s}{D_p}$ increase as the primary volts rise.

2. With frequency constant, and primary volts constant, $\frac{V_s}{V_p}$ decreases and $\frac{D_s}{D_p}$ increases as the secondary current increases.

3. With constant secondary current, $L\rho$ decreases as the primary volts are increased.

4. With small constant secondary currents the efficiency diminishes as the frequency increases.

5. For large secondary currents the efficiency is approximately independent of the frequency.

6. Shunting the secondary with a condenser increases the efficiency.

Afterwards a paper, entitled "Further Contributions to Dynamometry," was read by Mr. T. H. Blakesley, M.A. The object of Mr. Blakesley's paper was in the first place to show what sort of physical quantities could be advantageously evaluated by using electro-dynamometers of two coils of low resistance in circuits conveying electric currents. The meaning of a dynamometer reading was explained to be the mean value of the product of two currents, either steady, or undergoing any periodic variations with sufficient rapidity. In mathematical language, such an instrument measured $\frac{1}{T}\int_0^T C_1C_2\,dt$, where C_1 and C_2 were the instantaneous values of the currents in the two coils, including, of course, the common case where these currents are identical. Any physical quantity whose value was such a product C_1C_2, multiplied into something which was independent of the time, and which, therefore, on integration came outside the integrator, was well adapted to have its mean value given by such instruments. Power was such a quantity, being merely (current)^2 × resistance. The square of an e.m.f. was another such quantity, but he did not wish to restrict the method to such evaluations. It follows that any quantity whose instantaneous value can be expressed by terms each quadratic in current, and whose other factor was independent of time, could have its mean value expressed in dynamometer readings. In addition, the particular place and mode of coupling of the dynamometers was indicated by the instantaneous equation, as well as the factor to be applied to each reading. Thus the equations are made to indicate the practical arrangement to be adopted, and the use to be made of the observations in each case.

Examples were given for the cases of transformers in series and parallel, and special applications of the method were suggested in the measurement of the power employed in such diverse apparatus as voltameters subject to direct or variable currents of any sort, welding machines, parallel generators, tuning fork circuits, vacuum discharges, and imperfect condensers. For parallel generators the power of each could be separately estimated, and in the case of electric welders the power employed in the welding circuit was shown to be measurable without introducing any resistance whatever into that circuit.

In the discussion following the paper, Mr. J. Swinburne said the author's assumption that there is no back or forward e.m.f. in the primary and secondary circuits of transformers except that due to $\frac{di}{dt}$, where i is the total induction in the core, was unwarrantable, for in all real transformers there was a "drop" due to waste field, and this made the split dynamometer method useless. It makes the full load efficiencies too high, and this, he thought, accounted for the extraordinary results obtained by Professor Ayrton and Mr. Taylor. If a dynamometer be used at all, it should, he said, be used as a wattmeter, as shown in Fig. 1, the moving coil of the dynamometer D consisting of one turn being joined in series with a non-inductive resistance R, and put as a shunt to the primary. The power absorbed by the instrument itself should be then determined by opening the switch. The power given out by the secondary should be measured by the same or a similar instrument, if the secondary be not non-inductive. Any errors due to self-induction in a wattmeter are, he said, equally present when it is called a split dynamometer, and, in addition to this, the wattmeter as a split dynamometer precludes the possibility of measuring power.

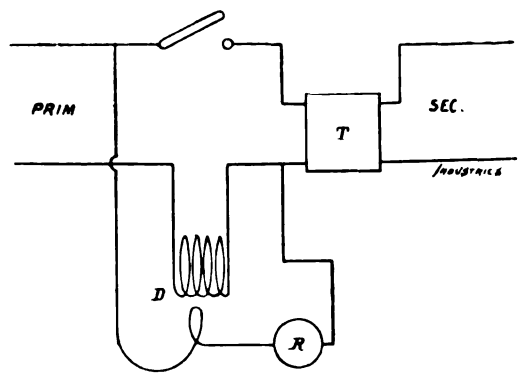


Fig. 1.

Mr. Mordey said the results obtained by Professor Ayrton and Mr. Taylor confirmed experiments he had made himself by an entirely different method, for he found that the losses in the iron decreased considerably as the secondary current increased, and this gave increased efficiency. In his experiments he kept the load constant until the transformer obtained a steady temperature, and then substituted a direct current for the alternating one, varying its strength until the same steady temperature was maintained. The power thus supplied is a measure of the loss in the transformer under the working condition. A 6-kilowatt transformer tested by this method gave a loss of 110 watts at no load, and at full load 205. Of this 205, 176 was accounted for

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by the loss in the copper coils, leaving only 29 watts as the iron losses at full load. Figures which he quoted from Professor Ayrton and Mr. Taylor's paper showed the same general result.

A "Note on Electrostatic Wattmeters," by Mr. J. Swinburne, and a paper on "Interference with Alternating Currents," by Professor W. E. Ayrton, F.R.S., and Dr. Sumpner, were postponed.

MODERN CHEMISTRY IN ITS RELATION TO SANITATION.

Professor C. M. Tidy delivered his first lecture on the above subject, at the Royal Institution, on the 5th inst. He commenced by quoting the statistics of the Registrar-General for the Administrative County of London for the year 1890, in which it is shown that out of every 1,000 deaths 259 are of infants under one year of age, 425 under the age of five, 594 under twenty, while 156 are of persons whose age is between twenty and forty, and 207 between forty and sixty. Thus, out of every 1,000 persons born only 43 reach the age of sixty and upwards. The death-rate may be likened to a bridge of sixty arches, over which the population passes in a continuous stream, but on which are numerous pitfall and traps, through which many drop to the river below. Less than half succeed in passing the twentieth arch, and of those that struggle on only 43 in every 1,000 who start to cross succeed in reaching the opposite bank. Modern science is endeavouring to place danger signals along the bridge, which may warn the travellers of the pitfalls and evil genii of the road, which are all the more dangerous because invisible. That living organisms accompany disease is a well-ascertained fact, and bacteriologists have proved that special organisms are always present with special diseases. Thus, wool-sorters' disease is always accompanied with the presence of an easily recognised organism, called the *bacillus anthracis*, and the first question to be answered is to decide whether the micro-organism is the cause or the consequence of the disease. If it be the cause, then it must always be present in the early stages of the disease, and must be capable of producing the disease in other individuals. The absence of the bacteria in parts not affected may also be urged as a proof that they are a cause of the disease. It is difficult, however, to demonstrate that the organisms can produce the disease, since it is well known that the lower animals respond differently to human beings in the case of poisons, and that, therefore, the non-production of disease in the case of the injection of micro-organisms into a guinea-pig is not sufficient proof that the organism does not produce the disease. An analogy exists in the case of vegetable poisons, since belladonna leaves have no injurious effect upon rabbits, and morphia is without soporific influence upon pigeons. The lecturer next proceeded to consider the conditions requisite for the growth, development, and activity of the bacteria. These may be shortly summarised as (*a*) good seed; (*b*) good soil; (*c*) proper receptivity. The term zymotic disease, as used by the Registrar-General, indicates that the subject is allied to fermentation, and the facts established by Pasteur and others when working on the formation of alcohol from sugar throw light on the problem of the spread and growth of disease. Alcoholic fermentation is determined by four principal conditions:—(1) The presence of a ferment (yeast); (2) the presence of a body which will ferment (sugar); (3) contact between these two; (4) a temperature between 0° and 50° F. It has been shown that the products of fermentation vary with the temperature, March and October brews, for example, being probably of a uniformly good character from the temperature conditions being similar in these two months.

Probably as the yeast converts sugar into alcohol, so in disease the bacterium converts healthy tissue into subtle chemical poisons, to which the evil effects of the disease may largely be attributed. It is difficult, however, to isolate these chemical poisons, even when a pure cultivation of the bacterium in some nutritive medium has been obtained. Brieger and others have proved that bodies of an alkaloidal nature are produced in many forms of zymotic disease, and the future of preventive and curative medicine depends on further progress in the chemistry of these bacteriological changes. In fermentation, it is well known that the action ceases if the sugar solution be too strong, and when the quantity of alcohol produced exceeds a certain amount, and it seems to be established that similar phenomena are true in the case of disease. In Koch's fluid the active properties are due to the presence of the chemical product or products of the diseased bacilli, and although its action cannot as yet be completely explained, the tuberculin present is death to the bacilli which produced it. Dr. Tidy then proceeded to show that infection, or the atmospheric conveyance of disease from a patient to a healthy person, is due to either a spore, the bacterium itself, or its poison (probably a crystalline body) being present in the air. It has been urged by some that infection could not be caused by a chemical poison acting in this way, owing to most diseases having a latent period before development, but nitro-benzene and mercuric methide are examples of chemical poisons which have well-ascertained latent periods before their toxic action is manifest. A spore may be the common source of infection as many pathogenic organisms have been proved to form spores, which are not only very potent in their action, but are more resistant to change than the bacteria from which they originate, and are known to retain their vitality through long periods of quiescence. A disinfectant to be of any use must be capable of destroying all these three forms of possible infection, and it is obvious that very few substances can be looked upon as fulfilling these requirements of a true disinfectant. Substances used for disinfection must be carefully distinguished from antiseptics, which only retard or prevent the growth of micro-organisms, and deodorisers, which sometimes destroy and sometimes only mask the unpleasant smells which arise from putrefaction. In order to arrive at the best artificial disinfectant it is well to study how nature herself prevents infection. Natural disinfection is brought about by (1) the action of the air; (2) of water; (3) of earth. Air acts in both a mechanical and chemical way. Public opinion on the objections to close rooms, close courts, and houses with no back ventilation, has obtained for each person a given quantity of air at night, but legislation is yet required to ensure the poor against infection arising from over-crowding during the day in the factory and elsewhere. The increase in mortality during cold weather is probably due to persons being more confined to close rooms in winter than in summer. Ozone is a powerful chemical disinfectant present in the air, and although not very abundant, may, by starting the destruction of infection, enable the atmospheric oxygen to bring about a change which it otherwise would be unable to accomplish.

COMPARISON OF ALKALI PROCESSES.

COST OF RAW MATERIALS FOR ONE TON OF ASH AND BYE-PRODUCTS.

Leblanc Process.	£	s.	d.	Ammonia Soda.	£	s.	d.	Haddock and Leith.	£	s.	d.
Saltcake	2	16	0	Brine	0	1	6	Saltcake	2	9	0
Fuel	1	1	0	Ammonia	0	7	6	Calcium sulphydrate	0	2	6
Limestone	0	9	0	Lime	0	13	6	Fuel	0	17	6
Wages	0	15	8	Fuel	1	0	0	Limestone and coke	0	8	0
Casks	0	7	6	Wages	0	12	6	Wages	1	2	6
				Packages	0	7	6	Packages	1	2	6
	£5	9	2		£3	2	6		£6	2	0

VALUE OF ONE TON OF ASH AND BYE-PRODUCTS.

Leblanc Process.	£	s.	d.	Ammonia Soda.	£	s.	d.	Haddock and Leith.	£	s.	d.
1 ton ash	6	13	0	1 ton ash	6	13	0	1 ton ash	6	13	0
HCl	1	6	0					1 ton 12 cwt. P.H.	3	4	0
								5 cwt. sulphur	1	3	9
								15 cwt. lime	0	9	0
								48 cwt. HCl	1	4	0
	£7	19	0		£6	13	0		£12	13	9
Less 3½ per cent.	0	5	6	Less 3½ per cent.	0	4	6	Less 3½ per cent.	0	8	9
Value	£7	13	6	Value	£6	8	6	Value	£12	5	0
Cost	5	9	2	Cost	3	2	6	Cost	6	2	0
	£2	4	4		£3	6	0		£6	3	0

SOCIETY OF CHEMICAL INDUSTRY.

LIVERPOOL SECTION.

At a meeting of this section, held on the 5th inst., Mr. J. Leith read a paper on "The Use of Sulphydrate of Calcium in the Manufacture of Alkali and Bye-Products," in which the author described the method of working his joint patent with Mr. Haddock for the manufacture of sodium carbonate without the production of alkali waste. The author, after pointing out that although the Chance-Claus sulphur recovery process has in a great measure overcome the difficulty the Leblanc manufacturers had of disposing of their waste, yet the bulk and weight of material to be removed is increased by this process, and thus entails greater expense for removal and depositing. The author, after experimenting with the Simpson and Parnell process, in which the waste is distilled with ammonium chloride, finally in conjunction with Mr. Haddock proposed to supersede the distilling operation altogether by using sulphate of soda instead of salt in the carbonating towers, and thus dispensing with the use of ammonia. The operations involved in the modified process are briefly as follows:—Salt cake is made in the ordinary way, and 50 per cent. of the "make" converted into caustic by the Leblanc process, the alkali waste from which is then worked up into a thick cream with water, and transferred into egg-ended upright cylinders arranged in series. Weak sulphuretted hydrogen from the carbonators is then blown through these vessels for some hours, when the calcium sulphide of the waste is converted into soluble calcium sulphydrate thus:—

$$CaS + SH_2 = Ca(SH)_2.$$

In this way nearly the whole of the sulphur in the waste is obtained in solution, the loss of about 8 per cent. of the total sulphur being inevitable in any sulphur recovery process. The solution also contains any alkali which may not have been removed from the waste, and which is finally recovered as soda. The solution in each cylinder is next allowed to settle for some hours, and is then run off into settling tanks, where the last traces of any sediment at all likely to discolour the sulphate of lime, produced at a later stage, is removed. The process so far is essentially one for rendering the lime soluble, and is equally applicable to the sulphides of the other alkaline earths, which may be economically obtained by heating the corresponding sulphate with coal if the new method is to be worked independently of the Leblanc process.

The second part of the process consists in first forming a saturated solution of the remaining 44 per cent. of sulphate of soda, and, after neutralising it by lime or by some of the mother liquor from a later operation, transferring it to a wooden mixing tank, into which the clear sulphydrate solution is also allowed to flow.

The reaction which then takes place is as follows:—

$$Na_2SO_4 + Ca(SH)_2 + 2H_2O = 2NaSH + CaSO_4 2H_2O.$$

The sodium sulphydrate solution thus found is separated from the precipitated calcium sulphate by filtration, and the latter, after pressing and drying, is ready for sale as pearl hardening, while the solution, after the addition of a little mother liquor from the bicarbonate of soda to remove any calcium sulphate which may be present by precipitation, is run off into Solvay's or other ordinary carbonating towers. Lime-kiln gases, as free from oxygen as possible, finally convert the sodium sulphydrate into bicarbonate and sulphuretted hydrogen, the latter being used to form a fresh quantity of calcium sulphydrate, as already described. The decomposition takes place as follows:—

$$2NaSH + 2CO_2 + 2H_2O = 2NaHCO_3 + 2SH_2.$$

The solid bicarbonate is blown on to a filter, freed from mother liquor and wasted to soda ash, while the liquor is concentrated to obtain soda crystals. It will be thus seen that from the raw materials, salt, sulphuric acid, limestoke, coke, and Leblanc waste, the patentees obtain caustic soda, hydrochloric acid, sodium carbonate as ash or crystals, calcium sulphate, lime, and sulphur.

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The following figures give the quantities of material required and the yield obtained for 1 ton of soda ash manufactured:—

Materials.		*Products.*	
Salt cake	28 cwt.	Soda ash	20 cwt.
Limestone	22 „	Sulphate of lime...	32 „
Coke	3½ „	Sulphur	5 „
Leblanc waste ...	60 „	Lime	15 „
Fuel.....	say 50 „		

The table on page 259 shows the comparative cost of working the new method with that of the Leblanc and ammonia soda process.

It will be seen that the new process claims to utilise all the materials employed, and that there are practically no waste products. The calcium sulphate produced is not only marketable as pearl hardening, but is available as a substitute for china clay in calico finishing, and as plaster of Paris, while the lime-kiln gases, which are wasted as carbonate of lime sludge in the Chance's recovery process, are present in the sodium carbonate produced. As all the stages of the process are wet ones, the loss which necessarily attends all furnacing operations are obviated, and these in the Leblanc process are known to be very high.

MANCHESTER SECTION.

At a meeting held on he 6th inst., Mr. Ivan Levinstein being in the chair, the first paper read was by Mr. Rowland Williams, on "The Relationship Between the Composition of Grey Cloth and Its Liability to Mildew." It was well known, the author said, that grey cloth having starch in its composition was liable to mildew, and there were few manufacturers who had not suffered loss in this respect. He had lately been investigating the subject on thirty samples of cloth representative of the Manchester market. He did not think that the heavy sizing so prevalent of late years was mainly responsible for the increase of mildew cases; in fact, under certain conditions, a pure cloth was attacked by fungoid growths more readily than a heavily sized one. Starchy matters, such as flour and farina, tallow and other fatty substances, china clay, and the chlorides of zinc calcium and magnesium were used in the grey cloth manufacture, especially in the lower grades. Some antiseptic was generally added to the sizing mixture to prevent mildew. Zinc chloride was generally employed, from 1 to 3 per cent. of this salt being added to heavily sized goods. In his experiments the samples of cloth were moistened with water, and subjected, in stoppered bottles, to a heat of 95° Fahr., and the time taken before mildew appeared was noted. The results were recorded in tables, and, in concluding his paper, Mr. Williams said the results, as a whole, showed that there was not so close a relationship between the composition of the cloths and their respective tendencies to become mildewed as might have been expected. He referred more particularly to the ratio between the $ZnCl_2$ and $MgCl_2$ and the total size. The figures, however, certainly showed that $ZnCl_2$ in sufficient quantity exerted a preservative influence on cloth containing large quantities of $MgCl_2$.

Three short papers were afterwards read by Dr. Kneckt, the first being entitled "The Carbonising of Wool in Presence of Silk." By the term carbonising the author meant the destruction of one fibre in a mixture. It was commonly applied to the separation of cotton from wool, whereby the cotton was destroyed and the wool recovered. A method was wanted to separate wool from silk in a mixture; in this case the wool was to be destroyed. He had found that wool was acted on by alkalies, and to a less extent by acids, but found that after all water alone accomplished the object. If the fabric was heated for three hours in high-pressure steam at 130° C. the wool was quite destroyed, and could be rubbed to a powder, leaving the silk unaltered. He showed a piece of fabric with a woollen weft and silk warp where the wool was quite rotted by this process.

The next paper was a note on "The Formation and Direct Fixation of Insoluble Tartrazine on Animal Fibre." Much attention, the author said, had lately been paid to the application of tartrazine to silk dyeing. Hitherto the colours had not been fast, but fast colours were now produced. The colour was prepared by mixing equal quantities of dioxytartaric acid and phenylhydrazine, both dissolved in hydrochloric acid. The solution, which at first was colourless, developed a deep yellow colour on boiling, and in this silk could be dyed a fast yellow.

The third paper was by Dr. Kneckt and Dr. Koechlin, on "The Application of Alizarine in Leather Dyeing." Alizarine, though chiefly used in cotton dyeing, had of late been used for wool, and even for silk, and its superiority for wool dyeing was now recognised in the market. For wool and silk a chromium mordant was used, the temperature of the bath being gradually brought up to 90° C., and maintained for half an hour. In applying alizarine to leather the authors found that the leather would not stand a higher temperature than 50° C., and that the best method of procedure was as follows:—The leather is first brushed over with an alkaline solution of alizarine, and afterwards passed through a bath containing the chromium mordant. By this method a fast dye had been obtained.

Notes.

THE FRENCH NAVY.

The estimates for the French navy for the year 1891 amount to 218,767,702fr. (£8,750,708), of which about 50,000,000fr. (£2,000,000) are reserved for the construction of new vessels or the alteration of existing ones. During the present year there will be in course of building in the Government Dockyards six ironclad battle-ships, two first-class and four second-class cruisers, two torpedo cruisers, two transport avisos, two torpedo avisos, one second-class transport steamer, and one sailing frigate, and of these nearly one-half are expected to be completed during the year. The vessels under construction in French private yards include two ironclad battle-ships, two armoured cruisers, two third-class cruisers, seventeen first-class torpedo boats, two sea-going torpedo boats, and two vedette boats. Of these there are expected to be completed during this year one ironclad battle-ship, two third-class cruisers, and all the torpedo and vedette boats.

ARTIFICIAL RUBIES.

The experiments of MM. Fremy and Verneuil on the artificial production of rubies have been in progress for some years, but it appears from their recent communication to the *Comptes-Rendus* that they have now successfully overcome the difficulties which attend their manufacture, and are obtaining much larger crystals. The artificial rubies have already been employed as pivots in watches, and are said not to be inferior to the natural stones in hardness. The process consists in heating alumina and a trace of potassium bichromate with barium fluoride or a mixture of fluorides of the alkaline earths to a high temperature for several days. Recent progress has been due to the discovery that the addition of a small quantity of potassium carbonate to the mixture, so as to render the fused mass alkaline, facilitates the formation of the crystals. It is believed that the crystals are produced directly from the interaction of the volatile compounds produced, and by employing crucibles of several litres capacity in gas furnaces as much as 3 kilos. of rubies are obtained in a single operation.

CLONMEL WATERWORKS.

The new waterworks at Clonmel, which are to be constructed according to a scheme prepared by Mr. W. H. Radford, will supply a population of 12,000, and the quantity of water required is 225,000 gallons a day. The water will be taken from the Glenmorgan mountain stream about three miles from the town, which affords an ample supply even in the driest summer. There is a watershed of 1,700 acres on the old red sandstone, and there are many constant springs above the intake. The water will be taken from below the surface and roughly screened at the intake through filter baskets. There will be a 7in. supply main, 3,680 yards long, from intake to reservoir, with a fall of 82ft., and delivery of 506,000 gallons a day. The reservoir and filter beds will be placed together on a hill near the town. The filter beds will be 450 yards in area, and divided into four parts for convenient cleansing. The service reservoir will be constructed of concrete, and covered with concrete arching. The capacity of reservoir will be 450,000 gallons, or two days' supply. The 9in. service main from reservoir to town will have a working hydraulic gradient of 1 in 139, and at that gradient it will deliver water 30ft. above the eaves of the highest building. At the hydraulic gradient it will deliver 38,640 gallons an hour; the average hourly consumption being only 9,375 gallons an hour.

THE MINERAL WEALTH OF INDIA.

We sometimes hear of the great possibilities of the industrial resources of China, on account of her vast mineral deposits, but hitherto those of India have been supposed to be confined chiefly to those depending directly or indirectly on agriculture. A book by Captain C. C. Townsend, R.A., of the Indian Ordnance Department, has been published by Thacker & Co., of Bombay, which seems to open up such a boundless vista of possibilities that we feel compelled to look forward to India as the future iron and steel producer of the whole world, and to see it a busy field of industrial enterprise long after the furnaces and factories of Britain shall be black and silent. Captain Townsend does not deal with the precious metals or stones of India, to which already considerable attention is being paid, but confines his attention to the vast deposits of iron ores and of minerals necessary to the iron and steel industry, and he indicates several localities in which all that is wanted to start large establishments could be found within a convenient area. He gives many suggestions which would be found of use to those who may turn their attention to a matter, which, if taken up in earnest, may have a great effect on the future of the industrial world, if Captain Townsend's facts are to be depended upon. He does not pretend to treat the subject in an exhaustive and scientific, but rather in a suggestive and commercial manner, and thus appeals to a wider circle of readers.

THE CONDITION OF MINERS IN HUNGARY.

The number of persons employed in the mines of Hungary is 35,533, of which 29,830 are men, 5,000 boys from twelve to sixteen years of age, and the remainder are women. The wages earned, according to the *Revue Industrielle*, are less in the mineral mines than in the coal mines, the average daily wage earned in coal mines being from 2s. to 2s. 6d., while in the mineral mines it is only 1s. 4½d. to 1s. 6½d. per day. In the mineral mines work is not usually carried on in the night, but in cases where it is done the day is divided into three shifts of eight hours each. In some newly-started mines the hours of labour are from 6 a.m. to 6 p.m., with a stoppage of one, and sometimes two, hours for meals, while in others the number of hours is eight, two shifts being employed. In the coal mines work is usually carried on both night and day by means of a double shift, each shift working twelve hours, with an allowance of two hours for meals. The miners are generally housed in houses built by the mining companies, the rent for the smallest house being £1 per year! Several of the large companies also provide their workpeople with all necessaries at cost price. Mutual help societies exist among the miners. Strikes among the Hungarian workers are fortunately rare, and when such occur, as in 1875, 1880, and 1887, are not of long duration, and have usually been found to have been caused by the incitation of foreign workmen.

THE CENTESIMAL METHOD OF MEASURING ANGLES.

At a congress of makers of surveying instruments, recently held in Bremen, an attempt was made by Dr. Foerster to ascertain to what extent the decimal division of the quadrant was employed by German instrument makers. Inquiries were forwarded to 150 firms, and twenty-two answers have been received. Of this number eight firms make use of the centesimal graduation to a certain extent, as shown in the following table:—

Firms.	Instrument with Decimal Graduation.
3	Less than 10 per cent.
2	More than 10 per cent.
1	More than 20 per cent.
1	More than 50 per cent.

The new graduation appears to be used most extensively in Baden, where, since 1820, it has been employed on the Government surveys. A leading firm of instrument makers in Carlsruhe report that, with the exception of the instruments they make for export, almost all the theodolites they sell are graduated centesimally. One dividing engine is used both for the 360° and 400° divisions. The centesimal division may easily be added to any existing dividing engine, so that there need be no mechanical difficulties to prevent the adoption of the decimal graduation. The explanation of the unpopularity of the centesimal method in this country and in the United States is to be sought rather in the unsatisfactory character of the trigonometrical tables available. All the tables calculated for the centesimal method, such as those of Borda, Hobert, and Plauzoles, are not arranged so clearly as Chambers' tables. The advantages of the new method are urged by Mr. T. G. Gribble, Assoc.M.Inst.C.E., in a work he has recently published on surveying, and the matter is one which certainly deserves the attention of surveyors.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

23rd February, 1891.

3220. W. Rothwell & Co., Ld., & Rothwell ..... Cutting knitting machine needle beds.
3224. Heywood & Holland ... Reciprocating "pegging" machines.
3226. Smyth, S. R. (of the Steel and Iron Company, Ld.) ..... Apparatus connected with the treatment of ores and metals in furnaces.
3231. Claridge, J. W..... Machine for drilling holes of various shapes.
3233. Fairweather, W..... Tilting gear for rolling mill plant.
3235. Begg, W..... Looms.
3238. Hales & Ramsden..... Machine for making corrugated paper.
3240. Williams, W. ..... Apparatus for ventilating mines.
3243. Rothwell, T..... Machines for opening and cleaning cotton.
3244. Higham & Appleton..... Pickers for looms.
3258. Steinmetz, S..... Machines for cleaning, husking, and preparing cereals.
3261. Weiss, O. ..... Petroleum engines.
3268. McGlasson, R. ..... Apparatus for governing and operating marine engines and propellers.
3269. Dunlap, F. W. ..... Mechanical telephones.

24th February, 1891.

3275. Petrie & Petrie ..... Machinery for washing, scouring, and cleansing cotton waste, rags, &c.
3280. Bateman, D. C. ..... Apparatus for grinding the points of wire cards.
3281. Holden, J. ..... Looms.
3285. Green, Green, & Clarthero ..... Rotary engine.
3288. Titus & Werner ..... Feed water purifiers.
3293. Eades, W. T. ..... Tube expanders.
3298. Young, W. ..... Railway signalling and facing point locking apparatus.
3302. Craven, P. P..... Spinning frames.
3316. Galtier, M. H. A..... Recording clinometer.
3322. McFarlane & Reid ..... Self-lubricating sheaves, pulleys, and wheels.
3324. Eddy, A. H. ..... Screw machines.
3325. Thompson, W. P. ..... Metallic railway sleepers (*Sweet*).
3327. Thompson, W. P. ..... Die stocks and dies (*Fletcher & Emmert*).
3329. Spencer, C. M. ..... Screw machines.
3330. Glover, J. ..... Apparatus for excavating.
3333. Hallowell, J. K..... Apparatus for treating ore.
3334. Dinstuhl, G. ..... Steam traps.
3337. Lake, H. H..... Vacuum pumps (*Berrenberg & Nickerson*).
3350. Coffey, B. H..... Gas engine.
3352. Lake, H. H. ..... Vacuum pumps (*Berrenberg & Nickerson*).
3368. Richards, G. B. (of Messrs. Westray, Copeland, & Co., Ld.) Marine and other steam engines.
3371. Mannesmann, M. ..... Apparatus for forming, rolling, and calibrating tubes.
3377. Clark, A. M. ..... Vacuum pump (*Bornholdt & Glatz*).

25th February, 1891.

3391. Atkinson, J. ..... Gas engines.
3396. Martin, E. ..... Filtering machinery.
3413. Lyon, C. W. ..... Apparatus for charging and discharging gas retorts.
3419. Munns, W. H..... Scroll sawing machine (*Laird*).
3420. Munns, W. H..... Car coupling (*Phelps*).
3422. Munns, W. H..... Wrench (*Huntsinger & Marshall*).
3454. Lake, H. H. ..... Apparatus for the manufacture of screw-threaded bolts or pins (*The Russell and Irwin Manufacturing Company*).

26th February, 1891.

3464. Michaud, J..... Rotary printing machines.
3466. Hetherington, J. M. ... Opening and scutching machinery.
3468. Young, J. ..... Machinery for making bobbins.
3503. Anderson, C..... Apparatus for exhausting the products of combustion from locomotives.
3511. Singer & Dombrain..... Apparatus for extraction of liquids from pulverulent materials.
3514. Wilcox, B. ..... Apparatus for condensing steam or vapour (*Fouché*).
3525. Chandler, J. C. ..... Apparatus for purifying gas.
3526. Loveday, Loveday, & Loveday ..... Slide valves of steam engines.

27th February, 1891.

3548. Lyon & Fearn ..... Machines for reeling yarn and thread.
3551. Boult, A. J. ..... Pneumatic ordnance (*Eichbaum*).
3555. Thompson, W. P. ..... Concrete mixing machines (*Hotchkins*).
3564. Bailey & Bailey ..... Sight feed valves for lubricators.
3568. Aimers, J. ..... Valve gear for steam engines.
3574. Hurtley, J..... Machines for balling warps.
3582. Mountain, B. ..... Machinery for rolling metallic rings and for making wire.
3583. Alpe, R. J. ..... Drilling machines.
3585. Phipps, T. ..... Stop valve for gases.
3586. Hill, C. W..... Balance piston arrangement for the valves of high speed engines.
3593. Schönberg, I. ..... Saw sharpening machine.
3599. Tyler & De Vesian..... Locomotive steam engines.
3601. Vanoutryve & Le-paintebr..... Machinery for the manufacture of chenille and like threads.

28th February, 1891.

3628. Postlethwaite, G. R.... Dynamometers.
3631. Wild, J. ..... Steam traps.
3635. Hoyle, E..... Steam engine governor.
3641. Brierley, W..... Taps and valves (*Hoyle*).
3672. Bradley & Crossley ... Igniting and starting apparatus for gas engines.
3682. Wertenbruch, F..... Gas and hydrocarbon engines and the pistons thereof.
3685. Horn, W. W. ..... Hub boring machine (*Bonner*).
3687. Horn, W. W. ..... Engine-reversing gear (*Barnes*).
3688. Whitehead, E. E..... Apparatus for cutting tubes.

ELECTRICITY.

23rd February, 1891.

3239. Raworth, Callender, & Webber ..... Underground conduits.
3262. Gimingham, E. A. (of the Edison and Swan United Electric Light Company, Ld.) Incandescent lamps.
3265. Grandinger, H. F. ..... Process of electro-plating.

24th February, 1891.

3331. Currie, S. C. C. ..... Storage batteries.
3336. Lake, H. H. ..... Electric welding apparatus (*Lemp & Schmidt*).
3349. Dewey, M. W. ..... Electric welding apparatus.
3364. Lake, H. H..... Incandescent lamps (*Nickerson & Berrenberg*).
3383. Kingdon, J. A. ..... Dynamos.

25th February, 1891.

3404. Elliot & Furtado ..... Switches for telephone circuits.
3426. Dowsing, H. J. ..... Brushes and brush holders for electric machines.
3449. Rabbidge, P. ..... Telephones.
3450. Power, W. H. ..... Primary batteries.
3455. Birkin, W. A'C. G. ..... Percussive rock drills.

26th February, 1891.

3495. Dorman & Smith ..... Switches.
3518. Guyard, E. ..... Inking device for telegraphic instruments.
3524. Sanders, R. D. ..... Manufacture of metal tubes by electro-deposition.

27th February, 1891.

3538. Mackie, J. ..... Apparatus for automatic stop motions and analogous applications in spinning, twisting, winding, and other machines.
3553. Thompson, W. P. ..... Conduit electric railways (*Reed*).
3589. Lake, H. H. ..... Electric batteries (*Dowse*).
3592. Whitehead, W..... Alarm apparatus.
3609. Hartmann & Braun ... Electricity meters.

28th February, 1891.

3673. Seibold, A. C. ..... Arc lamps.
3675. Edwards, E. ..... Apparatus for the transmission of messages by direct or alternate currents.

CHEMISTRY.

23rd February, 1891.

3222. Clark & Clark ..... Reducing metallic oxides.
3230. Ascough, J..... Manufacture of borax and soda and other compounds containing sodium or boron or both.
3270. Fischesser, A. ..... Azo colouring matters.

25th February, 1891.

3387. Lapone, H. ..... Manufacture of aluminium from aluminia.
3439. Willcox, B. ..... Azo dyes (*Farbenfabriken vormals Friedrich Bayer & Co.*).

27th February, 1891.

3557. D'Andria, M. N. ..... Manufacture of barium nitrate and strontium nitrate.
3657. Howitt, J. J. ..... Apparatus for the manufacture of carbonates of soda.
3622. Vidal, R. ..... Production and separation of methylamines, ethylamines, phenylamines, and naphthylamines.

MISCELLANEOUS.

24th February, 1891.

3276. Whitaker, R..... Wood screws.
3358. Dvorkovitz, P. ..... Manufacture of gas from fluid hydrocarbons.
3359. Jagenburg, R. ..... Valve packing.

25th February, 1891.

3416. Smethurst, J. ..... Lock nuts and bolts (*Gledhill*).
3444. Horn, W. W. ..... Nut lock (*Barlet*).

26th February, 1891.

3510. Lang & Wigham ..... Process for protecting iron and steel wire against corrosion.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

1237. Mannesmann.
1238. Mannesmann.
1283. Imray (*Mannesmann & Mannesmann*).
1284. Imray (*Mannesmann & Mannesmann*).
1285. Imray (*Mannesmann & Mannesmann*).
2034. Rider.
2860. Turner.
3004. Weygang.
3040. Bennison & Bennison.
3054. Heggs.
3079. Etherington.
3193. Swinburne.
3268. Coppard.
3272. Fletcher.
3286. Sowerby.
3383. Johnstone.
3595. Stanley.
3639. Elsey & Kirk.
3718. Thomas.
3819. Mance.
3854. Fowler.
3862. Pass.
3937. Rawson & Snell.
3983. Batchelor.
3988. Stretton.
4051. Harrison.
4081. Brooks & Edge.
4082. Brooks & Edge.
4122. Jackson.
4128. Walker & Stephenson.
4147. Muller.
4271. Topliss & Kay.
4311. Warren.
4397. Little.
4410. Harrison.
4471. Lake (*Maxim*).
4489. Perkins.
4491. Walton & Walton.
4545. Campbell & Cameron.
4617. Sturgeon.
4662. Bayly (*Delancett & Child*).
4680. Gooding & Ladd.
4681. Thompson (*White*).
4704. Varley.
4727. Fulton.
4730. Belshaw.
4859. Welch & Bartlett.
4869. Merrywheather & Jakeman.
4898. The Harrison Self-Tightening Steel Rail Key Company, Ld., & Harrison.
4923. Dixon.
4935. Ayres & Evans.
4978. Phillips & Courteen.
4984. Robinson.
5002. Lake (*Peer & Ely*).
5008. Furtado.
5016. Bary.
5076. Chandler.
5565. Causer.
5571. Campbell & Boyd.
5581. Skelsey.
5637. Fowler, Fowler, & Fowler.
5667. Clark.
5705. Thompson (*Edwards*).
5750. Crompton (*Fritsche, partly*).
5804. Pollak.
5878. Wild.
5887. Golding.
5938. Boettcher.
5979. Petter.
6023. Hart.
6027. Campbell.
6035. Baker.
6067. Kershaw.
6070. Sturrock & Macdougald.
6128. Cook.
6147. Drummond.
6154. Croker.
6155. Croker.
6180. Bayly (*Alexius*).
6198. Horn (*Caldwell*).
6215. Walter.
6239. Hastings.
6258. Kirk & Lee.
6262. O'Donnell, Timmis, & Smith.
6265. Orr.
6267. Marx.
6269. Livesey.
6282. De Soldenhoff.
6296. Smith & Smith.
6312. Kendrick.
6316. Fox.
6319. Lacy.
6330. Aylippe.
6351. Sloan.
6354. Willans.
6368. Croker.
6372. Cohen.
6382. Haddan (*y Azcona*).
6388. May.
6392. Blathy.
6399. Von Langer & Cooper (*Pietzka*).
6409. Ash.
6429. Vicars, Vicars, & Vicars, Jun.
6438. Kebtch.
6444. Darne.
6446. Salter & Lamplugh.
6469. Jones.
6473. Forman.
6475. Lowrie & Hall.
6483. Nightingale.
6485. Mellstrom & Bremberg.
6491. Reed.
6495. Clark (*Wirth & Co.*).
6517. Lovold.
6532. Hunter.
6536. Fox & Williamson.
6541. Paley.
6551. Pedley.
6582. Sheath.
6585. Lake (*Maxim*).
6592. Williamson.
6593. Williamson.
6769. Stott.
6793. Siemens Bros. & Co., Ld. (*Siemens & Halske*).
7002. Bernard.
7100. Lodge & Littlewood.
7166. Livingstone & Livingstone.
7335. Cruikshank (*Ressig, Maccallum, & Landin*).
7470. Baird.
7588. Goss & Goss.
8650. Butlin.
9024. Cooper & Holdsworth.
9439. Penlington.

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9884. Keller.
10048. Von Skoda.
12508. Prescetto.
12806. Smith.
14004. Gill & Evans.
14848. Robinson.
16418. Rothlisberger.
16786. Hall.
17174. Lee. (1st May, 1890.)
17668. Clarkson.
17948. D'Eye & Rowland.
18116. Tischer.
18249. Kay. (12th May, 1890.)
18788. Haddan (*Espiau*).
18981. Taylor & Walker.
19173. Mallonee.
19638. Jordan.
19667. Leathers (*Radam*).
20030. Van Vestraut.
20186. Gregory.
20348. Cohn.
20480. Vignier.
20710. Philpot.
20882. Lake (*White*).
20900. Redfern (*Siegmüller*).
20989. Zachary. (15th August, 1890.)
21183. Mills (*Ongley*).
21229. Ellinwood.
9955. James.
11037. Foster.
12792. Watts.
13805. Faber.
14295. Dran.
14639. Unge.
16720. Jensen (*Dodson*).
17145. Nevill.
17552. Dienz.
17921. Eitle.
17988. Tennant, Tennant, & Tennant.
18624. Lake (*Patten*).
18866. Syrett & Redman.
19121. Needham.
19427. Subers. (1st May, 1890.)
19966. Wallace.
20086. Saxlehner.
20815. Redfern (*Malin*).
20423. Carr.
20510. Lake (*Wood*).
20862. Newall & Ireland.
20887. Lake (*White*).
20963. Parker & Watts.
21073. Johnston.
21078. Leith.
21194. Foss.
21239. McCahey.

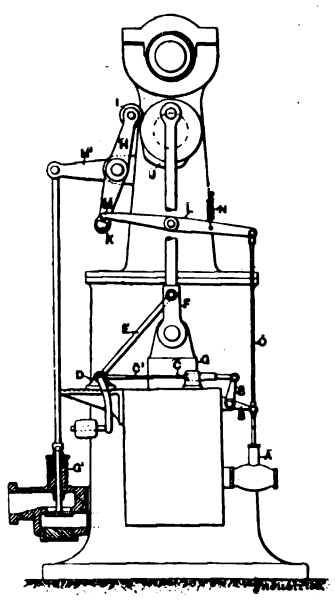
1891.

84. Mayer.
224. Lee.
232. Payne.
344. Richard Mullins Moody & Frank William Mugford.
719. Downing (*Mense*).
928. Neave.
969. King (*Guenther*).
987. Mills (*The Rau Manufacturing Company*).
1188. Mills (*Berger, Cornet, & Martin*).
1236. Kittner.
1285. Poynter.
1325. Erskine, Finlay, & McDowell.
1401. Hunter.
1461. Egge.
1491. Dechaud.
1499. Porter.
218. Wilson.
228. Nicoll.
249. Rycroft & Mason.
446. Butterfield.
502. Kerby.
663. Springer.
905. Maldifassi & Bozza.
965. Leigh (*Gardiner*).
979. Dallaway & Tait.
1034. Lake (*Groshon*).
1052. Niclausse & Niclausse.
1216. Abraham & Ramshaw.
1268. Mertz.
1287. Richards (*Bellamy*).
1342. Gibson.
1346. Boisrenoult.
1436. Frazer & Cosford.
1487. Chapman & Merritt.
1498. Flohr.
1532. Taylor & Warburton.
1537. Fitzpatrick (*Werner*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Gas Engine Governors.—*C. D. Abel, London. (The Gas Motoren Fabrik Deutz, Köln-Deutz, Germany).*—The governor constructed according to this invention is shown in the annexed illustrations applied to a gas engine of vertical construction. A is the gas valve, the rod of which is connected by a bell-crank lever B to a sliding rod C, opposite which is a rod C^1 pivoted to



a slide D, and having a weighted arm D^1 fixed to it, the slide D having a to and fro motion imparted to it by a link E, connected to the rod F that works the gas slide G of the engine. G^1 is the discharge valve of the engine, closed by a spring and opened during the discharge period by means of a bell-crank lever H H^1, the arm H of which bears with a roller I against a cam J on the countershaft that works the gas slide. The bell-crank lever has a tail with a projecting stud K, and a lever L pivoted to the engine frame, has a hooked end M, which catches over the stud K when the bell-crank lever H H^1 has been moved inwardly by the cam J, in which position it holds the discharge valve open, the lever L being acted upon by a spring N, which tends to hold it in this position. The other end of the lever L is connected by a rod O to the rod of the valve A, so that when the valve is forced open by the action of the parts B C C^1, the lever L is at the same time moved so as to release the stud K, whereupon the discharge valve G will be closed by its spring when permitted to do so by the cam J. From the above description it will be seen that every time the discharge valve is opened by the cam J it will be held open by the catch M until this is withdrawn again on the opening of the gas valve A, so that when this fails to be opened by the device C C^1 of the inertia governor, on the normal speed of the engine being exceeded the discharge valve remains open, allowing the products of combustion to be drawn back again into the cylinder from the discharge pipe, until by the reduction of the speed the inertia governor again causes the gas valve to be opened during the charging stroke, whereupon the discharge valve will close again. Three claims are made.—No 4164. March 17th, 1890. 8*d.*

Hydrocarbon Engines.—*H. A. Stuart, Bletchley, Buckinghamshire, & C. R. Binney, London.*—The invention relates to those engines operated by the explosion of mixtures of combustible vapour, &c. Referring to the accompanying illustrations, Fig. 1 is a sectional side elevation, Fig. 2 an end elevation, and Fig. 3 a cross section of the vaporiser of such an engine of the two-cycle type. The piston A of the cylinder B is connected to the crank-shaft C in the usual manner. At the back of B and communicating with it is the vaporiser D formed with ribs D^1 (Fig. 3), as described in a prior patent No. 15994 of 1890, and with an air valve E. The vaporiser D is surrounded by a casing F provided with a damper F^1. The frame work of the engine contains the hydrocarbon tank G from which the oil is drawn by means of a pump H actuated through a bell-crank lever I, a cam J on a counter-shaft K, and suitable gearing from C, through a spraying nozzle L into D. A suitable valve, placed in the pipe connecting G with H and governed by a governor M, actuated from C (Fig. 2), serves to regulate the supply to H and so control the speed of the engine. The exhaust valve N, communicating with the rear end of B, is actuated through the lever N^1 from a second cam J^1 on the shaft K. Claims: In an engine operated

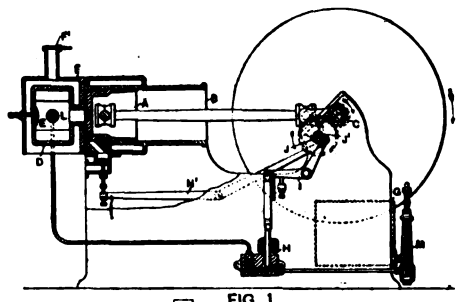


FIG. 1

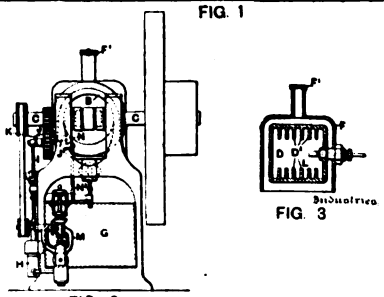


FIG. 3

FIG. 2

by the explosion of hydrocarbon vapour and air—(1) The employment of a vaporiser in direct communication with the working cylinder, which vaporiser is maintained at the requisite degree of heat by the combustion of the combustible mixture therein, and also serving to ignite the combustible charge; (2) forming the mixture of gas and air by introducing the gas or vapour into a charge of air under compression; (3) the combination with a vaporiser of a cover surrounding the same and provided with upper and lower openings; (4) the employment of governing mechanism to operate upon the suction valve of the oil injecting pump in such a manner that, when the engine is running above its normal speed, a reduced supply of oil will be delivered into the vaporising chamber for the purpose described; (5) the manufacture and use of the improved hydrocarbon engine, described and illustrated.—No. 7146. May 8th, 1890. 8*d.*

High-pressure Valve Taps.—*A. W. King, Eastbourne, Sussex.*—Sliding in a straight portion of the valve body is a tightly fitting tube, to one end of which is connected, by means of suitable webbing, the valve proper, which, by moving the tube carrying it longitudinally in the body of the valve, can be forced against a suitable seating in the said body. This seating is formed separately, and has projecting from its outer periphery a flange, which is firmly held between flanges formed on the two parts of the valve body. These parts are suitably bolted together, so securing the valve seating. A flange, slightly smaller than the interior of the valve body, projects from the underside of the valve seating, between which and the former the reduced end of the tube carrying the valve proper slides. This tube is moved longitudinally by means of a rod connected thereto and passing through an inclined slot formed across the valve body. Thus, by moving this rod to the right or the left, the tube will be moved in one or the other direction by the rod following the direction of the slot. Claims: (1) In a valve cock an inclined slot in the outer casing to impart a vertical movement to the valve by rotating a handle projecting through said slot, and connected to the valve; (2) in combination with a valve cock, a cushion, consisting of an indiarubber ball, containing air confined therein, the ball being situated in the waterway to avoid concussion in the pipes.—No. 2973. February 25th, 1890. 6*d.*

Crushing Machines.—*D. Brennan, Bayonne, New Jersey State, U.S.A.*—The machine embraced by this invention is for the purpose of crushing ores and such like material by means of two adjustable rollers, and is shown in the annexed illustrations, of which Fig. 1 is a sectional side elevation, Fig. 2 a plan, and Fig. 3 an end elevation. On the hollow bed A are bolted the fixed heads B carrying suitable bearings for securing the spindle of the roller C driven from D. Opposite C is the adjustable roll C^1 running in bearings in heads B adapted to slide on A, but held thereon by bolts E sliding in slots A^1 in A. The heads B B

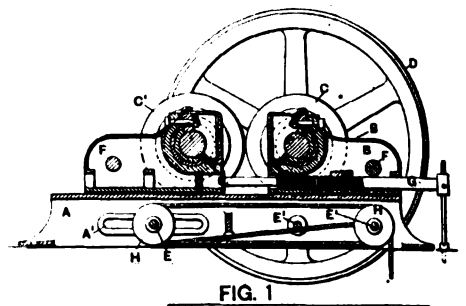


FIG. 1

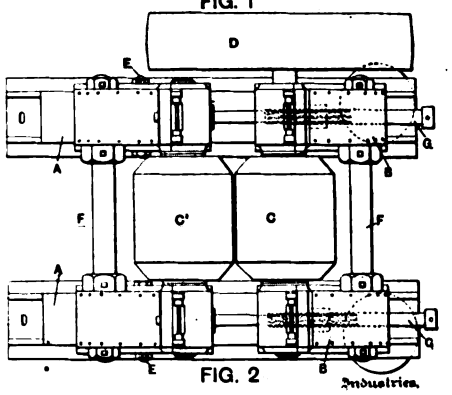


FIG. 2

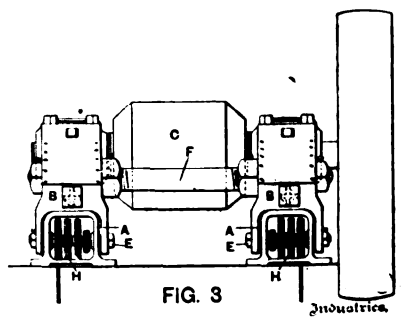


FIG. 3

are bolted together by bolts F. The space between the two rollers can be increased or diminished to suit the fineness to which the ores and other material are to be ground, by means of screwed adjusting rods G, working through the lower portions of the heads B. Carried on the bolts E E in B B are sheaves H, around which pass suitable wire or other ropes, having one end fixed to the bolt E^1, and the other end carrying a suitable rod (not shown). The lower end of this rod is flanged, and supports a helical spring, upon which are placed suitable weights, the number of these, of course, depending upon the pressure it is desired to put on the rollers. The bearings in the heads B B are of a form substantially as shown in Fig. 1, suitable passages being made therein to allow the waste oil to pass from the backs of the bearings on to the surface of A. Eleven claims are made.—No. 20531. December 16th, 1890. 8*d.*

Brick Machines.—*J. & R. T. Dixon, Horwich, near Bolton.*—The object of the present invention is to close the top of the trough after the shale is fed into it, and before the ram enters, so preventing the escape of the shale. For this purpose a plate arranged to work in slides on the top of the receiving trough is used, such plate being held in a parallel position with the back ram by the slides and operated by a rocking shaft having two arms and coupling links connected to the plate, the rocking shaft receiving its motion either from the fly wheel or from the back ram shaft which has two projections fastened to it, so as to come in contact with a cam on the rocking shaft. The motion of the plate closes the opening into the trough after the ram has received its full charge of shale or clay, so converting the trough into a box, and, this remaining shut, the shale is pressed into the mould. The slide then moves back and the trough receives a new charge. Claims: (1) In brick machines the use of a slide for closing and opening the trough or feed box as and for the purpose described; (2) the combination of parts as described.—No. 5188. April 3rd, 1890. 6*d.*

Railway Chairs.—*G. W. & R. B. Rittersbach, both of Philadelphia, Pennsylvania, U.S.A.*—Two bed-plates of a suitable length, width, and thickness are secured to the opposite ends of a tie. These plates have formed on each end of them upwardly extending hollow ears, between which ears the rail is placed. Suitable cheek pieces are then passed through these ears so that the inner ends thereof press upon the lower flange of the rail, so securing it. Suitable holes are formed in the outer ends of these cheek pieces and in the bed-plates, so that when the cheek pieces have been placed in position the holes coincide, so allowing the securing spikes to be driven through them into the tie. Claims: (1) A railway chair, consisting of a bed-plate with ears and cheek pieces horizontally entering said ears, the plate and pieces

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having openings and slots for securing devices as described; (2) the bed-plate and cheek piece formed and secured as described; (3) a bed-plate formed of wrought metal with ears pressed out of said plate to form apertures with the surface of the plate, in combination with cheek pieces adapted to be inserted horizontally, said plate and piece having openings for the reception of securing spikes; (4) the arrangement as described.—No. 18632. November 18th, 1890. 6*d*.

LET-OFF MECHANISM OF LOOMS.—*J. & R. Lindsay, both of Dundee, N.B.*—The mechanism referred to in this patent is for the purpose of rendering the tension of the warps as uniform as possible, and is shown applied in the accompanying illustrations, of which Fig. 1 is a side elevation and Fig. 2 a plan. The weighted lever A pivoted at A¹ carries a hinged lever B, which,

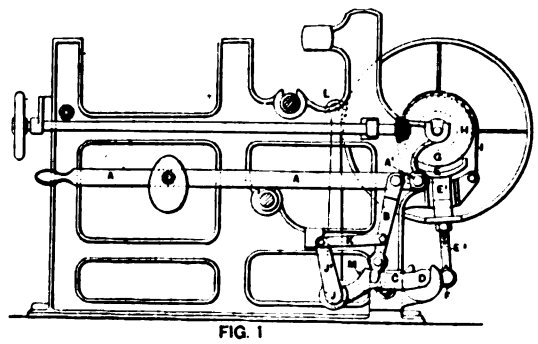


FIG. 1

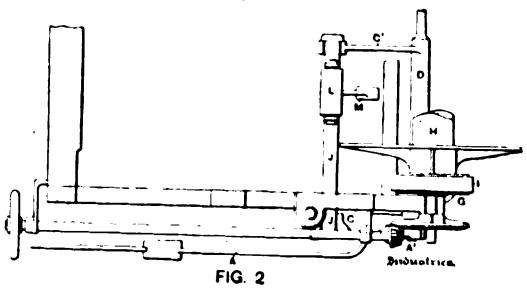


FIG. 2

operating upon the radial arm C of a spindle D, transmits the pressure to the frictional block E, which is supported by a block E¹ and rod E², the latter being pivoted at F to a second radial arm on D. The block E presses against a drag head G fixed on the warp beam H, and so causes it to be retarded in its motion by the frictional band I. Revolving in bearings on the end of the arm C and a second radial lever C¹ on D is a shaft J connected by radial arm J¹ and link K to B. Formed on J are two radial arms carrying a roller L adapted to be pressed against the yarn beam by weight M. It will thus be seen that as the yarn beam diminishes in size the shaft J will be gradually revolved, so causing, through arm J¹ and link K, B to operate on C nearer its fulcrum, thus diminishing the frictional pressure of block E. Claims: In let-off mechanism of looms for weaving, applying to the warp beam frictional apparatus in which the pressure is transmitted from one or more weighted levers through one or more strut links acting on one or more curved levers, the said strut link or links being moved nearer the fulcrum of the curved lever or levers in proportion as the diameter of the yarn on the warp beam diminishes by a lever or levers which keeps in contact with the yarn on the beam, the parts being arranged, combined, and operating substantially in the manner described.—No. 4334. March 20th, 1890. 6*d*.

APPARATUS FOR INSULATING ELECTRIC CONDUCTORS.—*S. Pitt, Sutton, Surrey.* (*J. B. Atherton, New York, U.S.A.*)—The apparatus embraced by this invention is for the purpose of winding one or more narrow strips of insulating material around a wire of any suitable diameter. In the accompanying illustrations

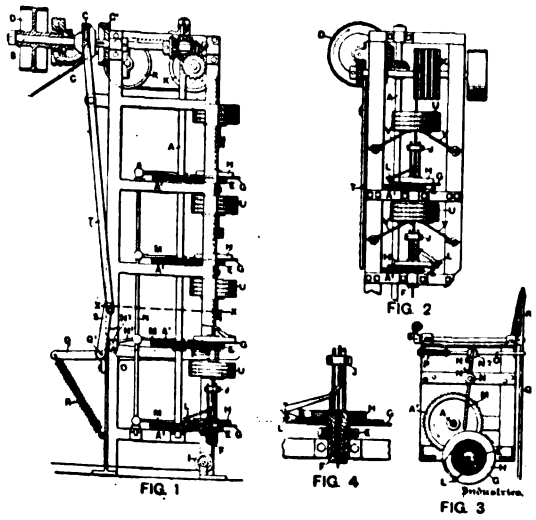


FIG. 1

FIG. 2

FIG. 4

FIG. 3

Fig. 1 is a side elevation, Fig. 2 a front elevation of the upper part of Fig. 1, Fig. 3 a sectional plan on line X X, and Fig. 4 a sectional detail of such a machine. In a suitable framework runs a vertical shaft A geared by intermediate gearing with the driving shaft B, on which slides the frictional clutch block C, capable of either engaging with the sleeve of the loose driving pulley D or being inserted in the stationary frictional block C¹. At suitable intervals along A are fixed gear wheels A¹, each of which gears with a pinion E on a short hollow shaft F mounted in bearings in the front cross-bars of the framework. Each of these shafts carries a plate G, on which are fixed the bobbins H of insulating strips. The wire to be covered is fed in around I, passes up through the shafts F, receiving a covering of paper from each of the bobbins H, which is smoothed by means of die blocks J supported on G, and is taken up by rollers K K driven by means of a worm and worm-wheel from B. The insulating material is fed from the outside of the bobbin, and passes around a knock-out latch L, so preventing the latter falling. Upon the breakage of the ribbon this latch falls, and its end is thrown into the path of a rod M projecting from a vertical shaft N. The momentum of the plate G causes the latch L to partially turn the shaft N, and by means of a rod N¹ working between ears N² on a horizontal sliding rod O, this rod is moved endwise against the pressure of its spring P and the end of the rod O, which dogs the hand-lever Q, carried by a rock shaft Q¹ is withdrawn from the lever, and by the action of a spiral spring R, the rear end of the lever is drawn down, the rock shaft turned, and by means of a crank S thereon the lever T is thrown outwardly, and the clutch C is pressed against the clutch surface C¹ and the motion of the machine immediately arrested. Suitable spare bobbins U are supported on arms V above G, and may be applied to the latter when the other bobbins are exhausted. The inventor also describes a modification of the above in which the shafts F are placed side by side, and not one above the other. Seven claims are made.—No. 911. January 17th, 1890. 8*d*

FLUID PRESSURE BRAKE MECHANISM.—*R. Battye, Sydney, New South Wales, Australia.*—The invention relates to mechanism used for controlling the action of railway and tramway brakes, and is so constructed as to be extremely sensitive to the smallest appreciable reduction of pressure in the brake-pipe, so rendering the application of the brake practically instantaneous. It further consists of the introduction between the brake-pipe and piston chamber of a controlling valve, and the use of a piston and quadruple valve in combination therewith. Referring to the accompanying illustrations, of which Fig. 1 is a sectional elevation, and Fig. 2 a sectional plan on line X X, A is the upper

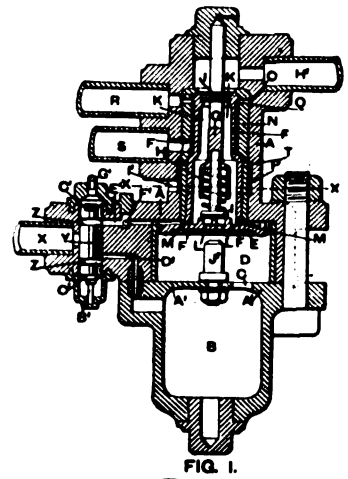


FIG. 1.

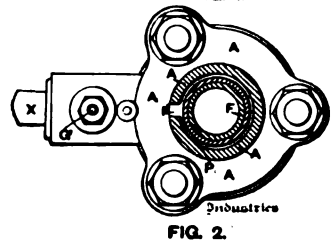


FIG. 2.

casing and A¹ the lower casing, B drip cup, C port in B communicating with piston chamber D, E cup-headed piston, F quadruple cylindrical slide valve, G centre valve spindle cupped to receive spring H of the central valve I, J screw plug attached to G and having perforations K, L port in E, M perforations in F, N O P annular grooves around F, Q slots leading from N to O, and also brake pressure and release cylinder pipes R and S, T slots leading to P; X train pipe connection, Y chamber of controlling valve Z operated by spring B¹ and having diaphragms C¹, D¹ passage leading from Y to B, E¹ passage from Y to M, F¹ back pressure valve in E¹, G¹ pipe connecting diaphragm chamber with auxiliary reservoir, H¹ pipe to auxiliary reservoir, I¹ exhaust port in A. The manner of operation is as follows:—Air being introduced at X, passes through Y along D¹ into B, thence through C into D, and pressing E upwards opens I, and passes through L into F, thence through K into H¹, which has the effect of introducing the pressure to the reverse side of E through perforations M. The downward movement of E unseats the valves formed by shoulders on F, causing Q to open, establishing communication with Q, and thence by R, to brake pressure cylinder. By the excess of pressure in the train pipe E and F are forced to their position of rest, and communication is opened between R Q O and S, thus putting off the brake by using the air from the brake pressure cylinder. The air so used will remain in the brake release cylinder until a downward movement is given to E and F, when such movement will establish communication between S N T I' and I¹, thus discharging the air from the brake release valve into the open air. The action of the controlling valve is as follows: When the pressure in the auxiliary valve has diminished sufficiently to allow B¹ to operate, C¹ is moved so as to open E¹ and close D¹, which will have the effect of introducing the air along E¹ through M, thence through K to H¹, instead of by D¹ to B, through C to D, and as E is then resting on a stud J¹ it is obvious that communication is also established with R. The inventor also describes a modification of the above. Five claims are made.—No. 16283. October 13th, 1890. 8*d*.

STEAM BOILERS.—*J. Kirkaldy, London.*—The steam boiler is made of a vertical cylindrical form with a dome top, and furnished at the bottom with an inner cylindrical fire-box, the top of which is also domed and has an outlet passage extending sidewise from it and carried to an opening formed through the cylindrical shell of the boiler. Above this opening another large opening is formed through the shell, and a corresponding large opening on the opposite side is made. Outside each of these openings is secured a flat tube plate, each tube plate flanged and shaped around its edges in such a manner that it may be secured to the exterior of the boiler shell. A number of tubes are passed across the interior of the boiler from one tube plate to the other. The products of combustion from the fire are led from the side outlet from the fire-box to one end of the tubes by a sheet metal casing secured to the exterior of the shell, and, passing through the tubes, enters a second sheet metal casing covering the other end of the tubes, and from which a chimney passes. In two claims the inventor embraces the construction of steam boilers substantially as described.—No. 5278. April 5th, 1890. 6*d*.

SINGLE-ACTING ENGINES.—*G. Richards, Altrincham, Cheshire.*—In the annexed illustrations, of which Fig. 1 is a front sectional elevation and Fig. 2 an end sectional elevation, is shown an

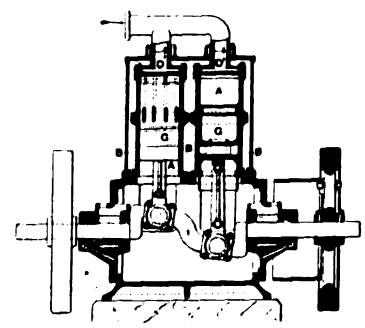


FIG. 1.

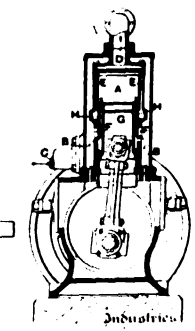
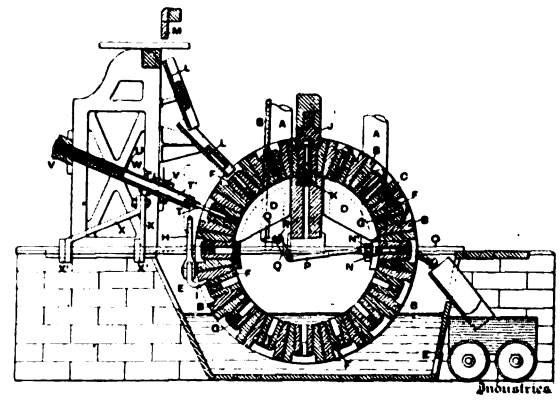


FIG. 2.

engine embracing the principle of this invention, both cylinders being in this case supplied with steam at the same pressure. The cylinders A are surrounded with a casing B, the interior of which is connected with the exhaust pipe C. The cylinder covers are made hollow and are connected with the supply pipes D, and small passages E in the cylinder casing pass therefrom to ports at about the centre of the cylinders. Similar exhaust ports F are formed in the cylinders below the supply ports, but not in the same vertical plane. Formed in the piston G are passages H connecting the upper end of the piston to ports at about the centre thereof. The crank pin I is set at an excessive angle, as shown, in order to rotate the pistons sufficiently to bring the ports therein successively opposite the supply and exhaust ports. The inventor also describes a compound engine constructed in a similar manner. Claims: (1) In a single-acting engine with one or more cylinders having the steam admitted and exhausted by a partially rotating piston, the method of arranging and constructing the ports for admitting and exhausting the steam for the purpose of reducing the angularity of the crank as described; (2) in a compound single-acting engine provided with high and low pressure cylinders arranged with two or more steam cylinders and having the steam admitted and exhausted by a partially rotating piston, the method of arranging and constructing the ports for the purpose of reducing the angularity of the crank.—No. 21002. December 24th, 1890. 11*d*.

RIVET-MAKING MACHINES.—*H. Fletcher, Greenwich, & T. C. McFarlane, Newcastle-on-Tyne.*—The accompanying side sectional elevation is that of a machine constructed according to this invention. A are columns for supporting the driving mechanism of the machine. B are wedge-shaped blocks connected together at the sides by pairs of links C to form a ring that is supported upon a saddle D and dips into water in a trough E. Each block B carries a die F fitted with a sliding stopper G that normally forms the bottom of the die. H is a rod that is reciprocated from the



driving mechanism of the machine and carries a finger or projection I, by which the drum is intermittently rotated. L are pivoted shoots, down which metal blanks cut by a movable shear blade M from a metal rod fall in regular succession into the dies as they are brought one by one below the lower edge of the lower shoot. The rivet blank is passed between the heading tool J and a bridge-shaped anvil K. N is a horizontal pusher, which by acting against the inner end of each stopper as it comes into a horizontal position, forces the stopper from the inner to the outer end of its corresponding die and thereby ejects the finished rivet from the die. The pusher N is carried by a cross-bar N¹ arranged to be reciprocated on guide rods O by a link P, crank arms Q, shaft R, and rods S from the driving mechanism of the machine. Each of the stoppers G has a groove formed in it in which is placed a spring which normally holds it in the die. The stoppers G are pushed back to the inner end of the dies after delivering a finished rivet by means of the pusher T carried by a rod T¹ held in a tube U sliding in guides V. This tube is reciprocated by the bifurcated part W of a frame X, provided with transverse bearing

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pieces X¹ arranged to slide upon guides O, and operated from the driving mechanism by similarly arranged levers and pusher N. Claims In rivet making machines of the kind described the stoppers G and special pusher T substantially as set forth.—No. 2889. February 22nd, 1890. 8*d*.

HYDRAULIC PRESSES.—*F. Horn & T. Keetman, both of Duisburg, Germany.*—Fig. 1 is a side elevation, and Figs. 2, 3, and 4 details of a press constructed according to this invention. The framework A, formed as shown, carries all the mechanism for actuating the hydraulic cylinder B sliding in guides C and carrying on its lower end the movable stamp D. The plunger of B is

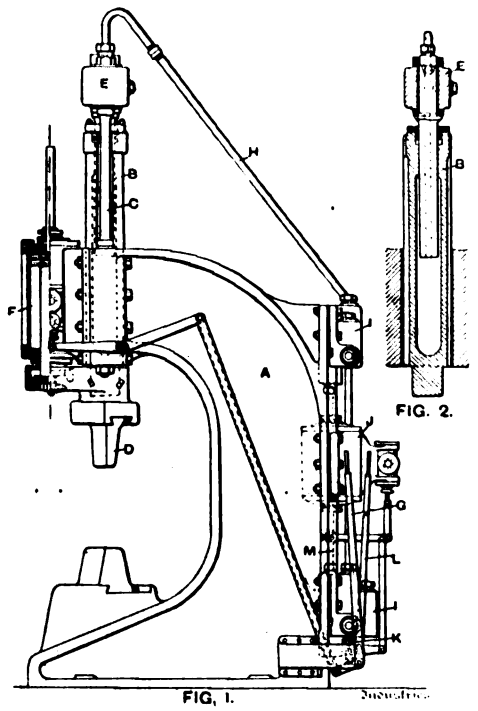


FIG. 2.

FIG. 1.

held by means of a cross-head E carried by C. The cylinder B is raised and lowered by means of the piston of the steam cylinder F, to the rod of which it is connected. The supply to the cylinder F is regulated by means of an unloaded piston slide valve operated by means of a hand lever G and suitable connecting levers. Water is supplied to the cylinder B through the plunger thereof (Fig. 2) and pipe H, the other end of which is connected with pumps I, the latter of which are connected with a water reservoir and are actuated from the piston of the steam cylinder J. The ascent of the hydraulic cylinder takes place upon the discharge of water, but as all the pump valves act as check valves a valve such as K (Figs. 3 and 4) is provided and is operated through hand lever G when this is moved to raise the steam piston in F. Figs. 3 and 4 are sectional views showing the connection of pressure pipe H with the suction or reservoir pipe past valve K. The pumps I are worked from steam cylinder J through hand lever L by displacing points. The effect of such displacement is, on the one hand, that the slide opens one of the admission ports bringing the pumps to work, and on the other hand that the slide by the movement of piston rod M, is brought back to close again, therefore a changed position of the hand

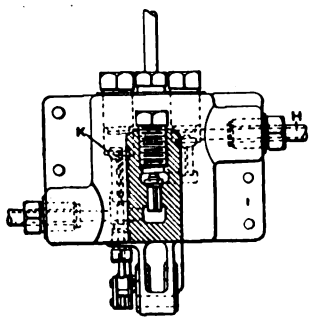


FIG. 3.

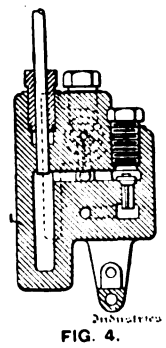


FIG. 4.

lever L brings about a proportionately changed position of the steam piston so that only such a movement of the slide valve is given as will effect a travel of the piston or pressure from stamp D corresponding to the nature of the work. Three claims are made.—No. 20675. December 18th, 1890. 8*d*.

GAS WASHERS.—*J. A. Kelman, London.*—The washer or scrubber constructed according to this invention is of a square or rectangular shape, and has a series of partitions, on which short tubes are mounted. Each tube has at its top end a dome shield fixed over it, the underside of which is provided with tangential vanes for breaking the gas up as it issues from the dome. Each of the partitions, which are fixed horizontally, is provided with an overflow for leading the water, which enters at the upper part of the casing from one partition to the other in succession. The pipes, through which the gas is first supplied to the lower chamber, project into this chamber above the water line, and have caps covering the upper ends thereof. Each of these caps is of curved formation on one side, and the dip from the curved portion is perforated for the passage of the liquor to the tar and liquor outlet, this having a check tube with openings at the bottom for the first exit of the tar, so leaving water on the surface, through which the gas has to pass. Each lower partition has its overflow pipe within a seal to prevent the gas rising except through the dome-covered tubes. The inventor also forms a condenser of a series of chambers superposed, and by a slight clearance around the tubes the gas flows from the upper chamber downwards. Seven claims are made.—No. 4824. March 19th, 1890. 8*d*.

ELECTRICITY.

INSULATED CONDUCTORS.—*E. F. A. Obach, Old Charlton, Kent.*—The invention relates to a method of preventing the action of sulphur in the insulating material upon the copper wires and their metal sheathings when used. For this purpose the inventor coats the wire with a gelatinous substance, such as glue, isinglass, and the like, and applies the vulcanised indiarubber or other insulating material containing sulphur. If a metal sheathing is used, the insulating material is then coated with a coating of gelatinous substance, and the sheathing applied immediately over it. Claims: Protecting electric conductors with their metallic sheathings from the action of sulphur contained in the material employed for insulation by interposing between the metal and the insulating material a coating of gelatinous substance, with or without paper or textile fabric, as described.—No. 4821. March 27th, 1890. 4*d*.

ELECTRICITY METERS.—*E. Hartmann & W. Braun, both of Bockenheim, Frankfurt-on-Main, Germany.*—The invention relates to an apparatus for measuring and registering at suitable intervals the quantity of electricity passing through a conductor. Referring to the annexed illustrations, Fig. 1 is a front elevation, Fig. 2 a side elevation, and Fig. 3 a detail of an apparatus for this purpose. The solenoid A, through which the current to be measured passes, has a core B formed (Fig. 3) of a piece of soft sheet iron wound around a spindle B¹ supported at its upper end by a spring C. The lower end of B¹ is connected to a lever arm of a spindle D geared with the registering mechanism E, the gear wheel, however, being only rotated in one direction by pawl E¹, and provided with a coil spring F acting by tension in opposition to the force exerted by A upon B. The spindle D also carries a pulley D¹, around which is wound a cord G connected to the armature H of an electromagnet H¹ wound with coils of high resistance and provided with a retarding device such as the piston and cylinder I. The pointer D² carried by D and working over a suitably graduated plate J is moved back to zero at

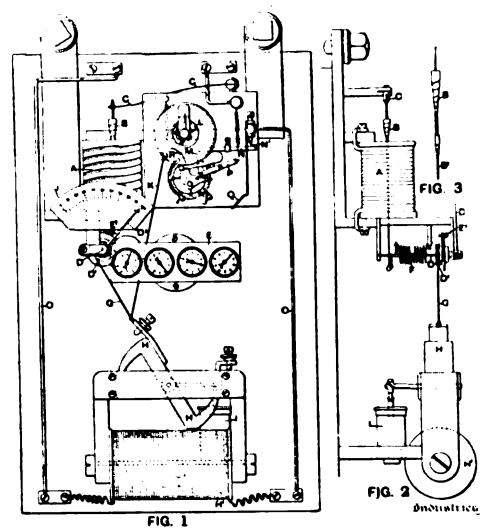


FIG. 3

FIG. 2

FIG. 1

given intervals by clockwork, allowing the current to pass through H¹. This clockwork, which may be of any suitable form, is driven by a spring which is automatically wound up by the action of H by means of a pawl and ratchet arrangement worked by a cord K. This clockwork being regulated by an ordinary balance L drives a cam or tappet M which acts on a contact making lever N. This lever, once in every revolution of the tappet M, makes contact at N¹ so as to put the electromagnet H¹ into circuit through the conductors O. When no current passes through the meter no electricity can circulate in the coils of the electromagnet, which then ceases to wind up the clockwork, and the latter runs down until the lever P comes in contact with the spring Q, and by the same movement engages with the brake lever R and causes the latter to stop the balance L. The contact at P to Q is connected with the contact at N¹ or with the electromagnet, and is so arranged as to enable the current to pass in the coils of the electromagnet H¹ directly the apparatus is put into circuit, thereby winding up the clockwork and releasing the balance. Four claims are made.—No. 18638. November 18th, 1890. 8*d*.

ALTERNATING CURRENT MOTORS.—*M. von Dolivo-Dobrowolsky & Die Allgemeine Electricitäts Gesellschaft, Berlin, Germany.*—The invention relates to such electric motors as are driven by a plurality of alternating currents of respectively differing phases. The improvements consist in an arrangement of the conductors serving to receive the operating currents. These conductors consist in a limited number of thick bars of a good conducting material, such as copper, the number depending upon the number of alternating currents employed. If, for instance, there is one pair of circum-rotating poles and two alternating currents, whose phases are shifted in respect to each other by a quarter of a phase, are used, four conductor bars are necessary, but if with two poles three alternating currents, having their phases shifted by a sixth of a phase, are used, six bars are wanted. These bars are passed longitudinally through, but insulated from, the body of iron composed of divisional parts such as discs. They are all electrically connected together by means of a disc, ring, or other means at one end, and at the other end are connected to the supply wires. Claims: In an electric motor driven by alternating currents of respectively different phases the combination with an iron body of a number of conductor bars passing through the said body and insulated therefrom: means for conductively connecting all the said bars together at one end, and a number of current-supply conductors connected to the other ends of the bars, substantially as described.—No. 20424. December 15th, 1890. 6*d*.

CHEMISTRY.

TREATMENT OF SEWAGE.—*G. W. Ewens, Bristol.*—According to the present invention the albuminous matter in the sewage is dissolved by the aid of either muriatic, sulphuric, or other acid when it becomes an adhesive mucus which readily adheres to all suspended matters, and that when in this condition by using an alkaline reagent, such as hydrate of lime, or slackened lime mixed well with water, or some form of soda or potass just sufficient to neutralise the acid, all this albuminous matter is immediately withdrawn from solution into suspension, and, being mixed with the suspended matter, the whole rapidly precipitates, leaving the effluent water pure. In carrying the above method into practice the inventor places a lead-lined tank at the head of the main sewers, in which the mixture of acid is effected so that when the sewage has reached the cleansing tanks the albumen will be dissolved, and the alkaline reagent may be added. The cleansing tanks are preferably three times as long as wide, and the floors should have an incline of about 1 in 200 from the receiving end to the overflow. When a tank is so full of sludge that it shows to the surface the flow is diverted to another tank and the superincumbent water discharged. This is effected by floating planks in the tanks of a suitable length and 3in. thick, and with holes perforated through them, in which holes are screwed the ends of 2in. tubes, so that the lower ends of the tubes are flush with the underside of the planks; to these pipes are connected iron pipes, let through the dam on a level with the floors of the tank. These siphon pipes are brought into action by pushing the planks under water. The sludge, when removed, is placed in suitable brick silos and covered over with a layer of clay, when, by fermentation of the organic matter, it will be dried. Four claims are made.—No. 1816. February 3rd, 1890. 6*d*.

DISTILLATION OF AMMONIUM CHLORIDE.—*J. Leith, St. Helens, Lancashire.*—The invention is designed to facilitate the use of an excess of ammonium chloride to Leblanc alkali waste, or other suitable sulphur compound of lime, and yet prevent the loss of ammonia. The inventor adds an excess of the ammonium chloride at the top of a distillation tower, and thus decomposes all the waste, but near the bottom milk of lime is added sufficient to decompose all the excess of ammonium chloride, which would otherwise be lost. The result is that all the ammonia is recovered, and the effluent gases are somewhat richer in ammonia as compared with the amount of sulphuretted hydrogen. Instead of alkali waste or sulphydrate of calcium, other sulphides of calcium may be used for this purpose. Claims: In the distillation of ammonium chloride with Leblanc alkali waste or other kindred substance, the use of an excess of ammonium chloride, and the addition near the completion of the process of milk of lime to the nearly exhausted materials containing the excess of ammonium chloride, whereby the latter is decomposed, and thus an increased relative proportion of ammonium chloride can be employed.—No. 2633. February 18th, 1890. 4*d*.

PRODUCTION OF CAUSTIC SODA AND CAUSTIC POTASH.—*J. C. Richardson, London, & T. J. Holland, Ivymeath, Snodland, Kent.*—The invention relates to the electrolytic production of caustic soda, caustic potash, and other productions of their salts. The inventors here dispense with the use of porous partitions in apparatus for the above purpose by the use of oxide of copper (CuO) placed next the cathode at or near which the caustic soda is formed. The mode of employing the oxide of copper is as follows:—In a suitable shallow tank containing a solution of common salt, the cathode is placed near the bottom, and is in the form of iron or copper gauze on which is placed the oxide of copper. At a suitable distance above this is placed the anode, formed of hard carbon rods or other chlorine resisting electrode. The action is as follows:—Upon the passage of an electric current the chlorine is set free near the anode and escapes out of the liquid, first charging the stratum of liquid above the lowest portion of the anode. At the cathode caustic soda is formed and concentrates at the bottom of the tank; the hydrogen in its nascent state combines with the oxygen contained in the oxide of copper. If instead of a caustic liquid and chlorine a hypochlorite be desired, as hypochlorate of soda, the position of the electrodes is reversed. Claims: In the electrical decomposition of salts of alkali or alkali earths in solution the employment of oxide of copper as and for the purpose described.—No. 2296. February 12th, 1890. 8*d*.

MISCELLANEOUS.

ENGINE PACKING.—*R. H. Attwater, Preston, Lancashire.*—The packing consists of non-corrosive soft metal wire and asbestos yarn intimately twisted together, which is then firmly plaited over and around a number of cores or cushions of flax which have been previously thoroughly lubricated with a non-combustible lubricant. Where great elasticity is required strips of indiarubber may be substituted for the flax yarn or four cores of flax and one of indiarubber may be used. Claim: The combination engine packing having central cores or cushions as and for the purpose herein set forth.—No. 19604. December 2nd, 1890. 4*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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MILLING CUTTER AND TWIST DRILL MACHINERY.

CONSTRUCTED BY MESSRS. HULSE & CO., ORDSAL WORKS, MANCHESTER.

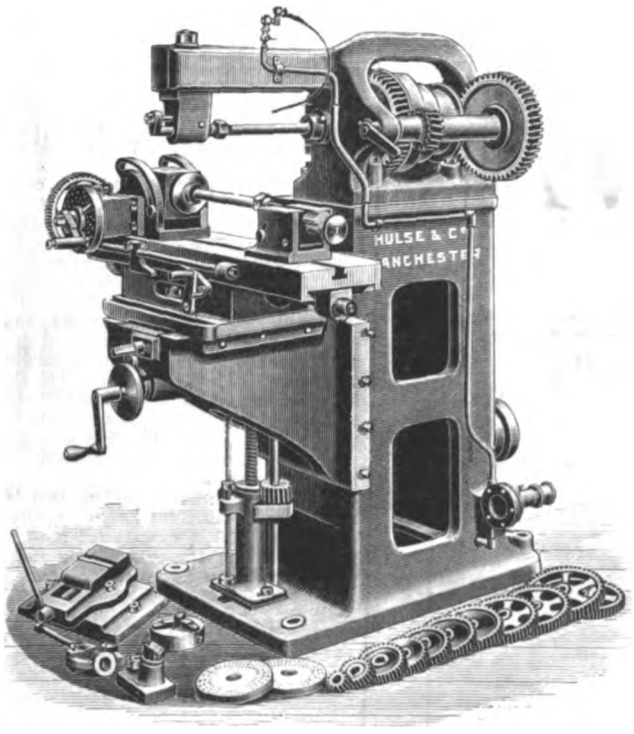


FIG. 1.

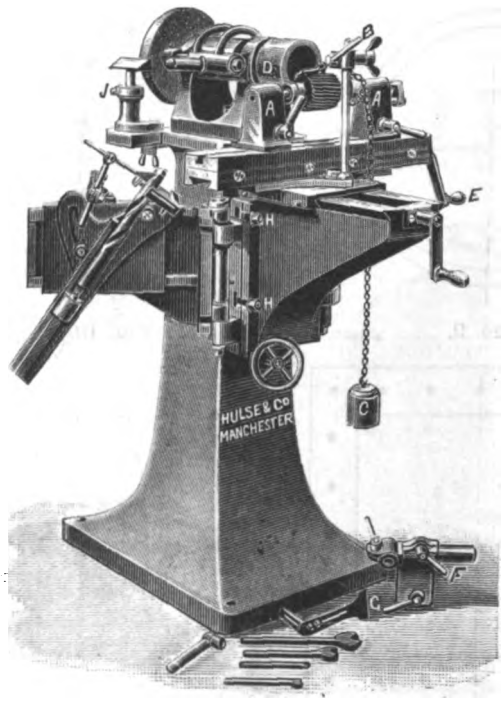


FIG. 2.

MILLING CUTTER AND TWIST DRILL MACHINERY.

WE illustrate above in Figs. 1 and 2 milling and grinding machines for making cutters and twist drills, designed and constructed by Messrs. Hulse & Co., Ordsal Works, Manchester. The milling machine (Fig. 1) is constructed with a strong hollow stand, in which there is provision for the storage of loose tools and lubricant. The headstock has a four-speed cone and is double geared, all the wheel teeth being machine cut. There is an overhanging arm cast solid with the mandrel frame, in order to afford steadiness in working. The table has vertical, longitudinal, transverse, and swivel slides, is strongly made, and is fitted with a universal dividing headstock which can be set to any angle between the horizontal and vertical. Two movable headstocks are provided to work with the dividing headstock, one of the ordinary type, and the other with a triangularly shaped swivel spindle to suit twist drill work of small diameter. The self-acting traverse is obtained without the use of universal joints common in the American type of machine, these being substituted by worm and mitre gearing, driven from the main spindle through cone pulleys. An automatic stop motion is also fitted. For spiral work the feed screw rotates the spindle of the dividing headstock during the traverse of the table, the angle of the spiral being determined by change wheels between the two spindles. The machine, as illustrated, is of medium size, and the table has a transverse movement of 21in., and a longitudinal traverse of 7in.

The machine used for sharpening cutters is illustrated in Fig. 2. The apparatus for cutters is hinged on one side of the machine and that for twist drills on the other, so that each can be used when required. For cutter grinding the cutters are placed on an arbor between the centres A A and held against the guide finger B by the chain and suspended weight C. They are ground by a face emery disc D, which, being large in diameter, does not wear perceptibly in going round a cutter, and has the advantage of producing a straight "back-off" instead of the curved one arising from peripheral grinding. Cutters with teeth to be ground on their faces are carried by the universal headstock F and held in position by the finger G. For twist drill work the requisite clearance behind the lips is obtained by the action of the large emery discs and rests J at the back of the machine, one operation only being required. The drill is then placed with its shank end in the small headstock carried on the radial bracket, and its upper end supported by a semi-circular recess in a rectangular plate, a set of the latter being furnished. The bracket is adjustable radially, and the guide-finger holds alternately the lips in position. The machine is very rigid, and can deal with cutters up to 8in. diameter and 12in. long, and twist drills from $\frac{1}{4}$in. to 3in. diameter.

THE HULL AND DISTRICT INSTITUTION OF ENGINEERS.

THE members of this Institution held a meeting on the 10th inst., the President, Mr. C. F. Amos, being in the chair, when an interesting paper was contributed by Mr. J. Brackenbury (Messrs. Amos & Smith's), on "Pumps and Air Vessels." In the paper the author referred to various types of pumps in common use, and gave the respective merits and advantages of different types. The delivery rate from single-acting, double-acting, three-throw, and four-throw pumps was shown by diagrams, which were based upon the assumption that the pumps were actuated by a uniformly rotating shaft. The mean delivery being taken as 100, single-acting pumps had a maximum of 314 and a minimum of 0; double-acting pumps, a maximum of 157 and a minimum of 0; three-throw pumps, a maximum of 104 and a minimum of 90·5; four-throw pumps, a maximum of 111 and a minimum of 78. The author showed how the irregularities of delivery could be minimised by the use of air vessels, which in any particular case would confine the variations between certain limits; and also how the correct capacity of air vessels depended on the pressure, the type of pump or pumps, and the variation of pressure which it was intended should exist. General formulæ and diagrams for pumps and air vessels were given and explained. Several applications of the formulæ to air vessels which had come under the author's observation were also given. The case of feed pumps on engines was specially treated, and the general conclusion arrived at was that feed pumps should be independent of the engine, and be of the three-throw or four-throw type, if a thoroughly reliable working result was desired.

A communication from Mr. J. C. Amos was read, which described an ingenious automatic arrangement for keeping air vessels fully charged with air, and which is in successful use at several large waterworks in the country. The writer further showed the necessity of fixing air vessels on long mains, to take up shocks, and thus prevent breakages.

An interesting discussion followed the reading of the paper. At the next meeting of the Institution a paper on "Refrigerating Machinery" will be contributed by Mr. J. C. Amos.

THE ORDNANCE SURVEY.

THE paper recently read by Sir Charles Wilson before the Society of Arts, on the "Methods and Processes of the Ordnance Survey," gives a considerable number of interesting details concerning a matter to which we directed the attention of our readers in our issue of the 30th January, and which will well repay careful study on the part of those interested in the matter. It is just a century ago since a trigonometrical survey of the country was ordered for the purpose of producing a military map, and six years later it was decided to publish a general map of the kingdom, founded upon a minute survey. The first sheet of this map was on a scale of 1in. to a mile, and was published on the 1st of January, 1801. In 1824 the survey was partially suspended in order that Ireland might be surveyed on a scale of 6in. to a mile, for a general land survey. In 1840, the survey of Ireland being almost completed, it was decided to continue the survey of Great Britain on the 6in. scale instead of the 1in. scale, and this arrangement was carried out until 1851, when there commenced a Parliamentary struggle, which has not inaptly been called the "battle of the scales," and during the twelve following years the subject was discussed by a Royal Commission and three Select Committees of the House of Commons. During the progress of the battle a large sum of money was absolutely wasted. Finally, in 1863, it was definitely arranged that the undermentioned plans and maps were to be published:—(1) Town maps, on a scale of $\frac{1}{500}$; (2) parish plans, on a scale of $\frac{1}{2500}$; (3) county maps, on a scale of $\frac{1}{10560}$; (4) a topographical map, on a scale of $\frac{1}{633600}$; (5) a map of the United Kingdom, on a scale of four miles to the inch; (6) map of the United Kingdom, on the scale of ten miles to the inch. Since 1863, the only changes of consequence that have taken place are:—The authorisation, in 1872, of a new 1in. map of England and Wales, based upon the cadastral survey; the issue of authority to revise the maps of Great Britain in 1886; and the order issued in 1887 to publish Ireland on the $\frac{1}{2500}$ scale.

Sir Charles Wilson gave a most interesting account of the methods and processes of the Ordnance Survey, but for this we must refer our readers to the paper, which will be found to be of great value not only to students of engineering, but also of interest to general readers. Our present object is chiefly to direct attention to the subject of our former notice of the survey—that is, the necessity for revision. Sir Charles admits that the revision of the survey has unfortunately fallen very much in arrear, so much so, in fact, that in many places revision means a re-survey. The necessity for revision has frequently been pointed out by the officers who have had charge of the survey; but it was not authorised until December, 1886, and since that date the Department has been fully occupied in placing Lancashire and Yorkshire on the large scale. The question of revision is purely one of money, and Sir Charles Wilson showed that the work is a much larger and more complicated one than is generally supposed, and involves a very large expenditure. In view of a periodical revision, the kingdom has been roughly divided into revision districts, and, as opportunity offers, the division offices are being moved into centres, which

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will probably be permanent. Arrangements are being made for preventing new work from falling into arrear, and the time taken to clear off the old arrears will depend entirely upon the annual grant to the survey.

Sir Charles Wilson pointed out that in the utilisation of the Ordnance Survey maps the Irish Government is quite twenty-five if not fifty years in advance of England. In Ireland townland boundaries and areas, as ascertained and shown upon the Ordnance Survey maps, are the legal boundaries and areas of the townlands, and so satisfactory is this arrangement found that disputes as to townland boundaries are unknown. The Irish Valuation Acts provide that the Ordnance Survey maps are to be used in ascertaining the areas of tenements, and a very good system of valuation is in force. In Ireland, moreover, all land is sold in the Land Judges' Court by the aid of maps prepared by the Ordnance Survey, and all maps on title deeds are drawn by the Department. In England the case is very different. There is a special Boundary Division, charged with the ascertainment of boundaries, which prepares elaborate reports and maps of all boundaries, and the area of every parcel is accurately computed. Yet the boundaries and areas on the Ordnance Survey maps are not legal, and the maps are rarely used for local assessment or administrative purposes. The nation deliberately undertook this elaborate survey on the ground that no private enterprise could accomplish it satisfactorily; and now, after spending millions on its production, England hesitates to make use of it in the manner intended by the able statesmen and scientific men upon whose recommendation it was authorised by the Government of the day. Sir Charles Wilson pointed out that the actual cost of production of the maps in England can compare favourably with foreign countries, and that the higher prices as compared with foreign maps arise from the heavy commission paid to the map agent. Our correspondent, Mr. Crook, informed us that the Committee of the British Association, appointed at Leeds, was taking steps to have these and other matters pressed upon the public and the Department. He feared, however, that little improvement will be made until public opinion is better instructed. He pointed out that it is from public interest alone that the impulse can come to move Parliament and the Government to make the necessary provision, without which the existing deficiencies of the work of the survey cannot be remedied. It is for this reason that we have again directed attention to the subject.

Railway Construction in India.—During the past year, from 1st April to the 15th of November, 255½ miles of new railway were opened for traffic in India. This includes 45 miles on the Bengal-Nagpore Railway, and 57 on the Tirhoot line, and 63 on the Southern Maratha Bellary-Kistna section.

EXPERIMENTS ON THE STRENGTH OF BOILERS.

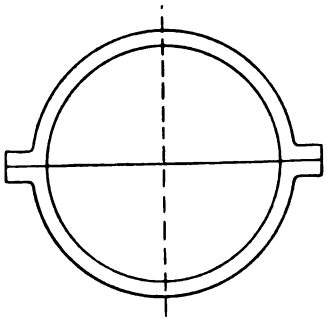


Fig. 9.

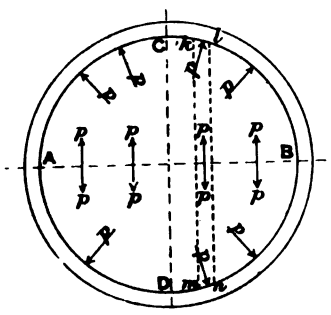


Fig. 10.

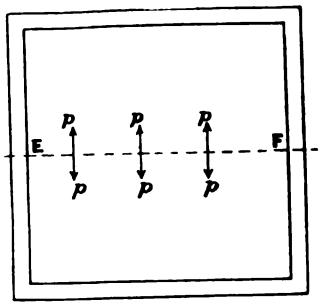


Fig. 11.

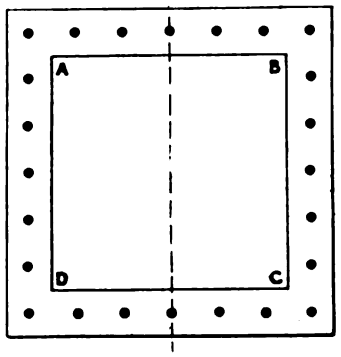


Fig. 12.

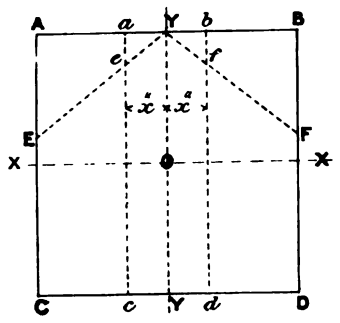


Fig. 13.

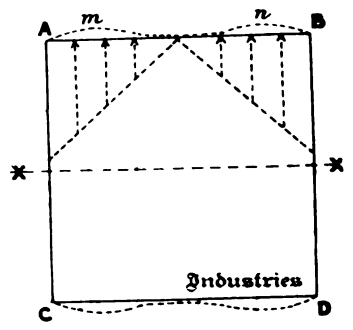


Fig. 14.

RESULTS OF EXPERIMENTS ON THE STRENGTH OF BOILERS.*

(*Concluded from page* 245.)

APPENDIX.

The basis of the author's former paper on this subject was the proposition that if a cylinder be made in two halves, bolted together at the centre, as in Figs. 9 and 12, the tensile strain on the bolts in the flanges, due to any pressure in the cylinder, is absolutely independent of the form of the vessel. It depends only on the area of ABCD and the pressure, and remains the same if one of the halves of the cylinder is removed and replaced by a flat plate, or by a half cylinder with its axis at right angles to the bottom half, or by any other shaped cover, provided that cover is strong enough to transmit the pressure on it to the bolts.

That this proposition is axiomatic did not then, and does not now, appear to him to be a question about which there can be any difference of opinion amongst engineers. Neither does it appear doubtful, that if the two halves of this vessel were joined together without flanges by the shell and end plate being continuous, that the strain on these plates must be the same in amount and distribution as on the bolts. To one saturated with the theory that the strength of boiler shells depends only on their resistance to circumferential tension, it was natural to infer, from an argument proving that in certain cases the circumferential tension is only a certain fraction of that formerly assumed, that in those cases the thickness of shell plate might be reduced in proportion to the diminished tension. The writer's experiments have proved the error of this inference which he had formerly drawn. He is now convinced that none of his models yielded primarily to circumferential tension, but to other strains not hitherto reckoned on, and in ways which he did not anticipate and cannot now calculate on. Whether this is so or not, there are some reasons for thinking that pressure within a boiler tends to stretch the end plates as well as the shell; and there are good reasons for suspecting that the contrary assumption is not true, or at least not the whole truth. He therefore proposes to trace the consequences of the first assumption as far as he can.

To simplify matters, suppose a cylinder of uniform strength throughout, without any joints, the end plates being of the same thickness as the shell plates. Ignoring the staying of end plates, and confining the attention to strains derived from the shell plate, let the cylinder be, say, 20in. long × 20in. diameter, subject to a pressure of 100lb. to the inch. Let it be further assumed that the thickness of the shell plate is sufficient to transmit any strains that may come upon it. Of course, it cannot be questioned that a uniform circumferential tension throughout the shell plate

$$= \text{radius} \times \text{pressure} = 10\text{in.} \times 100\text{lb.} = 1{,}000\text{lb.}$$

would exactly balance this pressure; but an essential condition of this solution is that the shell plate must be free to stretch uniformly throughout its length, which it is not so long as the ends offer any resistance.

If ACBD, Fig. 10, is the end plate of this cylinder, any pressure transmitted to it from the shell will be uniform all round the circumference, if this pressure is p lb. per inch acting radially, and if $klmn$ is a vertical strip in this plate, the vertical component of the radial pressures on the curves kl and mn will produce a tension $= p$ lb. per inch, tending to stretch the strip in the direction of its length; and in the same way the pressure on ACB and on BDA will produce a uniform tension $= p$ lb. per inch, tending to split the plate through AB, or to stretch the plate in the vertical direction. This is, of course, true for all other diameters.

Again if ABCD, Fig. 12, is a square, the strain on the bolts in the flange AB will be the same as the strain on the bolts in the flange BC. In the same way as EF (Fig. 11) = AB (Fig. 10) the section through the cylinder is a square, and the strain on the section of plate at EF will be the same in amount and distribution as the strain on the section of the end plate at AB. It has been proved that the strain on AB is a uniform tension $= p$ lb. per inch, therefore the strain on EF is also a uniform tension $= p$ lb. per inch. The pressure tending to rupture the cylinder, through AB and EF = 20″ × 20″ × 100lb. = 40,000. If this is resisted by a uniform tension $= p$ lb. per inch in the two sections of shell plate, and the sections of the two end plates, then—

$$p \times 2\,(20'' + 20'') = 40{,}000\text{lb.}, \text{ or } p = \frac{40{,}000}{80} = 500\text{lb.}$$

As all the central sections of a cylinder are alike, it may be said that, under the assumed conditions, 100lb. pressure within the cylinder will be balanced by a uniform circumferential tension in the shell plate of 500lb. per inch of length, and a uniform shearing strain of 500lb. per inch of circumference at the junction of shell with ends. Now, a circumferential tension of 500lb. per inch will exactly balance a pressure of 50lb. on the shell, because 50lb. × radius = 50lb. × 10in. = 500lb. The problem may therefore be divided into two parts. The shell, considered as an endless ring, sustains a pressure of 50lb. to the inch, and considered as a beam supported at the two ends, it also sustains a pressure of 50lb. to the inch. The first part presents no difficulty; the second part is not so simple, but still some steps towards its solution can be taken.

In the first place it is evident that in this beam the bending moment in any direction, say vertically upwards, due to pressure on the top half, is exactly balanced by an equal and opposite moment due to the pressure on the bottom half, and that all bending moments cancel each other. The next point to be considered is the distribution of shearing strains throughout the beam:—

If ABCD (Fig. 13) is the outline of the beam,
XOX being the axis of the cylinder,
YOY being the centre of the length,
ab cd is a ring 2*x*in. wide.

If a pressure of 50lb. per inch on this ring is transmitted to the two ends it must produce a strain $= 50 \times x$ on each side of the circumference on the two circles *ac* and *bd*. This pressure acts radially and tends to shear through the plate all round the circumference, and is resisted by the resistance to shearing of the plate. The shearing stress at the point A will be 50lb. × AY = 50lb. × 10in. = 500lb. per inch of circumference. If AE = 500lb. on any scale, the line EY will give the shearing stress at any point; thus at the point (*a*) the stress will be given by the length of the line *ae*. Thus if any pressure is transmitted to the ends of the beam, it will be transmitted as a shearing stress increasing uniformly from 0 at the centre to a maximum value at the ends. The same result would be obtained if we had commenced by assuming that the ends offered a resistance = 500lb. per inch, or it might be stated as a particular case of the general law of shearing strains in beams uniformly loaded.

The conclusion arrived at is, that a pressure of 100lb. per square inch in this cylinder will produce a uniform circumferential tension in shell = 500lb. per inch of length, and a shearing strain on the shell varying from 0 at the centre to 500lb. per inch of circumference at the two ends. The result of these strains on the cylinder is the next thing to consider. Suppose a tension of 500lb. per inch would stretch the shell plate $\frac{1}{n}$th part of its length, this would correspond to a uniform increase in diameter of shell $= \frac{1}{n}$th part of diameter. And, as previously stated, a stress of 500lb. per inch applied to the circumference of the end plates would produce a tension of 500lb. per inch in every diameter of the end plate, as the end plate is assumed to be the same strength as shell plate. This tension would stretch the end plate $\frac{1}{n}$th part of its diameter, and, consequently, as both shell and ends would be increased by the same amounts, the cylinder would remain a parallel cylinder, $\frac{1}{n}$th part greater in diameter than before pressure was put on.

Up till now it has been assumed that the pressure is such that any strain produced by it will not exceed the elastic limit of the resistance of the shell to that strain. But if the pressure is increased beyond this limit it will be seen that the distribution of strain will no longer continue as above. If there are any weak points in any structure, say a line of rivet holes in a boiler plate, the strain which would normally be distributed along the whole line is concentrated on the metal left between the holes. And in the same way if pressure within a cylinder is resisted both by the resistance to shearing and the resistance to tension of shell plate. If one of these resistances fails to sustain its normal share of the pressure, then the other will have to sustain more than its share.

Thus if ABCD (Fig. 14) is an outline of the cylinder, XX being the axis, the normal distribution of strain brings one-half of the total pressure on the two ends and the other half on the ring as tension. If, now, it were possible to shear through the connection between shell and end plates, without allowing the pressure to escape, then the whole of the pressure would come at once on the ring, and the pressure which was formerly producing shearing strain would then produce circumferential tension. Or, again, the pressure acting on AB might find it easier to bulge the cylinder at some distance from the ends than to shear through it at the ends. If the shearing stress at *m* and *n* were greater than the elastic limit of the resistance to shearing at these points, then they would begin to bulge rapidly, but they could not bulge without increasing the diameter of cylinder, and this would be resisted by the circumferential strength of plates, and as the resistance of the ends decreased the strain on shell as a ring would increase. If the pressure could be increased after the shell began to bulge near the ends the decreasing support from the ends and the increasing strain on the ring would cause the crest of these bulges

* Paper read by Mr. J. C. Spence before the North-East Coast Institution of Engineers and Shipbuilders, on the 20th ult.

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EXPERIMENTS ON THE STRENGTH OF BOILERS.

TABLE V.

TEST OF PLATES MADE BY THE STEEL COMPANY OF SCOTLAND AND USED IN THE MODELS.

Plate No.	Size of Sample.			Size of Fracture.				Initial Strain.		Breaking Strain.		Extension Per Cent. on 8in.	Shearing Strain.	Long or Cross.
	Breadth.	Thickness.	Area.	Breadth.	Thickness.	Area.	Per Cent.	Actual Tons.	Per Sq. In. Tons.	Actual Tons.	Per Sq. In. Tons.			
6,000	1·15	·18	·207	·95	·125	·1187	45	3·73	18·0	5·9	28·5	25	20·7	—
	,,	·195	·224	·89	·14	·1246	44	4·1	18·3	6·45	28·7	20·5	20·5	+
6,001	,,	·185	·213	·92	·105	·0966	54	3·8	17·8	5·95	27·9	24	20·32	—
	,,	·19	·219	1·00	·15	·150	31	3·8	17·3	6·3	28·7	23	20·4	+
6,002	,,	·17	·196	·94	·11	·1034	47	3·7	18·8	5·45	27·8	24·5	20·17	—
	—	·19	·219	·94	·145	·1363	37	4·1	18·7	6·2	28·3	20	20·27	+
							Average value =		18·15	—	28·3	—	20·41	

A pressure of 322lb. per square inch on the models would produce a strain of 18·15 tons per inch of plate in the joints, on endless ring hypothesis.
,, 503 ,, ,, 28·3 ,, ,,
,, 586 ,, ,, 18·15 on plate ,,
,, 915 ,, ,, 28·3 ,, ,,

to travel towards the centre, and give the barrel form which was assumed by Model No. 8.

In this connection it is instructive to notice that in Mr. Scott's experimental boiler the form shown in Fig. 7 may be observed getting gradually more pronounced as the pressure rises to 580lb., where the structure was evidently strained up to or beyond its elastic limit, and that the next increment of pressure destroyed this form by greatly increasing the bulge on centre course, a result probably due to the fact that the end courses were unable to transmit any more pressure to the ends, and therefore the additional pressure only increased the circumferential tension. Such a distribution of strain is consistent with all the results of these experiments. If the circumferential tension is much less than that ordinarily assumed, it can be easily seen how all these models stood a much greater pressure than can be accounted for on that assumption. It accounts for the form taken by Models Nos. 1 and 2. And if in No. 3 the plate had begun to yield in a similar manner at an equal distance from its ends, as in the longer models, it can be easily understood that, as the distance between these points would be very small, the additional strain brought on the short ring between these two humps, by the ends failing to transmit their proportion to the ends, would produce the barrel form that was produced. And, as in this case the pressure was applied very quickly, and the space for leakage was very small, it was possible to follow up the yielding ends until the joint at the centre burst, a result which could only be obtained where the supply of water was enormous in comparison with the size of vessel.

A strain of this character tending to increase the diameter of the ends more than the centre, if the resistance of the ends to increase of diameter was greater than the resistance of centre to contraction, might account for the contraction observed in Model No. 1. If Nos. 1 and 2 were destroyed by a strain normal to the circumference, this would account for the fact that the solid plates suffered as much as the weak joint, a fact not easily explained if circumferential tension were the strain that destroyed these models. The only fact not explained by this hypothesis is that these models yielded near and not at the ends. If the reason why these plates failed to transmit more than a certain strain to the ends, and the limit of their resistance were known, the problem would be solved.

In conclusion, the writer considers he is justified in assuming that, in any boiler working, as all boilers ought to work, at a pressure much below the elastic limit of the structure, the pressure is not balanced solely by circumferential tension in the shell plate, but is uniformly distributed over any central section through shell and ends. That this distribution of strain will continue until, as in these models, the elastic limit of resistance to shearing has been exceeded. After which, the proportion of pressure balanced by circumferential tension will be increased; but it can never be the sole resistance until the connection between shell and ends has been entirely destroyed.

THE MECHANICAL TREATMENT OF MOULDING SAND.*

LITERATURE on the art of founding, and on the materials employed in the moulding of iron, steel, and brass, is unfortunately scanty, owing no doubt partly to the lack of the same personal interest in the foundry that is taken in other departments of engineering works; and in a large number of instances this want of familiarity with foundry practice causes the production of castings to depend on the experience of individual workmen. If a "waster" casting be the result, it is invariably and not unnaturally attributed to accident, when it may be more probably due to want of skill; for even moulders themselves are not generally credited with a scientific knowledge of the principles on which their art depends. In large shops there is, of course, a competent foreman, who is responsible for the execution of orders in the most economical way; whereas in smaller foundries even important work, such as the preparation of cores and mixture of sand, is not infrequently carried out by unskilled workmen in a rather empiric manner. On the subject of the present paper there seems to be as much difference of opinion as there is diversity in practice; the writer, therefore, hopes discussion may help to settle debatable points. Some moulders place faith only in kneading or treading the few simple materials composing their facing sand, jealously guarding the preparation as a trade secret, and condemning all machine work; whilst others are equally emphatic in favour of the particular machine for grinding, riddling, or combing, to which they have been accustomed.

Sand.—Before describing the foundry processes in use it may be interesting to examine specimens of the ingredients generally incorporated. Fig. 1 is a view, considerably magnified, of sand found and much used in the West Riding of Yorkshire. In its natural state it will be noticed that a portion of the grains adhere together in clusters, varying in size from masses containing hundreds of sand grains to smaller groups of three or four grains, most of them small enough to pass through an ordinary fine riddle without disintegration. The form and size of the groups are very irregular, and many are covered with a fine scaly powder. Samples from the bulk show a preponderance of grain groups devoid of any uniformity. There are exactly the same appearances in fine Mansfield and other sands, though the presence of sharp crystals may be more frequent, and the abraded corners not so conspicuous. Fig. 2 represents new sand mixed with coal dust and burnt sand. The black spots dotted over the new grains are particles of coal which attach themselves in this manner, and when subjected to the heat of molten metal are converted into coke, often enveloping the sand grain with a crust, as shown in Figs. 3, 4, and 6. In none of the specimens examined was coal found in a separate loose state. Figs. 3 and 4 show samples of old sand very much like gas coke, with perhaps more of a metallic lustre. Fig. 5 shows the extent to which sand may be destroyed by burning or chemical action. Numbers of these friable hollow husks occur in a more or less broken condition, and are easily reduced to fine powder by concussion with other particles. If used again in sufficient quantity they will cake and cause metal to boil. Fig. 6 illustrates the formation of a shell round a sand grain; the shell may be cracked like a nut, exposing a kernel of clean sand. Coal dust, as commonly found, takes the form of angular splinters with laminated surfaces. When considerably magnified (Fig. 7) it appears only like a fine powder; the larger pieces are not present in quantities, if the coal has been properly ground. These materials, after incorporation, are generally coated with some other substance, plumbago being the most preferred; but it is difficult to give a correct impression of this article in a drawing. The flakes shown in Fig. 8 are taken from a surface polished with black lead, presenting to the naked eye merely its own peculiar lustre over a large area. When viewed in bulk it is fluffy, like soot; and the outlines of separate flakes are not well defined by the prevailing light and shade.

The chemical composition of sand will obviously affect the nature of the casting, no matter what treatment it undergoes. Stated generally, good sand is composed of 94 parts silica, 5 parts alumina, and traces of magnesia and oxide of iron. Sand containing much of the metallic oxides, especially lime, is to be avoided. Geographical position is the chief factor governing the selection of sand; and whether weak or strong, its deficiencies are made up for by the skill of the moulder. For this reason the same sand is often used for both heavy and light castings, the proportion of coal varying according to the nature of the casting. A common mixture of facing sand consists of six parts by weight of old sand, four of new sand, and one of coal dust. Floor sand requires only half the above proportions of new sand and coal dust to renew it. German founders adopt one part by measure of new sand to two of old sand; to which is added coal dust in the proportion of one-tenth of the bulk for large castings, and one-twentieth for small castings. A few founders mix street sweepings with the coal, in order to get porosity when the metal in the mould is likely to be a long time before setting. Plumbago is effective in preventing destruction of the sand; but owing to its refractory nature it must not be dusted on in such quantities as to close the pores and prevent free exit of the gases. Powdered French chalk, soapstone, and other substances are sometimes used for facing the mould; but next to plumbago, oak charcoal takes the best place, notwithstanding its liability to float occasionally and give a rough casting.

Hand Riddling and Treading.—For the treatment of sand in the moulding shop, the most primitive method is that of hand riddling and treading. Here the materials are roughly proportioned by volume, and riddled over an iron plate in a flat heap, where the mixture is trodden into a cake by stamping with the feet; it is turned over with the shovel, and the process repeated. There is no doubt that tough sand can be obtained in this manner, its toughness being usually tested by squeezing a handful into a ball and then breaking it; but the process is very slow and tedious, and consequently expensive if tried on a large scale. Other things being equal, the chief characteristics of a good moulding sand are toughness and porosity, qualities that depend on the manner of mixing as well as on uniform ramming; indeed, the same result would follow from want of attention to the one as to the other. For instance, it is well known that a mould rammed too tightly in one place and loosely in another will cause a swelled uneven surface on the casting. Similarly, if quantities of fat sand and poor sand occur alternately through improper mixture, the power of resisting the pressure of the molten metal is not equal, apart from the liability of causing the metal to scab, and a wavy rough surface will be the consequence. In America a moulder will often prepare his own sand by hand riddling and treading, rather than have it put through a machine. For the pneumatic method of moulding with compressed air and flexible pressure-plate, it is claimed that it gives sand of uniform density at all points equidistant from the pattern; yet in this system, as in hand moulding, the thorough mixture of the sand is of the first importance. The practice of piercing the mould with a vent rod will never give results equal to those realised with sand having its ingredients properly incorporated.

Power Riddling.—It is only a step from hand riddling to power riddling; and the latter has been made to approach as nearly as possible to the former by a succession of impulsive movements for the purpose of opening out the sand. Usually a power riddle, as shown in Fig. 10, consists of a set of transverse horizontal bars called breakers, placed over a coarse riddle, below which again is a fine riddle, the whole being set slightly sloping downwards towards the outer end. Lumps that do not pass through these roll off into a heap at the lower end. The frame carrying the bars and riddles is suspended from straps, and oscillated by a crank or cam. For quantity, this mode of mixing is a decided advance on the slow hand process, though it presents the objection of not opening out the groups of grains.

Roller Mill.—Another means of treating sand is the roller mill (Fig. 11), which is said to answer very well for hard sand containing stone. With soft sand the writer's experience has not been favourable to rolling, inasmuch as the castings made with sand so treated show a strong tendency to scab; but other founders state they do not find any serious disadvantage from its use. Viewed through a microscope the effect of slight pressure on sand would tend to confirm the writer's opinion; sand was placed between two slips of glass on the microscope stage, and a gentle sliding movement being given to the upper slip by the thumb of one hand, the rounded grains were seen to fly asunder into sharp crystalline forms, as depicted in Fig. 9. It is true that only those grains in immediate contact with the rollers would be thus violently acted upon, the rest forming a cushion; yet the former must be a considerable percentage of the whole quantity. If all the sand were actually crushed, the result would be the reverse of beneficial, for it would be too fine, and the fragments would form so close and dense a mass as to render it impervious to gas.

* Paper read before the Institution of Mechanical Engineers by Mr. Walter Bagshaw on the 30th January, 1891.

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THE MECHANICAL TREATMENT OF MOULDING SAND.



FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.



FIG. 5.



FIG. 6.



FIG. 7.



FIG. 8.



FIG. 9.

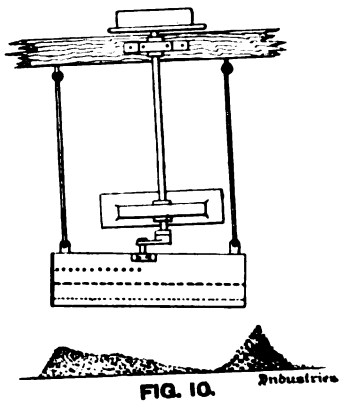


FIG. 10.

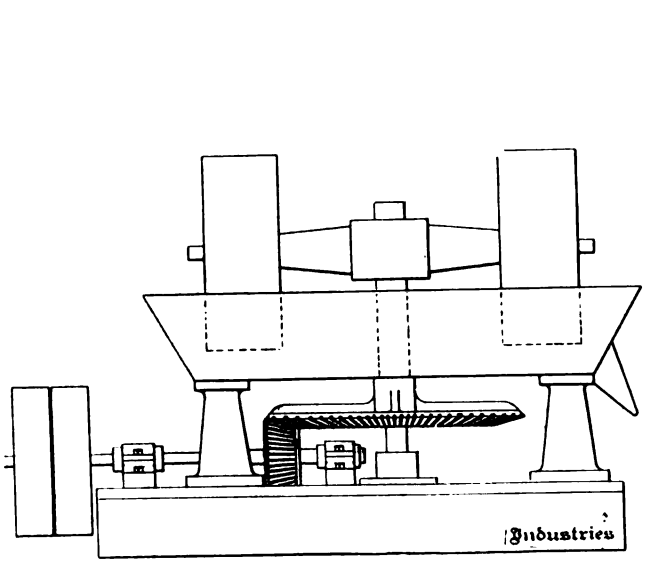


FIG. 11.

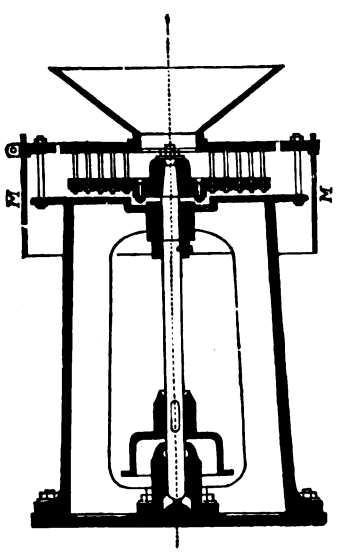


FIG. 12.

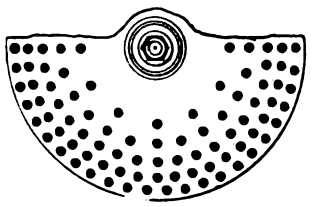


FIG. 13.

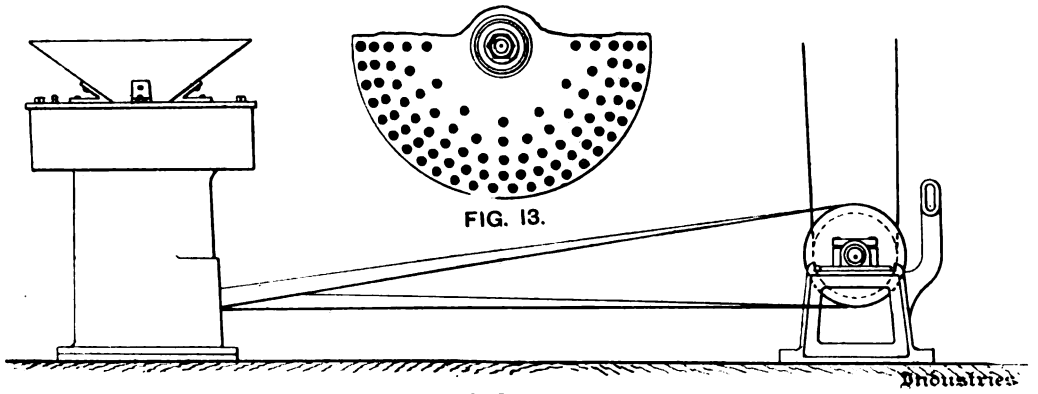


FIG. 14.

Centrifugal Mixer.—Schütze's centrifugal mixer, shown in Figs. 12 to 14, combines the advantages of all the other plans, besides giving a considerably greater output of sand. The particles of clay or groups of sand grains are so thoroughly disintegrated and mixed with the coal dust that the gas generated in the mould can get round every particle of sand, and so escape easily and equably, which is a desideratum for a fine casting. Agglomerated sand in large lumps, too big to pass through any riddle, comes out of the centrifugal mixer in a fine powdery condition along with the other materials; consequently no previous sifting is required. In ordinary work the materials are placed in layers, sandwich fashion, on the floor, in a convenient position for being shovelled into the hopper of the machine, through which they are passed as fast as two men can shovel them in. The actual quantity thus mixed is at the rate of 12 tons per hour, or a ton in five minutes. The action of the machine will be readily understood from the illustrations. The revolving table, shown in Fig. 12, is mounted on the top of a vertical spindle, and carries on its upper face a number of vertical pins or beaters, fixed alternately in a series of concentric circles, Fig. 13. The table is driven by a 3in. belt (Fig. 14) at the rate of 1,200 revolutions per minute. The cover of the table has a hinge for turning it up in order to allow pieces of metal or other foreign substances to be readily taken out, which can be done at any time in only a few minutes. Falling upon the centre of the table from the hopper above, the sand is projected at a great speed from one row of pins to the next, until every part has been combed out. Round the outside of the table an indiarubber shield guides the sand into a circular heap after it has been whirled from the table. Moulds made with riddled sand and with sand mixed by this centrifugal machine—one half of the mould being made with each kind—certainly induce a preference for the machine mixing, after examination of the skin on the casting. Moreover with the machine one man can do the work of several in the preparation of the sand, thus securing economy in time and wages. This machine was first seen by the writer when in Germany, where there are 400 now at work; and he was so much struck with its simplicity and efficiency that he ordered one for his own works, and found the result of its adoption to be a great saving in wages and better work. The prejudice, however, in favour of existing methods is so great that few other works in England have as yet ventured to adopt it. In response to inquiries concerning the cost of mixing sand by hand labour and by machine, only two firms out of twenty applied to could give any estimate. Longer life of the sand is ensured by the complete intermixing of the materials; the reason for this may be seen in the protecting coat or shell shown in Fig. 6. Moreover, a more even surface must result from the fact that, while the clay in the sand contracts under heat, the coal expands.

Toughness of Sand.—In order to test the relative toughness, sand mixed in various ways was pressed under a uniform load into bars 1in. square and about 12in. long, and each bar was made to project further and further over the edge of a table until its end broke off by its own weight. Old sand from the shop floor had very irregular cohesion, breaking at all lengths of projection from ¼in. to 1¼in. New sand in its natural state held together until an overhang of 2¾in. was reached. A mixture of old sand, new sand, and coal dust—

mixed under rollers,	broke at 2in.	to 2¼in.	of overhang;
,, in the centrifugal machine	,, 2in.	,, 2¼in.	,,
,, through a riddle	,, 1¾in.	,, 2¼in.	,,

showing as a mean of the tests only slight differences between the last three methods, but in favour of machine work. In many instances the fractures were most uneven, so that minute measurements were not taken. Tests for porosity were also made by putting the various sands into a tube, and forcing air through. These, however, have no practical value, because the conditions when in contact with molten metal are quite different.

Working Expenses.—Although the centrifugal machine will actually mix twelve tons per hour, it is not assumed that this quantity would be passed through it continuously; therefore a moderate estimate of only thirty tons per day is taken in the following data. The power will of course vary with the work. No dynamometrical test has yet been made with the machine working to its full capacity; the power is calculated from the belt, and a belt of an inch width running on the fast pulley will suffice. A machine in Devonport Dockyard takes one horse-power when mixing two tons per hour, or about half the power allowed in the following estimate:—

	s.	d.
One labourer for 9 hours	4	0
Three horse-power for 9 hours	1	1½
Depreciation 10 per cent. on £33 for 300 working days per year		2½
Repairs 5 per cent.		1½
Interest 5 per cent.		1½
Total per day	5	6½

The cost per ton is therefore nearly twopence. Messrs. Marshall, Sons, & Co., Gainsborough, have three men employed on one machine to mix sand for 150 moulders and 14 moulding machines; but eventually their system will reduce this to one man's work. Other firms find one man working 9 hours per day can serve 60 moulders.

Equivalent Hand Labour, &c.—The average output in riddling and treading sand is 4 cwt. per hour per man, which with wages at 5d. per hour gives 2s. 1d. as the cost per ton, or twelve times more than by the centrifugal machine. As no exact cost of mixing sand by other systems at present in use could be ascertained, no allowance is made for power, depreciation, and repairs; for wages only the cost of mixing by power riddling amounts to 1s. 8d. per ton, and by rollers to 1s.

Durability.—After two years' working of the centrifugal mixer no expense of any kind has yet been incurred for repairs. The working parts are so few that the cost of maintenance leaves nothing to be desired.

THE CHANNEL TUBULAR RAILWAY.

WRITING to the *Times* on this scheme on the 11th inst., Sir E. J. Reed remarks:—"In conformity with a courteous intimation which I received from the Secretary of State for War at the end of last week, I find in to-day's 'Votes and Proceedings' of the House of Commons notice of his intention to move that my Bill for sanctioning the construction of this railway be read six months hence. I am less concerned at this notice than might be supposed, because, although I thought it my duty to submit my plans to the War Office, to which the Board of Trade would probably make reference, my tubular railway (unlike the tunnel) really is not a matter of direct concern to the War Department, because it would devolve upon the Navy, and not upon the Army, to prevent the use of the railway by a hostile force. Hitherto the Board of Admiralty have not expressed any opinion upon my system, and it was only yesterday that I had the opportunity of going over the plans with the naval authories. I am hoping also to have a further interview with the Board of Trade. It will be my desire to meet the scruples—for I can hardly believe in the existence of more than scruples—of the War Office if

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THE "PYROS" FEED-WATER HEATER AND CIRCULATOR.

CONSTRUCTED BY MESSRS. A. W. ROBERTSON & CO., ENGINEERS, LONDON, E.

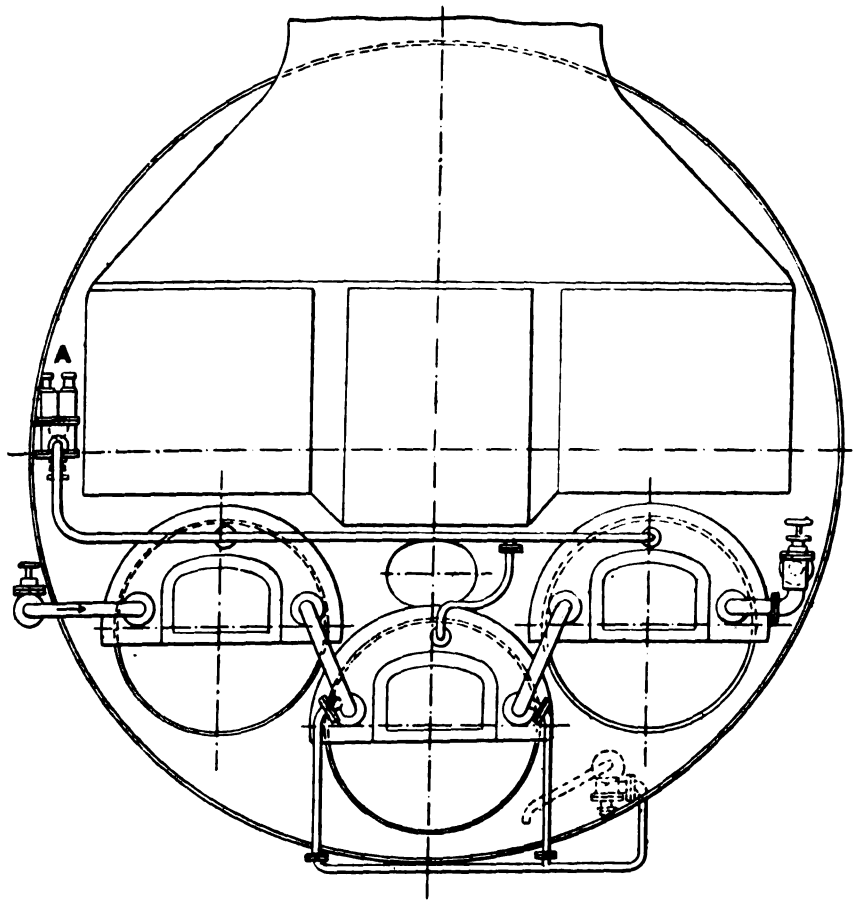


FIG. 1.—FRONT ELEVATION.

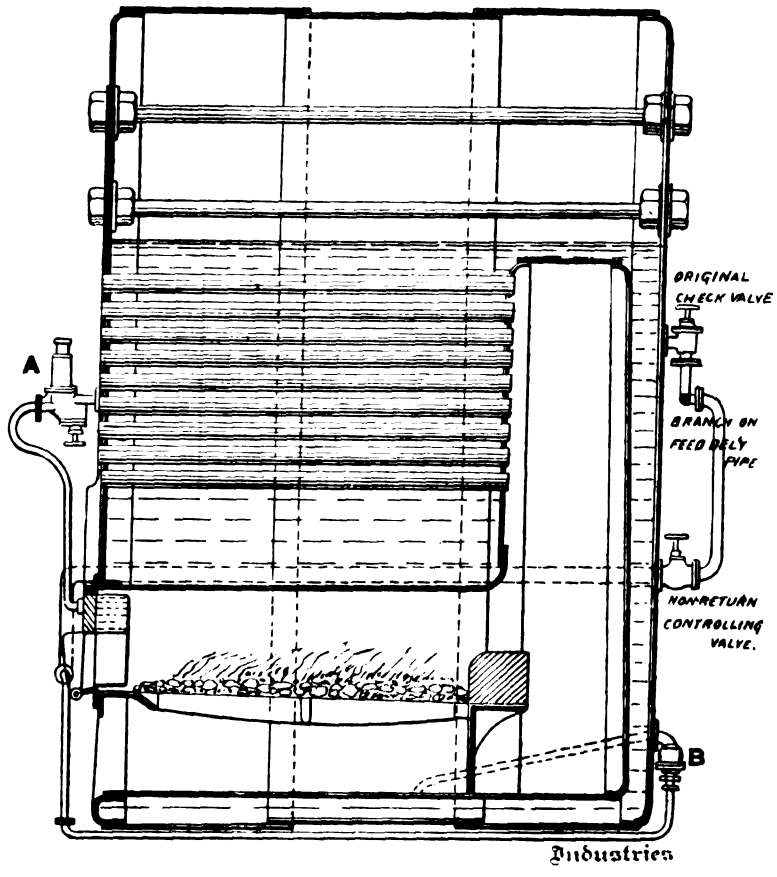


FIG. 2.—SECTIONAL ELEVATION.

possible, and to this end I shall be willing, if desired, to postpone the second reading of my Bill in the House of Commons at least until after Easter; but, knowing as I well do that many members of the House who always oppose the tunnel are quite ready to vote for my Bill—my scheme in their estimation, as well as in my own, affording the country abundant guarantees against the military abuse of the railway—I shall have carefully to consider whether I should do right in refusing the House an early opportunity of pronouncing its judgment by making a longer postponement. I must be allowed to say that I feel glad to know that it is only from the War Office at present that the Government opposition comes, for the War Office obviously are not entitled to anything like a decisive voice in this matter. Every inch of the twenty odd miles of this railway will be exposed to naval attack should an enemy dare to attempt to make use of it, and for that reason it is obvious that the voice of one or two military officials at Pall Mall or the Horse Guards cannot alone debar the country—may I not say the Empire, or even the world?—from some readier, pleasanter, safer, and less disgraceful means of communication between England and the rest of the world than that which the Channel has offered since Monday last. I cannot but think that your columns of to-day supply eloquent commentaries upon Mr. Stanhope's opposition to my tubular railway. Under the heading, 'Great Gale and Snowstorm,' on page 11 of the *Times* of to-day, vivid descriptions are given of the perils and miseries of those who have attempted this week to get to or from England; the smashing up of the mail steamer is no less vividly portrayed, and this evening we are told that a very strong gale is still blowing at Dover and Folkestone, and that the Channel is 'boisterous and strewn with wreckage.' I have very good reason for believing that, although this state of things and much worse would be submitted to by passengers and the public rather than that any real danger to the country should be incurred, it is a state of things which will not be endured when it is understood that the opposition to a safe and commodious railway is based upon mere voiceless or inarticulate prejudice, or, still worse, upon fears which are purely imaginary, and which people can hardly discuss without a sense of humiliation. My proposed railway offers no secret subterranean and profoundly inaccessible road into this country. It is a way that no regiment could traverse if any British man-of-war, even the smallest, were to say nay, and it is this fact which makes me so confident of speedy success in the enterprise that I shall do all I can to make it easy for the Government and Parliament to treat it fairly and reasonably. Hence my readiness to delay the second reading still longer if that appears desirable."

THE "PYROS" FEED-WATER HEATER AND CIRCULATOR.

THE importance of maintaining at a uniform temperature the shell of a steam boiler has long been fully recognised, and an effectual method of accomplishing this is to employ some means to keep the water in the boiler in constant circulation while getting up steam. The accompanying illustrations show in Figs. 1 and 2 a

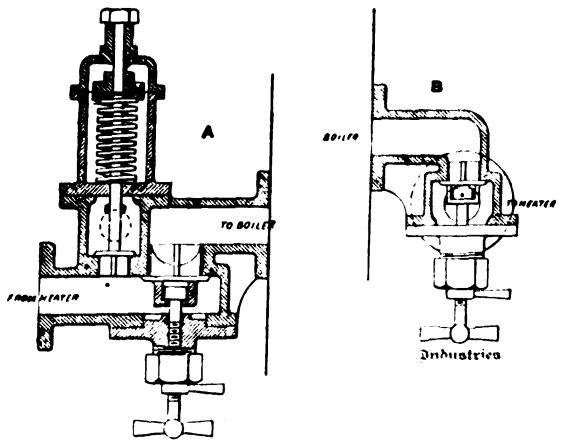


FIG. 3.

front elevation and side sectional elevation of one of the boilers of the s.s. "Cardiganshire," attached to which is an apparatus for circulating the water in the boiler and heating the feed-water prior to its entry, invented by Mr. C. E. Hudson, and called the "Pyros" feed-water heater and circulator. In Fig. 3 is shown a section of the valves marked A B in Figs. 1 and 2. The "Pyros" arrangement simply involves the removal of the furnace fronts and substituting for them heaters of iron or steel of suitable strength for the working pressure of the boiler. These heaters are constructed of a depth equal to the dead plate, and do not interfere in any way with the grate surface. They are fed with water from the bottom or any other portion of the boiler where the circulation is sluggish. The radiant heat from the fires impinges on the back of these heaters, and raises the temperature of the water contained therein. This decreases its density, and causes it to rise through suitable piping and the valve A into the boiler at about the working water level. When the water in the boiler has attained a unifom temperature the circulation ceases, and the heaters then become of use as small auxiliary boilers. It will thus be seen that the action of the apparatus is automatic, and to heat the feed water it is merely necessary to connect the feed valve to one of the heaters. Among the advantages claimed for this apparatus are that in steamships the temperature of the stokeholes is materially decreased, and that the renewals of fire-doors and baffle-plates are reduced to a minimum. We are informed that the apparatus has been at work for a considerable time on the "Cardiganshire," which is of 3,700 tons gross weight, and that from comparisons made with the coal returns of previous voyages a saving of 7 per cent. has resulted. Messrs. A. W. Robertson & Co., engineers and shipbuilders, of Custom House Works, Victoria Docks, London, E., are the makers of this apparatus.

THE CAUSES OF IGNITION OF FIREDAMP.

THE Prussian Firedamp Commission, in its general report, has laid down some general principles which it would be well for us to carefully consider in this country. One of its most important conclusions is to the effect that the use of gunpowder and other slow explosives should be forbidden in fiery mines, and that the use of dynamite and of other explosives should be tolerated, provided that the proportion of firedamp does not pass beyond a danger limit easy to recognise by the aid of a safety lamp. Amongst the rapid explosives, dynamite-guhr appears to be the least secure against inflammation of firedamp and coaldust. Compressed powder, recommended by the French Commission, is highly dangerous in the presence of firedamp. Schultze's powder, of great exploding power, was found to be harmless in the presence of firedamp and coaldust, but inferior qualities do not yield such satisfactory results. Securite and carbonite are both spoken of very favourably by Herr Hasslacher.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 17th March, 1891.

The Iron Market.—Last week the iron market continued very firm at about the same prices as during the previous week. Some orders were given, but there is not as yet a sufficient demand to cause quotations to rise, although fuel was as expensive as formerly. The prices established by the Paris syndicate for the week were as follow:—Best bars, 128s. 6d., and joists, 136s. 6d. per ton. The commercial prices were, for bars 124s., and for joists 132s. 6d. As stated in our last report of the French market, many of the larger contracts lately given out, such as the Cosne and the Briare bridges, which are in steel, have given occupation to steel works, whilst the iron mills are still slack, but affairs are gradually improving for the latter with the recommencement of the building industry. The low state of the English, German, and Belgian markets has also a sinister influence on the French iron trade. A general meeting of rolling-mill owners was held at Paris recently, at which it was proposed to form a committee to control the output of rolling mills and to arrange for an exportation fund. It was also unanimously agreed to raise the tariff of rolled iron and steel 8s. per ton. The latest reports from the Meurthe-et-Moselle district show a decided improvement in the state of the metal trade. The Pont-à-Mousson works have received an order for 16,000 metres of iron pipes of 1 metre diameter, to be delivered within thirteen months. In the North the market is firm without any improvement in prices, and the same may be said of the Loire-et-Rhône district, where the military establishments at Bourges are very busy. In the Haute-Marne orders are beginning to flow in; the wire makers here are especially well occupied. The administration of the "Postes et Télégraphes" has given an order to the Sommevoire works for about 100 tons of castings. In the Gironde the Society of Dyle et Bacalan have taken an order, from the General Society for working the Dutch railways, for rolling stock to the amount of nearly 1,000,000fr.

Coal.—There was no change whatever in the price of coal last week. The increased consumption of fuel by manufactories quite counterbalanced the diminishing demand for domestic purposes. At least two-thirds of the total produce of the French mines has already been bought for future delivery this year. A contract has been entered into by one company to deliver 30,000 tons at Hamburg at 16fr. 25c. per ton.

Copper, Tin, Zinc, and Lead.—Nearly every description of copper fell in price last week. Best Chilian bars were quoted at £57 15s., and ordinary Chilian bars at £55 15s. per ton. Cornwall tin declined 10s. per ton. The other marks showed a slight improvement on the prices of the previous week—viz., Banca, £99 7s. 6d.; Billiton, £96 18s.; and Detroit, £95 10s. per ton. The zinc market was weak, and prices retrogaded to the quotations of three weeks ago. Lead remained firm, without any change in price.

Statistics of the Iron Trade.—The following statistics, taken from documents collected by the Minister of Public Works, gives a comparative view of the output of iron in the Meurthe-et-Moselle, Meuse, and Vosges districts for the past two years:—

		1889. Tons.		1890. Tons.
Meurthe-et-Moselle	Cast iron	943,456	...	1,083,705
"	Wrought iron...	40,734	...	37,838
"	Steel	43,360	...	61,988
Meuse	Cast iron	3,591	...	506
"	Wrought iron...	8,757	...	7,006
"	Steel	8,605	...	7,503
Vosges	Wrought iron...	120	...	210
"	Steel	1,680	...	1,660

BERLIN, 16th March, 1891.

The Metal Trades' Employers' Association.—This association, which held its annual meeting last week, was formed about two years ago as a protection against strikes and unfair demands on the part of the workmen. The threatened demonstration for the 1st May last year caused many firms to join the association, and the unanimous resolution not to grant a holiday on the 1st of May effectually broke the resistance of the men, and only a few moulders absented themselves on that day. Most of these were replaced by other workmen, or locked out for a considerable period, and since then there has been no disturbance of any importance in the metal trades in Berlin. On the 1st of July, 1890, the association founded a central labour agency in Berlin, and all persons desirous of being employed in any of the workshops connected with the association have to apply at the central agency, where their antecedents are carefully examined. In this way leaders of strikes and malcontents are kept away from the workshops of the association.

Electric Lighting at Potsdam.—Potsdam is to be lighted with electricity. The German Continental Gas Company, of Dessau, have purchased large premises in Potsdam for the purpose of erecting a central station.

Locomotives.—It is stated that the Saxon Machine Works of Chemnitz have received an order for the supply of fifty-one locomotives for Java. These works have orders which will occupy them for some considerable time.

Sea Canal.—It has been decided to abandon the projected Berlin-Hamburg Canal, and to promote as much as possible the Berlin-Stettin scheme, which is much shorter and less expensive. The canal is to have a depth of about 24ft. 7in. Upon the completion of the canal from the North Sea to the Baltic, a canal for sea ships from Stettin to Berlin will be of great importance.

Thermo-Electric Battery.—Much interest was manifested in a paper read at a meeting of the "Verein zur Beförderung des Gewerbefleisses," by Mr. Gülcher, upon his experiments with regard to the direct production of electricity from heat. He exhibited his thermo-electric battery, with which he was able to produce an electric power equivalent to 1·08 per cent. of the heat consumed, and hopes to exhibit at Frankfort a battery which will give at least 5 per cent. net effect. He is of opinion that with an economical source of heat, his thermo-electric battery will even excel a dynamo machine. A German patent has been granted for these improvements, and a proof of the interest taken in his patent is the fact that the printed specifications are all sold. Mr. Gülcher has carried on his experiments at the works of Mr. Julius Pintsch, who is well known in connection with his lamps for buoys, lightships, and railway carriages.

The Production of Oxygen.—In a paper upon the production of oxygen, Dr. Elkan has stated that there is not the demand for it in Berlin as in London, because, for scenic effects, the electric light is used on a much more extensive scale in Berlin theatres.

VIENNA, 16th March, 1891.

The Iron Market.—The large decrease in the price of iron in the German market has not hitherto had any influence on the prices in Austria, chiefly by reason of the renewal of the syndicate. A decrease in prices must, however, ensue, as the consumption of iron is not large enough to prevent the accumulation of stocks. Makers of sheet iron are inclined to make concessions, but the prices of bar iron and of iron for constructive purposes are maintained by hopes of a prosperous building season. The regular state of trade maintained by the syndicate was interrupted a fortnight ago by the arrival of three waggons of German bar iron for a Prague manufactory, which had been ordered during the struggle between the German and Austrian works.—An important order for iron water pipes to the amount of 59,000fl. has been placed by the Vienna Municipality. Some orders have also been given in connection with the construction of railways. The Northern Railway is enlarging its Galician lines, and a new railway is to be made in Bosnia, which will connect the centre of that country with the frontier of Dalmatia.

The Coal Market.—The coal market continues animated. During the present month traffic has been very brisk, and large quantities of coal have been sent here. The Bohemian railways have been busily employed in forwarding the coals, which were intended both for home consumption and for export. Last month the Bustichrad railway forwarded 400,000 tons of coal, being 35,000 tons more than the amount forwarded during the previous month.

Electrical Engineering.—The Budapest Electric Railway Company has now been formed, the Count of Szapary being elected chairman. The capital of the company amounts to 3,000,000fl., which is divided into 30,000 shares of 100fl. each. The new company will take over the Budapest City Railway, which now belongs to Messrs. Siemens & Halske, and will enlarge it. This is the sister company of the General Austrian Electricity Company, which was formed a short time ago by Messrs. Siemens & Halske and the Anglo-Austrian Bank.—The International Electricity Company intends to make its provisional central station in Fiume a permanent installation. Up to the present time an output of 10,000 watts has been used for lighting purposes, and about 30,000 watts for the distribution of power. The distribution of power is effected by alternate current motors made by Messrs. Ganz & Co., in Budapest, and is used for the working of four elevators of 10 to 12 effective horse-power. The high tension current is reduced by transformers to a pressure of 50 volts, and the primaries and secondaries are connected together in parallel. Six elevators are to be worked by power supplied by the permanent central station, and more than 100 h.p. is already required for lighting purposes. The harbour authorities are the largest consumers, as they require light for all the piers and the ships lying at anchor.—The electric lighting installations in Austria-Hungary are continually increasing. There are at the present time 185,000 incandescent lamps and 4,000 arc lamps, which are supplied from 1,200 dynamos. Nearly one-third of the total amount is in Vienna, where there are 60,000 incandescent lamps and four central stations. New central stations for Larger Vienna are projected, but much will have to be done before the lighting of Vienna rivals that of London and Paris, with their eighteen and seventeen central stations. The International Compressed Air and Electricity Company has now received a concession, and will at once undertake the construction of a central station.

BRUSSELS, 17th March, 1891.

The Iron Market.—The condition of the iron market is suffering through the uncertain state of the coal market. After a short period, during which prospects seemed to improve, the situation has again become worse, and business is very slack. The state of trade is seriously affected by troubles caused by workmen, who see that wages must necessarily be lowered in the near future. The steel works have a sufficient number of orders to make their position less unsatisfactory than that of the rolling mills. The blast furnaces are feeling the effects of the crisis. The condition of the constructing shops is more favourable, and fine weather will probably increase their activity.

The Coal Market.—It is feared that the revival of trade which was beginning to show itself in the coal market will be adversely affected by recent agitation on the part of workmen. The effects of this agitation are already being felt, and are the more disastrous, as they happen at a time when the crisis which affected the iron market was subsiding by reason of the steadiness of the price of coal. The prospect of a renewed crisis causes sellers to be disinclined to make concessions, and bad news from the Ruhr district is already causing many orders to come here. The market is becoming firmer, and Belgian coal owners will reap some advantage from this circumstance. In the central district prices are especially firm, and in the other districts prices remain at 14fr. to 15fr. for furnace coal, 12fr. to 13fr. for steam coal, 11fr. to 12fr. for small coke, and 18fr. for best coke.

Launch of a Steamer.—Recently a large steamer, built by the Société Cockerill at their Hoboken yard, was successfully launched. The steamer, which is called "Le Prince Baudouin," has a length of 320ft. and a breadth of 40ft.

Glass Works.—A syndicate has been formed to control the sale of glass in all countries. Messrs. Morel & Co. are the only firm which has not joined the syndicate. In view of the present condition of the American glass trade, the formation of the syndicate should be advantageous for Belgian glass works.

Telephones.—An extension of the telephone system towards the north of France has been projected. A connection is to be made between the telephone lines of Lille-Roubaix and those of Tournai and Courtrai. The frequent correspondence between Belgian and French towns towards the frontier makes such a connection quite indispensable.

DÜSSELDORF, 17th March, 1891.

The Iron Market.—This market is quiet, and business is suffering in consequence of the high prices of fuel.

The Coal Market.—The opinion that no general strike of the coal miners will occur this spring gains more and more ground. In the past two years wages have been considerably increased, and the feeling that in the case of a general strike the miners would find against them not only the coalowners, but also the Government and public opinion, has made a deep impression on the bulk of the miners. The demand for all kinds of coal and coke continues to be a very strong one, but the fact that the tender of German coal for the Amsterdam gasworks has been beaten by an English offer has made a bad impression. The quantity required amounts to 81,000 tons, and it is feared that this diminution in the amount which in previous years has been shipped through the Ruhrort Harbour will sensibly affect the Rhine traffic. The fact has been registered on the Berlin Stock Exchange by a downward movement in most of the coal shares.

Desulphurising Process.—The steel works at Hoerde have introduced most successfully a new process for desulphurising pig iron, and most of the large steel works are applying for licences.

The Glass Industry.—The Gerreshein Glass Works, which have a yearly output of about 80 millions of bottles, have paid a dividend of 9 per cent. A Belgian company has just opened a large manufactory for making plate glass at Ratingen, near this town.

AMSTERDAM, 16th March, 1891.

Steamers.—Messrs. Meyer & Co., steamship owners and shipping agents at Amsterdam, the representatives of Holt's Company (Liverpool), whose project of starting a new line of steamers between Holland and the Dutch East Indies has been mentioned in a previous letter, will form a new steamship company for the purpose, which will take over whatever rights and contracts the former may acquire in the course of their present negotiations with the Home Government.

Co-operative Building at the Hague.—A committee has been formed at a public meeting, held at the Hague, for the purpose of founding a small company with the object of building dwellings for the working classes upon the co-operative system.

The Queenborough Route to the Continent.—The directors of the Zeeland Steamship Company at Flushing, whose boats have kept up the Channel service between Queenborough and Flushing with wonderful regularity during the recent storms, are fully alive to the necessity of increasing traffic facilities so as to cope with the severe competition of the Dover and Folkestone routes. The day service is again to be accelerated, and to be brought into closer connection with the continental fast trains. A new English guidebook, fully illustrated, is also to be issued shortly, showing the many advantages of the Flushing route. The Zeeland Company will also start a bi-weekly steamship service between Flushing and Hull, for merchandise in the first instance, and the service is afterwards to be extended to passengers, should occasion demand it.

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For that purpose, a new company is to be formed, called the Zeelandic Steamship Company, which will be under the same management as the Zeeland Steamship Company, and will acquire new steamers for the intended service.

Fiscal Union between Holland and her Indian Colonies.—The plan which existed to form a fiscal union between Holland and the Dutch Indian Empire has been abandoned for the present, the Dutch Indian Government intimating that such a union would involve serious losses to the Dutch Indian Treasury, which it could not well bear under present circumstances.

STOCKHOLM, 14th March, 1891.

New Industry in Sweden.—The chemical works of Mr. S. Barnekow, in Sweden, are about to be extended, so as also to comprise the manufacture of carbons for electric arc lamps and for dry cells. The works will be completed in the course of the summer, and will be fitted with the most approved machinery. It is intended to supply the export trade as well as the home market.

The Bollnäs Silver Mines.—The work at the new silver mines at Bollnäs is being steadily proceeded with. So far, the findings have only been of moderate quality, but it is expected that the ore will improve as the workings are carried deeper. A similar mine is to be found at Lenninge, but it has not been worked since the beginning of the century, when the work was discontinued for want of money.

Export of Charcoal.—It seems likely that charcoal will find a market for export. There are inquiries for large quantities for England, and the Swedish Export Society favours such export. It might, however, prove a dangerous policy to raise the price of this necessary commodity by creating an export trade, as it might place obstacles in the way of the production of iron, which is by no means too remunerative.

The Swedish-Norwegian Railway Company.—The sale of this company's property in Sweden, which consists of the railway from Lulea to Gellivara, with the harbour accommodation at Lulea, to the Swedish Government, has now been definitely settled.

New Curtain Manufactory.—The active movement in the textile industry continues, and a new company has been formed for the erection of a curtain manufactory in Malmö. The style of the new concern is the "Aktiebolaget Svenske Gardinfabriken."

The Gellivara Company.—This company has now been reconstructed, the Stockholm banks having been paid through the sale of the Munksund and the Pitea works. The anticipated collapse of the company has thus been averted, and their property will ultimately prove a valuable one, especially since the Swedish Government has bought the Gellivara-Lulea railway.

CHRISTIANIA, 14th March, 1891.

New Steamer.—The Moss Engineering Company has just secured a contract from Captain I. Henrichsen for the building of a new steamer for the Vestlandske Godsdampskibsselskab. The steamer is to be ready in September, and is intended for the Christiania and Bergen trade.

Difficult Submarine Work.—An interesting and somewhat difficult work has been done at Smörviken, where three water pipes have been laid down into the Mjösen lake. These pipes, of which one is a 10in. and the two others 5in. pipes, are intended to furnish the milk condensing factory at Toten with fresh and clean water. The pipes have been laid several metres below the bottom of the lake, which it was found necessary to lay dry at the place in question. Divers were employed in carrying out the work.

Raising of a Steamer.—The steamer "Egil," which foundered at Sandtorv, has been raised by the "Nordenfjeldske" Salvage Company. This company has, since its formation in 1871, raised fifty-five vessels, thirty-one of which were steamers.

COPENHAGEN, 14th March, 1891.

Railway Works at Elsinore.—The important railway works at Elsinore, which have been rendered necessary by the steamer ferry traffic, which is to be carried on between Elsinore and Helsingborg, are now approaching completion. One of the more interesting features is a viaduct across the Strandoei. This viaduct consists of one single granite arch 24ft. broad, and with a span of 75ft. The arch is very flat and thin, a result which has been made possible by the insertion of lead between the granite. The removal of the scaffolding took place a few days ago, and was a delicate operation. The scaffolding rested on about a hundred iron buckets filled with sand. In order to lower it an equal quantity of sand was let out of each bucket through holes at the bottom, and the arch gradually stood free of its scaffolding.

The Copenhagen Steam Tramways.—The steam tramways between Copenhagen and Kloenpenborg, a distance of about six miles, are by no means a lucrative undertaking. Last year shows a surplus of 1,972kr., the receipts being 186,188kr. and the expenses 184,216kr. This is, however, an improvement upon the previous year's balance sheet, which showed a loss of 36,885kr.

The Copenhagen Tramway Company.—The report for last year shows the receipts were 630,017kr., and the expenses 536,054kr., leaving profits of 93,963kr., which will give the shareholders a dividend of 10s. per share. The repairs of tramcars have amounted to 34,922kr., the permanent road has entailed an expenditure of 56,000kr., and the horses one of 338,992kr.

MADRID, 16th March, 1891.

Scrap Iron.—The development of the steel industry at Bilbao and Asturias is causing a large demand for scrap iron. The supply is not at present equal to the demand, and scrap iron is eagerly bought in the centre of the country for transport to Bilbao. This state of affairs has upset the scrap iron industry at Barcelona and Sevilla, as these works are now unable to obtain a supply of scrap iron from the small districts in the neighbourhood. The ore process or the new Adam's process must be introduced in Spain shortly, as the manufacture of steel is to be increased.

Siemens Improved Furnaces.—It seems likely that these furnaces will be introduced very largely in Spain. Arrangements have been made to use these furnaces both for heating and puddling, and some ironmasters are intending to apply them to the manufacture of steel.

The Death Rate of Madrid.—The returns for last year show that the death rate of the capital is now nearly 45 per 1,000. Much comment is being made on the unfavourable nature of these returns, but it seems unlikely that any definite action will be taken. The want of a proper system of sanitary engineering is largely responsible for the result, and it must be added that the cost of food in Madrid is very high, and that wages are not high in proportion.

Long Distance Telephones.—A plan is now being considered by the Spanish Government for the establishment of a complete system of long distance telephone lines, such as does not yet exist in any country. The scheme consists in putting Madrid into communication with the 49 provincial capitals. The central office will be at Madrid, and the provincial capitals will thus obtain communication with one another. It would seem advisable that the preliminary step of placing the larger town in connection with Madrid should first be adopted. Capitalists should hesitate before investing their money in a concern which may turn out to be unsuccessful like the tobacco monopoly. With reference to this scheme, it seems important that uniformity of time should be established throughout the country, so that appointments may be made at fixed hours between the inhabitants of distant towns.

ROME, 16th March, 1891.

International Exhibition of the Building Industries at Padua.—La Société d'Hygiène of the town and province of Padua, in Italy, is organisising an International Exhibition of the Building Industries, to be held during the present year. The object of the Exhibition is a humanitarian one—namely, to arrive at a system of perfect hygienic construction in buildings, and more especially in workmen's habitations. The Exhibition will be held during the months of May and June next.

Exhibition of Implements Used in Wine Production.—It is announced by the Italian Ministry of Agriculture that there will be an International Exhibition and trial of implements used in the production of wine at Portici, next September. Intending competitors can receive full particulars by applying to Mr. Guido Rossati, Regia Stazione Enotechnica Italiana, 31, Old Jewry, London, E.C.

The Production and Consumption of Fuel.—From recent returns issued by the Government, it appears that whilst in 1871 Italy produced 80,336 tons of lignite and imported 791,389 tons of coals from abroad, in 1888 the production of lignite was raised to 366,794 tons, and the importation of coals to 3,872,905 tons. In addition to the lignite the country also produced, in 1888, 30,000 tons of turf and 490,000 tons of bricks. The total quantity of fuel used in 1889 amounted to nearly 5,000,000 tons. Of this amount steam engines for industrial and agricultural purposes used 1,300,000 tons, or 26·44 per cent.; lime kilns, glass works, and foundries, 1,300,000 tons, or 26·44 per cent.; locomotives for railways and tramways, 750,000 tons, or 15·25 per cent.; gas and electric lighting, 850,000 tons, or 17·29 per cent.; shipping companies, 313,565 tons, or 6·38 per cent.; coal used for household purposes, 330,307 tons, or 6·71 per cent. It should be added that in Italy there are also many hydraulic engines, with a total output of 600,000 horse-power.

NEW YORK, 7th March, 1891.

Gas from Wood.—The Attleboro Gas Company has introduced in its works a Ramsdell apparatus for the manufacture of wood and oil gas. It is claimed that gas from wood is the most healthful produced by any process, and that it possesses a higher degree of illuminating power than any gas made. It is said that one cord of dry wood and 300 gallons of crude Lima oil will produce 60,000 to 80,000 cubic feet of gas, of 20 to 30 candle-power, with a residue of nearly two barrels of fine tar and and sixty-five bushels of merchantable charcoal. The gas is manufactured in retorts in from two to three hours. By this process, the gas, according to the *Manufacturers' Gazette*, can stand much colder weather without condensing or stratifying, being superheated afterward as near a fixed gas as coal gas. This gas is made in one operation, and only one fire is required to make a perfect fixed gas. The same retorts are used as in making coal gas, with a mixer and a superheater attached. The wood used is maple. When the gas has been extracted, the wood is carbonised, leaving a fine quality of charcoal. With the wood, Lima oil is used in the manufacture to produce the required candle-power. The patentee is Mr. George Ramsdell, who has been fifteen years in completing the process.

The East River Tunnel.—The East River Tunnel, from Atlantic Avenue, Brooklyn, to the foot of Whitehall Street, New York, will be commenced about the 1st of April. Most careful rock borings have been made, the plans are completed, and tenders are now being considered. Mr. Charles M. Jacobs, M.Am.Inst.C.E., is the chief engineer. This is a part of Mr. Austin Corbin's project for rapid transit in New York.

A New Station Indicator.—A new station indicator for railway carriages, which is intended as an improvement on the prevailing system of having the names of each station announced by the guard of the train, has been brought out by the Allison Company, of Montreal, Canada. The Allison indicator is very simple in construction, and is operated by the guard of the train. It has already been fitted with success to the first-class carriages running between Montreal and Toronto.

A New Pump.—The Deane Steam Pump Company, Holyoke, are putting on the market a new style of sinker pump. It is an outside packed plunger pump, designed to pump gritty or muddy water without injury to the mechanism. It has all the movable covers hinged, so that in opening the pump to pack it or adjust the valves the parts will remain attached to the pumps, thus precluding their getting lost or falling into the shaft. It has also an improved patent valve motion, which is very simple and positive in its action. The pump is arranged to be suspended from a derrick within the shaft, during the process of sinking the shaft. Several of these pumps have been sold to mines in Colorado, and are stated to be giving perfect satisfaction.

PHILADELPHIA, 6th March, 1891.

New Wire Plant.—The Western agent of Messrs. Washburn & Morn, the barbed-wire manufacturers of Massachusetts, have purchased for that company 800 acres of land adjoining the town of Waukegan, a few miles north of Chicago. As soon as the season opens that company intends to erect a large plant for carrying on their manufacturing business in the West.

St. Louis Improvements.—The new Merchants' Bridge Terminal Railroad Company has decided to erect a large depôt at a cost of nearly $500,000, and to make other improvements at a further cost of about $15,000,000. The depôt will have a frontage on Broadway, and will be 800ft. long. The ordinance providing for these improvements is now in the mayor's hands, and will be operative in a few days.

Technical Education.—A new manual training school was recently opened in Philadelphia, in which iron work has a prominent place. Adjoining the principal class-room is the iron work department. The furniture in this room consists of two rows of benches, with twenty-four vices, and beside each vice lies a complete set of tools. In one corner of the room is a forge for tempering tools and for forging. The only expense for each boy is the furnishing of two aprons and a set of mathematical instruments.

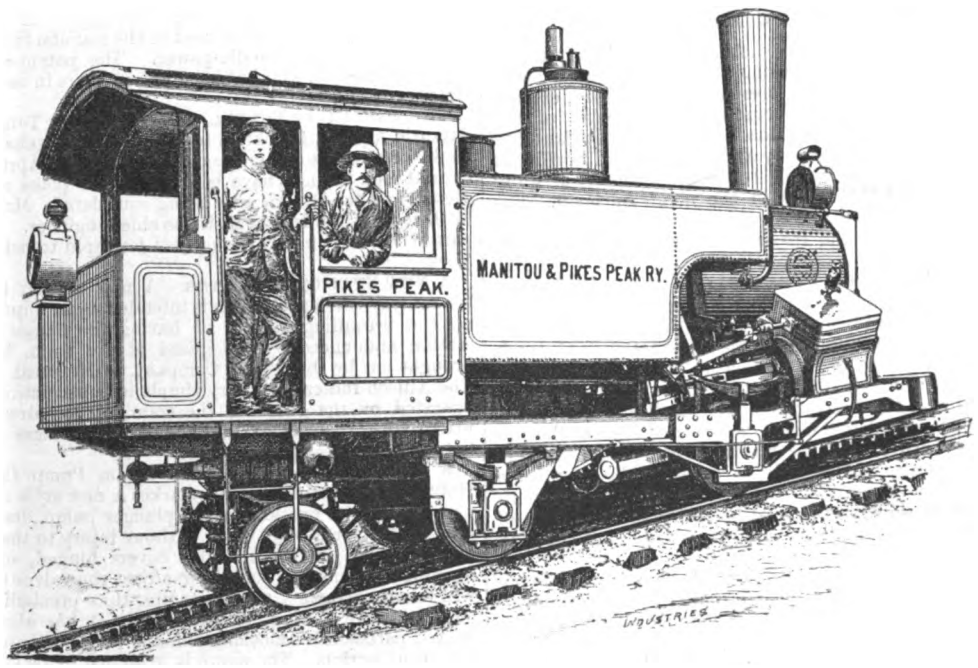
Reduced Freights for Iron and Steel.—The reduction in iron and steel rates decided on a few days ago by the Central Traffic Association will benefit Pittsburgh manufacturers by nearly $50,000 a month. Ordinarily a reduction is obtained only by continued demands, but the Pittsburgh people are indebted to the furnace proprietors in the Mahoning and Shenango Valleys for the present one. Complaint has been made for over a year that the competition of Southern furnaces, when aided by the low rates at which their product was carried to market, was too severe. They demanded lower rates on manufactured articles, pig iron, and coke. This reduction is the first the railroads have ever made in aid of the furnace proprietors. It will particularly benefit the mill proprietors by enabling them to market their iron cheaper, and keep the custom, which has been seriously menaced by Western rolling mill and steel works. Twenty-three of the furnaces which are now idle in these districts are likely to be blown in within the next few days.

Mining Statistics.—The inspector of the Fifth Anthracite District has forwarded his report for 1890 to the Secretary of the Interior at Harrisburg. There were 66 fatal accidents in the district during the year, an increase of 6 over the previous year. Of these, 6 were due to the men falling down the slopes or shafts, 22 to falls of coal, 14 were due to men being crushed by mine cars, 3 were caused by explosion of fire-damp, 4 by suffocation by gas, and the remainder by minor accidents. The amount of coal produced for each fatal accident varied from 52,200 tons, in the mines of Messrs. Leutz, Lilly, & Co., to 137,807 tons, in the mines worked by individual operators. The number of miners employed in the district was 19,150, producing 6,299,821 tons of coal, or 321 tons for each employé.

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THE "ABT" LOCOMOTIVE

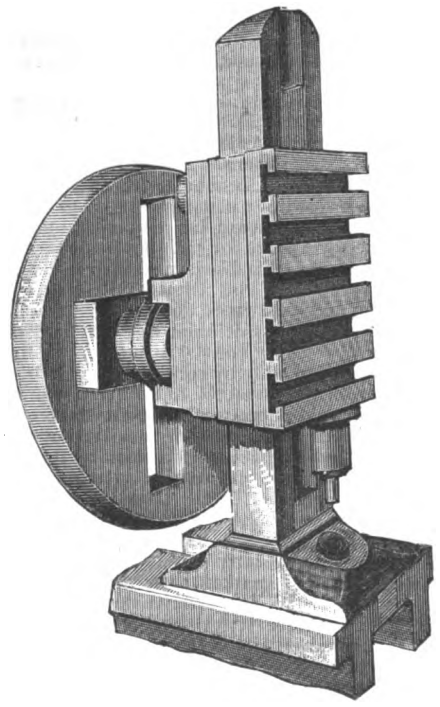
For the Manitou and Pike's Peak Railway, Colorado, U.S.A.



General View of Locomotive.

AN IMPROVED LATHE ATTACHMENT.

The accompanying illustration represents an appliance for attaching to lathes and other similar tools for obtaining a vertical reciprocal motion. It is made by Mr. F. M. Rogers, 21, Finsbury Pavement, London, E.C. The action of the apparatus is simple, and will be understood from the illustration. A vertical standard, which can be bolted to the lathe bed, has free to slide upon it a grooved face plate. This can be moved up and down by means of a roller or guide block mounted upon a pin



bolted to the chuck plate of the lathe. The pin is free to move backwards and forwards in the roller path formed on the back of the slide, the length of stroke, of course, depending upon the distance between the pin and the mandrel centre. The appliance, which is likely to be found particularly useful in small shops, can be used for a variety of purposes. By placing a cutting tool in the slide rest of the lathe, and feeding either by hand or automatically, a piece of work fixed to the reciprocating plate can be either planed or shaped, or the appliance could be used for punching or shearing if desired.

THE "ABT" LOCOMOTIVE.

The illustration given above represents a perspective view of the "Abt" locomotive, three of which have been built by the Baldwin Locomotive Works, of Philadelphia, U.S.A., for working the traffic on the Manitou and Pike's Peak Railway, which was opened last autumn. This railway, which extends from Manitou, at an elevation of 6,563·3ft., to Pike's Peak, 14,115·3ft. above sea level, and is nine miles long, is worked on the "Abt" cog-wheel system. Each locomotive weighs 26 tons, and has a capacity for 600 gallons of water, carried in saddle tanks, and 1¼ tons of coal carried at the rear of the engine. The cylinders are 17in. diameter by 20in. stroke. The main frame is of the bar type at the front and of channel iron at the rear, the back horn-block being made of a plate riveted to the channel-iron frame. The rear truck swings on a radius bar. The power is transmitted by a main toothed drum gearing with back sets of pinions; a forward set of pinions being driven by connecting rods from the middle set of pinions. The back sets furnish the greater portion of the power during the ascent, the forward set being used principally when applying the brake. In the descent the engine cylinders are used as air compressors, and can be controlled at will—thereby regulating the speed of the train. The front sets of pinions are attached to a novel kind of steam brake, by which they can be locked instantly, and a hand brake is fitted to the back pinions. The cars are 43ft. long, 8½ft. wide, and are capable of seating 50 persons. The maximum and minimum speeds of the trains are eight and three miles per hour respectively, and the whole journey is completed in one hour and forty-five minutes. Our illustration is taken from our American contemporary, the *Railroad Gazette*.

THE INSTITUTE OF MARINE ENGINEERS.

A meeting of this Institute was held on the 10th inst. and presided over by Mr. F. W. Wymer, when a paper on "An Improved Water Cooler," prepared by Mr. Cooper (a member located at Bombay), was read, in the absence of the author, by Mr. W. W. Wilson. The author briefly referred to the various methods in use for cooling water and for the manufacture of freezing mixtures. The special apparatus was then described as follows:—A barrel sufficiently tight to hold water is obtained. On it is placed a drum of sufficient strength to withstand atmospheric pressure on the outside. The inside of the drum is connected in any convenient way with the condenser by means of a pipe. Another pipe of decreasing diameter is also connected to and coiled around the drum, the smallest diameter being connected to the atmospheric by means of an adjustable cock or valve. The space between the drum and the barrel inside is then filled with water to a convenient level, and the water cooler is complete ready for action. The principle involved is the expansion of the air in its course through the increasing diameter of pipe, thence into the drum, which, being connected to the condenser, is equivalent to expanding the air ultimately into a vacuum. The efficiency of the cooler is further increased by the addition of drops of water, which are allowed to enter with the air into the small end of the pipe.

A discussion followed the reading of the paper.

The honorary secretary intimated that the next meeting would be held on the 24th inst., when possibly Mr. Manuel would be able to attend and read a paper. It is expected also that specimens of weldless steel chain, showing the different processes of manufacture, would be exhibited and explained by a representative of the London agent of the manufacturer.

THE MANCHESTER SHIP CANAL.

III.

We publish on page 276 two views of the locks at Irlam. Fig. 5 shows the locks with the sluices in the foreground, and Fig. 6 shows the formation of the lock bottom. In later issues we shall give further views of this very important work.

LEEDS ASSOCIATION OF ENGINEERS.

At a meeting of this Association, held on the 10th inst., the President (Mr. A. Atkinson) gave an interesting account of his visit to the anniversary gathering of the Birmingham Association. He said that during his stay he, along with the other delegates, visited the electric tramway installation, and Mr. Pritchard, the engineer, explained the working of the system. The engines, boilers, and dynamos are in duplicate. Each boiler is capable of generating steam for one engine, each engine delivering 100 horse-power on the fly-wheel. The two boilers are of steel, multitubular, of the economic safety type, 12ft. 6in. long and 7ft. 6in. diameter. The engines are horizontal, of the receiver type, non-condensing, having cylinders 12¾in. and 20in. in diameter, with a stroke of 24in. The dynamos, two in number, are in the same room, each driven with leather-linked belts 16in. wide. The dynamos are of the Elwell-Parker continuous-current type, shunt wound, each giving 120 volts and 500 amperes at an approximate speed of 540 revolutions per minute, and doing the whole of the work of charging the accumulators for twelve cars, and also lighting up the depôt and supplying an eight-unit motor, which drives the machine tools, &c. The cars will each carry fifty passengers, and can travel at eight miles an hour. The motors are also of the Elwell-Parker type, running at 140 revolutions per minute, but a velocity of 700 revolutions is required to maintain a travelling speed of eight miles an hour. The visitors journeyed some distance on the cars, which they found to run very steadily, the chief objection being the noise, which might be lessened by more suitable gearing. The overhead system has been passed by in favour of the storage system, for the sake of appearance. The latter had, however, the disadvantage of very heavy cars, which came to a gross weight of 10 or 12 tons. Mr. Atkinson then described the wire rope or cable system of tramways, which they next inspected. This system is being worked over a course of three miles, in two sections of a mile and a half each, the engines and boilers, which are in duplicate, being placed at the lowest point in the gradients, between the two sections. For a distance of over three miles the electrical system was doubtless the most economical; but for shorter distances the wire rope or cable system was the best. The overhead method of propelling the cars, as proposed for Leeds, would be cheaper in first cost, and far cheaper in working than the accumulator or storage system; but the under-grooving system was the best of all. Afterwards they visited the works of Messrs. Tangye, where the clean and good castings seen were especially admired. Mr. Atkinson described the method in use there of distributing and checking the work, which was done by a system of cards. The delegates were then driven to the house of Mr. George Tangye, which had once been the home of James Watt, and which contains the room in which he used to work, just as he left it. On the 26th inst. Mr. Henry McLaren will read a paper on "Boiler and Engine Tests."

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SHIPBUILDING NOTES.

On the 24th ult. the last of the three protected cruisers was launched at the yard of Messrs. James & George Thomson. The "Tribune" is similar to the two sister ships, and her length is 300ft.; breadth, 43ft.; depth, to upper deck, 22ft. 9in.; and displacement, 3,400 tons. She is fitted with vertical inverted triple-expansion engines. The speed expected to be attained is 18 to 20 miles per hour. The armament will be two 6in., and six 4·7in. quick-firing guns, eight quick-firing 6-pounder Hotchkiss guns, one 3-pounder Hotchkiss gun, four 5-barrelled Nordenfeldt guns, and four torpedo tubes. An arched steel deck extends from stem to stern. There is a cellular double bottom, and the hull is divided into compartments by numerous bulkheads.

On the 24th ult. Messrs. Ropner & Son launched at Stockton-on-Tees the steel screw steamer "Lammermoor," of the following dimensions:—Length, over all, 324ft.; breadth, 40ft. 6in.; depth, moulded, 23ft. 7in. She will be classed 100 A1 at Lloyd's, and carry 4,350 tons deadweight on Lloyd's summer freeboard. The vessel has a cellular bottom for water ballast, and is built on the web-frame principle. Her engines are by Messrs. Blair & Co., Limited, on their improved triple-expansion principle, of 1,200 i.h.p., with two large steel boilers working at 160lb. pressure. The steamer has been built for Messrs. W. Runciman & Co., of South Shields.

On the 24th ult. Messrs. Sir Raylton Dixon & Co. launched from their Cleveland Dockyard, Middlesbrough, the steel screw steamer "Pembridge," built to the order of Messrs. J. Temperley & Co., of Newcastle and London, for the Temperley Steam Shipping Company, Limited. This vessel is built with web frames, and has long full poop, raised deck forward and forecastle. Her dimensions are:—Length, over all, 323ft. 6in.; breadth, 41ft.; depth, moulded, 23ft. 1½in., with a carrying capacity of about 4,300 tons. Her machinery will be fitted by Messrs. T. Richardson & Sons, Hartlepool, having cylinders 23in., 38in., and 62in., by 42in. stroke.

On the 24th ult. Messrs. Edward Withy & Co. launched from their yard at Hartlepool a large steel screw steamer, the "Calcutta City," built to the order of Mr. C. Furness, M.P., West Hartlepool. She is a fine type of a modern cargo boat, measuring over 320ft. in length, and built throughout of Siemens-Martin steel, with a large measurement and deadweight capacity, and built to the highest class at Lloyd's. The holds are fitted with iron grain divisions and wood cargo battens; all decks, deck erections, skylights, bulwarks, and bulkheads are constructed of steel and iron. Cellular bottoms are fitted fore and aft for water ballast. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. She will be fitted with triple-expansion engines by Messrs. Richardson & Sons, Hartlepool.

On the 25th ult. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay-on-Tyne, a steel screw steamer, "Cape Comorin," of the following dimensions, viz.:—Length, 300ft.; breadth, 38ft. 8in.; depth, 23ft. 2in., and to class 100 A1 at Lloyd's on the partial awning deck rule. This vessel has water ballast fitted right fore and aft on the cellular system, and is also fitted with all modern improvements for the rapid loading and discharging of cargo. The engines, which are to be supplied by the North Eastern Marine Engineering Company, Limited, are of the triple-expansion type, having cylinders 23in., 38in., and 63in., with 42in. stroke, and working at a pressure of 150lb.

Notices of Meetings.

THIS WEEK.

Physical Society.—Friday, March 20th. Papers to be read: "The Theory of Dissociation into Ions and Its Consequences," by Mr. S. U. Pickering, F.R.S.; "Some Points in Electrolysis," by Mr. J. Swinburne; "The Variation of Surface Tension with Temperature," by Mr. A. L. Selby; "On Magnetic Proof Pieces and Proof Planes," by Professor S. P. Thompson.

Junior Engineering Society.—Friday, March 20th, at 8 p.m. Paper to be read: "Iron, from the Ore to the Casting," by Mr. H. J. Young.

Sanitary Institute.—Friday, March 20th, at 8 p.m. Paper to be read: "Sanitary Law, English, Scotch, and Irish; General Enactments; Public Health Act, 1875; Model Bye Laws," by Mr. A Wynter Blyth.

Balloon Society.—Friday, March 20th, at 8 p.m. Paper to be read: "The Factories and Workshops Bills," by Miss E. Lupton.

Royal Institution.—Saturday, March 21st, at 3 p.m. Lecture VI., on "The Forces of Cohesion," by Lord Rayleigh, F.R.S.

South Staffordshire Institute of Iron and Steel Works Managers.—Saturday, March 21st, at 7 p.m. Papers to be read: "Smoke Prevention and Gaseous Fuel," by Mr. J. W. Sheel; "The Manufacture of Basic Steel by the Open-hearth Process, with Special Reference to Some of the Furnaces Employed," by Mr. G. A. Millward.

NEXT WEEK.

Society of Arts.—Monday, March 23rd, at 8 p.m. Cantor Lecture III., on "Photographic Chemistry," by Professor R. Meldola, F.R.S.

Royal Institute of British Architects.—Monday, March 23rd, at 8 p.m. Sessional meeting.

North East Coast Institution of Engineers and Shipbuilders.—Monday, March 23rd, at 7.30 p.m. Paper to be read: "Electrical Engineering, with Special Reference to Electric Lighting," by Mr. W. C. Mountain. Graduates' Section, Monday, March 23rd, at 7.45 p.m. Paper to be read: "The Development of the Screw Propeller," by Mr. R. L. Gaine.

Institution of Civil Engineers.—Tuesday, March 24th, at 8 p.m. Ordinary meeting. Paper to be read and discussed: "On the Reception and Storage of Petroleum Oil in Bulk," by Mr. W. T. H. Carrington, M.Inst.C.E.

Society of Architects.—Tuesday, March 24th, at 7.30 p.m. Ordinary meeting.

Sanitary Institute.—Tuesday, March 24th, at 8 p.m. Paper to be read: "Sanitary Laws and Regulations Governing the Metropolis," by Mr. A. Wynter Blyth.

Chemical Society.—Wednesday, March 25th, at 8 p.m. Anniversary meeting.

PRICES CURRENT, 18th March, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

Market quiet.

PIG IRON.

Middlesbro' Warrants, No. 3.	39/6 Cash.
Scotch Warrants, m/n	44/1½ „
Hematite Warrants, m/n	48/10 „

Stocks in Stores.			
Scotch	537,220—Dec. for week	3,387	Tons.
Middlesbro'	125,914—Dec. „	174	„
Hematite	193,255—Dec. „	4,621	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	68/-	.....	60/-	f.o.b.	Glasgow.
Gartsherrie	60/-	.....	56/6	„	„
Summerlee	62/6	.....	56/6	„	„
Carnbrae	48/-	.....	47/6	„	„
G.M.B. ex store	44/9	.....	44/6	„	„

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	67/6	57/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£25	0	0	to	25	5	0
Copper: British Cakes and Ingots	56	10	0	„	57	0	0
„ Chili Bars, G.O.B.'s	52	0	0	„	52	5	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	52	0	0	„	52	5	0
„ Manufactured (strong)	65	0	0		.....		
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	90	2	6	„	90	10	0
„ Australian	90	7	6	„	90	15	0
„ English Ingots	94	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: Steady, with limited business. Chili bars have advanced, and it is noticeable that during the past week the margin between cash and forward metal disappeared, owing to the scarcity of "spot" offering. Three months' quotations are, however, again a shade dearer, prices to-day being £52 to £52 5s. cash, and £52 to £52 7s. 6d. three months. Manufactured £65, "strong."

Tin continues exceptionally steady, values to-day being exactly as on the 11th, the date of our last report.

Lead: Slightly weaker, with small demand.

Spelter is a shade easier, owing to increasing slackness in the galvanising trade.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5¼	to	0 0 6¼
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 8½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 15 0	—	.....
„ Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	25 0 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 12 6	—	.....
„ Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 0 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 9	—	.....
„ (50/90 %)	„	0 3 7	—	.....
Copper Sulphate	ton	17 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	25 10 0	—	.....
„ Brown „	„	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 10 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
„ White	„	0 3 6	—	.....
Salts: Epsom { Bags	ton	3 0 0	--	.....
Salts: Epsom { Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 10 0	—	.....
„ Recovered	„	7 5 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	11 2 6	—	.....
„ „ „ 60%)	„	9 17 6	—	.....
„ „ (Cream 60%)	„	9 10 0	—	.....
„ Crystals	„	3 3 0	—	.....
„ Bicarbonate	„	7 10 0	—	.....
„ Hyposulphite	„	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 8	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Many complaints are now being made of the dulness of the chemical trade. There is a very slow demand for carbolic acids, but prices remain steady. Benzoles are quiet. Creosote moderately active. Sulphate of ammonia has advanced, and is tending further upwards. Sulphate of copper is easing slightly. All lead salts are steady.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	35 10 0
„ Ceylon	„	28 10 0
Cottonseed	„	20 10 0
Cod	„	23 0 0
Lard	„	33 10 0
Linseed	„	22 10 0
Olive, Spanish	„	43 0 0
Palm, Lagos	„	25 0 0
Rapeseed: English	„	29 15 0
Seal: Pale	„	26 0 0
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	21 0 0
Turpentine	per cwt.	1 9 0
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 5½
Spirit	„	0 0 7

The first issue of "*The Health Record*, an Irish Journal of Sanitary Science," has recently appeared. The journal will contain articles dealing with the medical, legal, and engineering aspects of sanitary science. In the present issue there will be found articles by well-known writers on the storage of water, the prevention of consumption, the public health and the necessity for the registration of plumbers, and electricity as applied for sanitary purposes.

We have received from Mr. Frederic Nell, engineer, 16, Mark Lane, London, E.C., a well-illustrated catalogue of the "Victor" turbine. Since the publication of the last catalogue several improvements in details of construction have been made, which are described in the catalogue. A table is given showing the scientific tests to which the Victor turbine has been subjected, and there are also tables giving the horse-power, cubic feet required, and revolutions per minute for each size of the turbine, with different heads of water.

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HOME INDUSTRIES.

LONDON, 19th March, 1891.

THE MONEY MARKET.—Money has been somewhat scarce this week, the issue of a quantity of Treasury Bills before the maturing paper which they replaced was due having taken a considerable sum off the market. Rates for short loans have consequently been fairly firm, but discount rates have not been similarly affected owing to a scarcity of commercial paper. The gold movement has been on the whole in favour of the Bank, but a substantial sum has been taken for the River Plate. The stock markets continue featureless and uninteresting. The buying of Consols by the Government and the banks, which attracted some attention at the close of last week, has ceased. Foreign Government securities have been firm, and the financial crisis in Paris has had very little effect on international stocks, its influence being purely local. In home railways the only activity has been in the Scottish stocks, and the unfavourable character of the half-yearly reports, just issued, of the Caledonian and North British, has caused a good deal of selling. American railways have shown a slightly improving tendency, but it has been rather of a halting and uncertain description. In Canadian railways there has been little movement. After remaining stationary for nearly a week, silver has fallen in price again, and the securities dependent on it have declined also. In mining and industrial descriptions there has been no marked movement or tendency.

THE INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.—On the 16th inst. a general meeting of the Congress was held at the rooms of the British Medical Society, 20, Hanover Square, at which the Prince of Wales presided. Sir Douglas Galton, president of the organising committee, stated that at the sixth International Congress, which was held in Vienna in 1887, it was resolved to hold the seventh congress in London during the present year. The congress is organised in two divisions and ten sections, viz.:—Division I., Hygiene, in nine sections (1, Preventive Medicine; 2, Bacteriology; 3, Relation of the Diseases of Animals to those of Man; 4, Hygiene of Infancy and Childhood; 5, Chemistry and Physics in relation to Hygiene; 6, Architecture in relation to Hygiene; 7, Engineering in relation to Hygiene; 8, Naval and Military Hygiene; 9, State Hygiene). Division II., Demography (Demography, Health, Statistics, and Industrial Hygiene). The congress is to be opened on the 10th of August by an inaugural meeting at the St. James's Hall, at which the Prince of Wales will preside, and the meetings of the various sections will take place on the five following days at Burlington House. Invitations have been sent to foreign Governments, to India and the Colonies, and to the various County Councils in the United Kingdom. A sum of between £5,000 and £6,000 will be required for the organisation of the congress and for the publication of the transactions.

EXHIBITION OF PRINTING APPLIANCES.—On the 16th inst. an exhibition of appliances connected with the printing and paper trades was opened at the Agricultural Hall, Islington, and will remain open till the end of this month. Some of the exhibitors had not completed their preparations at the time of opening, but the Exhibition seems to be a fairly representative one. Various appliances used in printing and lithographing are shown by some of the leading firms engaged in those trades, and many recent inventions are exhibited. Machines for multi-colour printing, automatic feeding machines, lithographic processes, and type founding are to be shown in operation during the holding of the Exhibition.

PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN.—An exhibition of collotype printing, a process in which photography plays the part of the lithographic artist and a sensitised gelatine film that of the lithographic stone, will be on view daily till the 14th of April, between 2 p.m. and 9 p.m., at the rooms of the Photographic Society, 50, Great Russell Street, Bloomsbury. Admission may be obtained on presentation of a visiting card.

THE JUNIOR ENGINEERING SOCIETY.—A numerously attended excursion of this Society took place on the 7th inst., when the boiler works of Messrs. Maudslay, Sons, & Field, at East Greenwich, were visited. The chief points of interest were a double-plate heating furnace; a hydraulic flanging machine capable of operating upon plates 1¼in. thick; powerful fixed hydraulic riveters, the largest of which has a 12ft. gap; a pair of horizontal engines for driving the machinery; and the hydraulic and electric light plants. The boilers in course of construction included a set of five for H.M.S. "Spartan"; a set of eight for H.M.S. "Royal Arthur," the vessel recently launched at Portsmouth; a similar set for H.M.S. "Theseus"; and sixteen for the Imperial Russian Government cruiser "George the Conqueror," now being built in Russia.

THE LATE CAPTAIN DANIEL PENDER, R.N.—Captain Daniel Pender, R.N., assistant hydrographer to the Admiralty, died on the 12th inst. During ten years he was employed on surveying work in the Pacific, of which he had an extensive knowledge. After leaving the Pacific station, he received the appointment of naval assistant in the Hydrographic Department of the Admiralty, and afterwards became chief naval assistant and assistant hydrographer.

THE BALLOON SOCIETY.—At a meeting of the Balloon Society, on the 13th inst., Mr. Lennox Brown being in the chair, Mr. Thomas Christy, F.L.S., read a paper on "Improvements in Surgical Dressings and Waterproof Materials." After referring to the fact that both oiled silk and gutta-percha tissue have been discarded by the Governments of England, France, the United States Denmark, and Norway, in consequence of their impracticability, the author proceeded to describe the new material, which has been named "Christia," and is made by a process of felting the pure fibre of the Manilla hemp. The material is a membrane-like tissue, very light and strong, impermeable to water, spirits of all kinds oils, and acids. It is made neutral, so that it can be rendered antiseptic with any desired medicament. It will stand tropical heat and Arctic cold without being in the least injuriously affected by the changes. It is particularly adapted for India and other hot climates, where gutta-percha tissue and oiled silk becomes in a short time amalgamated together to such an extent as to be not only useless to the surgeon, but injurious to anything with which it comes in contact. Another advantage is that it is only about half the price of oiled silk.

MANCHESTER, 19th March, 1891.

THE AIR OF MANCHESTER.—An exhaustive inquiry into the character of the air in Manchester, especially during the prevalence of fog, has been carried out by Drs. G. H. Bailey and J. B. Cohen and Mr. P. J. Hartog, of Owens College, and Dr. J. F. Tatham, Medical Officer of Health for the City. Some alarming statistics have been collected. It is shown that the deaths from respiratory diseases, which are normally about 60 per week, during a foggy week in December last reached 200. Observations were accordingly made at various points in the city, and the amount of sulphuric acid and carbon estimated. The quantity was obtained by ascertaining the amount carried down by the snow, by collecting deposits on the roofs of greenhouses and by examining the incrustation on leaves of outdoor plants. It was found that during three days of fog an amount equal to 6 cwt. of sulphuric acid was carried down by the snow in one part of the city, and further away from the centre, near Owens College, the amount was over 4 cwt., the "blacks" over 2 tons, and the hydrochloric acid about 2 cwt. One of the results of the inquiry has been to emphasise the demand for cheaper gas, so as to stimulate its use for heating purposes in lieu of coal, and an effort is being made to bring pressure to bear upon the Corporation to reduce the present cost.

NEW RAILWAY.—The line of railway from Preston to Blackpool, which was sanctioned by Parliament about six years ago, is at last to be commenced. The capital has been found by the Manchester, Sheffield, and Lincolnshire Railway Company, and the contract has been given to Mr. Thos. Riley, of Fleetwood. The new line will open up direct communication between the South Yorkshire and Cheshire districts and the Lancashire seacoast, the only means of access at present being through Manchester.

SHORTER HOURS IN THE ENGINEERING TRADE.—A demand is at present under consideration by the Iron Trades Employers' Association for the reduction of the working week from 54 to 53 hours. It is said that one important firm has conceded the point, but there are others who are not disposed to do so. In some cases it will mean an advance of about 2 per cent. on the cost of production.

THE CHANNEL TUNNEL.—A lecture was delivered by Professor Boyd Dawkins on the 13th inst. on this subject. After dealing with the general aspects of the question, the lecturer said that the borings showed that there was over the whole distance a grey impervious rock well suited to the purpose of a tunnel. The inclination of the rocks was very gentle, being 1 in 72 on the English side, and reaching 1 in 42 on the French side. The character of the rock was eminently suited for boring easily, and as during construction compressed air would be used the ventilation would be perfect.

THE SHIP CANAL.—An influentially signed requisition of citizens of Manchester asking the Mayor to call a meeting to consider the proposal of the City Council to advance to the Ship Canal Company the sum of money required to complete that work has been presented, and the meeting is fixed for the 23rd inst. The report of Admiral Richards, Acting Conservator of the Mersey, has been issued, and states that no improvement of value is to be noticed in the condition of the channels from the dredging at the bar. A report is appended of the progress of the Ship Canal works, and the report states that the works within the estuary are so far completed that no further legal or technical questions will be likely to arise.

THE LINEN AND JUTE TRADES.—There has been a better feeling this week, merchants having received larger orders from their retail customers. A strong feeling of dissatisfaction is, however, expressed by agents for manufacturers at the condition of business from their point of view. This feeling arises from the excessive home supply of goods, to which reference has previously been made in the course of our reports. Prices are of course cut down to a very low level under existing conditions, and they will probably decline further, as far as coarse grades of linens are concerned. Standard 10½oz. 40in. Hessians have been sold at the extremely low price of 1¾d., a figure which approximates to the then unprecedentedly low figures accepted in 1885, when Dundee Hessians were sold at 1½d., and Calcutta was competing with the Forfarshire manufacturers at their very doors, the burlaps of the Indian capital being sold in Dundee itself. The shipping business continues to be unsatisfactory. Another large failure in Montreal has had little effect here, as the feeling of extreme depression has passed away so far as the Dominion is concerned.

GLASGOW, 19th March, 1891.

THE PIG IRON TRADE.—The promoters of the Pig Iron Warrants Bill, who were thought to have been defeated by the Iron Trade Association, and to have been forced to abandon the Bill, seem indisposed to do so. They intend to persevere with the Bill, notwithstanding the storm of opposition it has raised. The opponents of the Bill say that, if it passed, there would be no longer an open market for iron, and that warrants would thereupon become unsaleable. The measure would, however, certainly operate in restraining undue speculation.

THE SCOTTISH RAILWAYS.—The North British Railway dividend of 1½ per cent. on the preferred ordinary and nothing upon the ordinary stock was neither more nor less than was anticipated, the forecasts of speculators having been in this instance exactly fulfilled. The full extent of the loss having been realised by anticipation, the stock began to recover from the lowest point almost immediately the dividend was declared. Still, there is not much inclination to force the price up again. In August, two months before it became apparent that a strike was probable, the combined prices of the split stocks was 154. On the making up of last account the combined stocks stood at 107½, representing a fall of 50 per cent. on the par value of the stock. Last half-year the North British Company paid a dividend at the rate of 3½ per cent. per annum on their ordinary deferred, and on the ordinary preferred at the rate of 3 per cent. The reduction of 5 per cent. out of the 6½ per cent. declared in the former half-year means a falling off in the amount available for dividend to the extent of about £208,000. The whole of this deficiency is not due to the strike. The accidents at Milngavie and at Winchburgh have together cost the company a large sum, and the aggregate amount of the items of loss, exclusive of the strike, is estimated at about £60,000, leaving about £150,000 which the company admit that they have lost through the strike. It cannot, perhaps, be ascertained at present whether the whole of the loss due to the strike has been charged. The loss of half a year's income to the ordinary shareholders of the 8¼ millions of ordinary stock of the North British Railway is, however, sufficiently serious.

CONFERENCE BETWEEN DIRECTORS AND RAILWAY EMPLOYÉES.—The North British Railway Company has issued a report detailing the concessions arranged at the conferences between the directors and the men which have been taking place during the past few days. The concessions are very important, and it is to be hoped will be generally and cordially accepted by the men. The system of payment by a fortnightly aggregate has been replaced by one of a weekly aggregate. The number of hours in this aggregate is seventy-two, involving, according to the circular of the company, an actual running time of ten hours per day The system of "booking off and on," which causes payment for a smaller number of hours than the number actually spent on duty, has been abolished, and the time of the men will in future be counted from the time they commence duty by order to the time they finish work. Intervals of at least nine hours' rest will be given so far as the necessities of the service permit. There are sundry minor concessions.

THE EDINBURGH RAILWAY SCHEMES.—The Caledonian Railway scheme for access to Edinburgh by means of a tunnel under Princes Street has been thrown out by Parliament. The Bill was opposed by the North British Railway in the interests of their own scheme, the Princes Street proprietors also appearing by counsel against it. There was an unusually full bar, almost all the leading railway counsel being employed in the case. The Edinburgh Town Council were not united in their attitude, and therefore their influence in the matter was rather discounted. On the 16th inst. a large and influential meeting was held in Edinburgh to protest against the carrying out of the scheme. The schemes, both of the Caledonian and of the North British Companies, are very unpopular in Edinburgh, and only urgent necessity would reconcile the people of Edinburgh to submit to either of the schemes. The Caledonian Bill has, however, been sacrificed to public clamour, while the North British Railway Bill has succeeded in passing. The Glasgow South Suburban Railway is a short line from Parkhead, in the extreme east of Glasgow, *viâ* Tollcross, Carmyle, Cambuslang, and Mount Florida, to Strathbungo. Parkhead is on the North British system, and Strathbungo is on the Glasgow and South-Western. The line will thus form an additional connection between the two railways.

SHIPBUILDING.—The Peninsular and Oriental steamers "Rome" and "Carthage" are about to be lengthened by Messrs. Caird & Co., Greenock. The vessels will be taken successively into Garvel Graving Dock, and there cut and lengthened. It is expected that the work will take about six months. There are at least two large contracts which Clyde shipbuilders seem reluctant to take at a fixed price in the present state of uncertainty of the prices of material and labour. Either the contracts will be given on the principle of "time and stuff," or they will be allowed to go elsewhere.

NEW GLUCOSE MANUFACTORY.—The manufacture of glucose, until a few years ago a product almost entirely imported from Germany, has within the past few years been developing in Greenock. A sugar refinery, which

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has been closed for some time, is just now being converted into a glucose factory. The rapid development of the preserve trade in Scotland has directed the attention of capitalists to the manufacture of materials used in the making of preserves. The preserve trade in this district has been very prosperous for several years, and several firms, which were only in a small way of business five years ago, are now building very extensive factories to meet the needs of a rapidly expanding trade.

(From our own Correspondents.)

LIVERPOOL, 18th March, 1891.

The "City of New York."—This American liner has just made a remarkable passage to New York; and although she has not beaten the record of the fastest run across the Atlantic, she has made 500 knots or more per day for four days in the passage, her runs being 502, 485, 501, 500, 503, and 359 knots, no steamer ever having made such running before. The total distance of 2,886 knots—being nearly 100 knots further than is usually run at this time of the year—was run in 6 days 2 hours 10 minutes. She left Liverpool at 9 p.m. on the 7th inst., and arrived at Sandy Hook at 8 a.m. on the 14th inst.

The North Wales Passenger Service. — There is every probability of the passenger traffic between Liverpool and the watering places on the North Wales Coast being carried on this next season without any competition. Last year the Liverpool, Llandudno, and Welsh Coast Steamboat Company—the old company—competed with the owners of the "St. Tudno." The former company has gone into liquidation, and the "St. Tudno" has been sold, and in their place a new company has been formed principally of the directors of the two competing companies. The "Bonnie Princess," the "Prince Arthur," and the new boat which was being built for the owners of the "St. Tudno," have been acquired by the company, as well as the goodwill, fixtures, and other assets.

Dock Extension in Liverpool.—The proposed Mersey Docks and Harbour Board extension works consist of (1) the deepening of the Canada Basin; (2) the construction of a pier or jetty from the Canada Basin to Brocklebank Dock; (3) the lengthening and deepening of the Canada Lock; (4) the removal of the passage between the Canada and Huskisson Docks; (5) a new dock at the north-east corner of the Huskisson Dock; (6) the lengthening and deepening of the Huskisson Lock; (7) a new half-tide dock with three-lock entrance; (8) a new graving dock; (9) the deepening of the navigable waterway of the Mersey. Three years are given for the compulsory purchase of the land, and ten years for the completion of the works. The estimated cost of the works is £1,600,000.

SHEFFIELD, 18th March, 1891.

Iron and Steel. — Business is good in both these branches of trade, and all the mills and forges are working full time. The Rolling Mills Association, whose members mainly roll the particular sections used in Sheffield trades, are fully employed at the increased rate of charges decided upon by the Association last year. Their mills are also turning out a large amount of round, square, and other sections of a very mild quality. Sheffield also manages to retain the bulk of the orders from the Birmingham and Coventry firms for cycle steel. The annual report of Messrs. Charles Cammell & Co., Limited, is, on the whole, very satisfactory. It shows the profit for the year 1890 to have been £187,527 7s. 6d., and the directors recommend a dividend on the A shares of 5 per cent., and on the B and ordinary shares 12½ per cent. Messrs. Wm. Jessop & Sons, Limited, have issued their fifteenth annual report, and will pay a dividend of £6 13s. 4d. per cent. The directors complain that the increased business of the firm has been unprofitable on account of the high cost of labour and fuel. The heavy steel casting trade done by this firm has not been so profitable as was anticipated in the first instance.

Coal and Coke.—Steam coal is in active demand, and the amount forwarded to London by railway is fully maintained. The Humber ports are also exporting a large quantity. Prices remain from 10s. to 11s. at the pit's mouth. Household coal is in brisk demand at full rates. There is a demand for the best hard coke, but the market generally is quiet.

SWANSEA, 18th March, 1891.

Dock Extensions.—Sir George Elliot stated at the recent meeting of the Alexandra Docks and Railway Company, Newport, that the great work of their South Dock extension is drawing near to completion. The number of hands employed has been increased, and Mr. Smyth, the engineer in charge, quite anticipates that water will be let into the dock during the present year. The services of Mr. Charles Liddell, the eminent engineer, have been retained for consultative purposes.—The Milford Docks Company have completed their dry dock, 600ft. long, which, with the newest appliances, can be emptied in from three to four hours. The steady progress that the trade of Milford manifests, although encouraging, does not yet include the making of this port their terminus by Atlantic liners. Clearly, however, this is not for want of accommodation, for the s.s. "Maryland" (4,000 tons), recently blocked at Swansea, left this place with sealed orders, put into Milford, discharged her cargo of copper ore, took in coals, and left the following day for Philadelphia. It is interesting to note that, notwithstanding the sealed orders, a union delegate arrived at Milford by an early train and did his best to prevent the ship being coaled. The dock manager, however, had no difficulty in arranging for trimmers.

BARROW-IN-FURNESS, 18th March, 1891.

Hematite.—The hematite pig iron trade still remains very quiet, and orders are few either on home or foreign account. The trade consists chiefly of operations on warrant iron, which is selling at 49s. 9d. per ton, net cash, while makers are quoting 52s. to 54s. for parcels of mixed numbers of Bessemer iron, net f.o.b. The trade in forge qualities is inactive, but Bessemer iron is likely to be in improved request. The output is steady, forty furnaces being still in blast, and thirty-six standing idle. The stocks of warrant iron have been further reduced this week by 3,464 tons, and now amount to 196,212 tons.

Steel.—The only feature in the steel trade is the presence of new foreign orders in the steel rail market. Makers have been on short time for several weeks, and new orders are required to maintain the state of activity which has existed for a few years past. Prices are easier at £4 12s. 6d. for heavy sections, £6 for light sections, and £7 for colliery rails. In steel shipbuilding material there is a good prospect of new orders, and the mills are busy. A development of the Siemens-Martin steel trade in Barrow is being carried out, which will extend this branch of industry. Hitherto the West Coast has mainly confined its operations in steel to the Bessemer process, but in future the Siemens-Martin process will probably take pre-eminence. Tin-plate bars are quiet, as also are blooms, billets, and slabs.

Iron Ore.—There is a very quiet trade in iron ore, and prices are easy at 10s. 6d. to 11s. 6d. per ton for ordinary qualities. At many of the mines short time is being worked, while at others iron ore is being stocked.

Shipbuilding and Engineering.—On the 25th inst. the Naval Construction and Armaments Company will launch the third and last of the fleet of three fast ocean steamers which have been built to the order of the Canadian Pacific Railway Company for the Pacific trade. She will be named the "Empress of China." "The "Empress of India" is now making a successful tour round the world, and the "Empress of Japan" is expected to leave Barrow in a few days in order to make her trial trip. The second cruiser built at Barrow for the Admiralty, the "Melampus," is nearly ready to go to sea for her trial trip. Prospects of shipbuilding at Barrow are very good.

MIDDLESBROUGH, 18th March, 1891.

Pig Iron.—The pig iron market is very dull in consequence of rumours of financial disturbances in London. Decreased shipments also have increased the depressed feeling and darkened the hopes which naturally arise at this season of the year. Makers, however, will not commit themselves to prices which would be unremunerative, and hope to obtain better prices in the immediate future. Cleveland warrants may be had at 40s., but buyers will not give more than 39s. 10½d. Makers hold out for 40s. 6d. prompt delivery, and 41s. for April delivery. The average quotations may be taken as—No. 1, 43s. 6d.; No. 3, 40s. 6d.; No. 4 foundry, 40s.; No. 4 forge, 39s. 6d.; mottled and white, 39s. per ton for G.M.B. for delivery over the month. In hematite iron East Coast brands are 54s. per ton f.o.b. sellers, makers' iron, mixed numbers. The stock in Connal's stores on the 16th inst. stood at 126,156 tons, being an increase this month to the extent of 1,727 tons. The Cleveland ironmasters held a meeting on the 16th inst., and decided to ask the executive of the National Association of Blast Furnacemen to meet them for the purpose of arranging a substantial reduction in wages.

Shipments of Pig Iron.—The shipments of pig iron from the port of Middlesbrough for the week ending on the 14th inst. amounted to 14,580 tons, as compared with 12,266 tons over the corresponding period of last year. The shipments for the current month up to the 16th inst. amounted to 32,550 tons, as compared with 41,093 tons to similar date last month, and 24,404 tons to the 16th of March last year. Of the 32,550 tons, 20,275 went to Scotland, against 5,361 last year; 3,535 to other parts of England and Wales, against 1,995 last year; and 8,740 to foreign parts, against 17,048 last year. No doubt the severe weather has been adverse to the foreign trade, and milder weather will cause larger shipments for abroad.

Manufactured Iron and Steel.—The manufactured iron trade is quite as dull and the outlook quite as gloomy, and this remark applies to the steel trade as well. At the Darlington Iron and Steel Works the men have received a seven days' notice, to be followed by a twelve hours' notice, which indicates a shortness of work. On the other hand, Messrs. Bolckow, Vaughan, & Co., in addition to some smaller orders, have just received an order for 16,000 tons of steel rails for India. Iron ship plates are quoted at £5 12s. 6d.; angles, £5 10s.; common bars, from £5 12s. 6d. to £5 15s.; steel ship plates, £6 2s. 6d.; angles, £5 17s. 6d.; heavy steel rails, £4 12s. 6d. per ton, all less 2½ per cent. f.o.b. at works. The minor branches of the iron industry are fairly well off for orders, but the future is hardly so promising. The tube works, wire works, and pipe works are very well employed, but the general foundry works do not fare so well, one cast steel foundry having closed for a time. Shipbuilding is steady enough in the meantime, but the prospect is not very good. The general engineering and marine engineering trades are busy. Coal is steady, and coke for blast furnaces can be had slightly cheaper, from 14s. 6d. to 15s. per ton delivered at the furnaces.

SUNDERLAND, 18th March, 1891.

The Shipping and Coal Trade.—Although freights generally continue to be depressed there is a slight improvement of trade. Unfortunately the Silksworth dispute has not yet been settled, and the remaining collieries of Lord Londonderry have also been laid idle. Coal shipments are low, only 56,629 tons having been shipped during last week, although in the previous week 65,820 tons were sent coastwise and abroad. The remaining shipments—patent fuel, coke, cement, and general cargoes—were of an average amount. The imports included 39,801 sacks of wheat, timber, and iron ore.

Shipbuilding and Marine Engineering.—Outdoor operations have been much retarded by the severe weather, but the work in hand, including a quantity of heavy repairs, suffices to maintain continued general activity. The marine engines and boilers for two vessels recently contracted for by local shipbuilders are to be constructed on the River Wear. Mr. John Dickinson, Palmer's Hill Engine Works, has secured the order for the engines and boilers for the Londonderry Company's new steamer, and Messrs. George Clark, Limited, Southwick Engine Works, have also received a contract for a set of triple-expansion engines and two large boilers.

The Shipping Federation and the Seamen's Unions.—At a conference held here between the representatives of the National Seamen's Union, the North of England Seamen and Firemen's Society, and the local committee of the Shipping Federation, on the 13th inst., it was decided that the Federation ticket should be generally adopted. Previous to the conference large numbers of the members of the societies had accepted the shipowners' requirements, and the result of the conference was a foregone conclusion.

The Glass Trade.—Messrs. J. Hartley & Co.'s employés are still idle, declining to accept the terms offered by the firm. Strike pay has been distributed.

NEWCASTLE, 18th March, 1891

The Coal Trade.—Since last week no appreciable change has taken place in the condition of the local coal trade. The shipments of coal and coke at Tyne Dock for the week ending on the 14th inst. amounted to 105,291 tons, being an increase of 2,599 tons as compared with the shipments in the corresponding week last year.

Shipbuilding.—In the shipbuilding trade new orders are still scarce, and the fact that shipbuilders have considerably reduced their quotations for tonnage does not seem to induce speculation on the part of owners. The unremunerative state of the freight market, coupled with the recent labour difficulties, are sufficient to account for the unwillingness of shipowners to make further additions to their fleets. There is also the circumstance that a large amount of tonnage is now laid up, and, under these conditions, it is useless to expect any appreciable increase of work in the shipbuilding trade. Special requirements will, of course, have to be provided for, and occasional orders will be forthcoming to fill up vacancies on the stocks of some establishments. On the whole, the outlook for the shipbuilding industry is far from encouraging, and when the old orders now in hand have been completed it is to be feared that a very serious slackness will be felt. Messrs. Armstrong, Mitchell, & Co. are about to launch from their Low Walker Yard a small twin-screw steamer for a special service. The firm have just put down the keel for a large vessel, and they have two others, also of large size, in the framing and plating stages. A few other firms have recently put down keels, but in several instances where launches have taken place lately the berths still remain vacant. A small steel steamer is being built for local owners at the Mushroom Slipway, near Newcastle. For some years past only repairing work and the building of small wooden vessels have been carried on at this establishment.

Engineering.—The leading engineering establishments continue to be well employed, and there is now a prospect that the overtime question, which, for some time past, has caused uneasiness, will be amicably settled. At Messrs. John Abbot & Co.'s establishment business is fairly active, colonial contracts for hydraulic machinery forming a large part of the work in hand. The works of Messrs. John Spencer & Sons, at Newburn and Newcastle, are kept briskly going, though orders for ship forgings are not so numerous as they were a few months ago. The erection of the new ordnance works at Jarrow is being pushed forward with all possible despatch, and it is probable that within a couple of months the buildings will be ready for the reception of machinery. Mr. W. F. Snowdon, the agent for the new American wood split pulleys, recently introduced by Messrs. Braithwaite & Son, Kendal, is doing a large business in these specialties, among recent orders being an important one from a Sunderland shipbuilding firm.

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THE MANCHESTER SHIP CANAL.

(*For description see page* 272.)

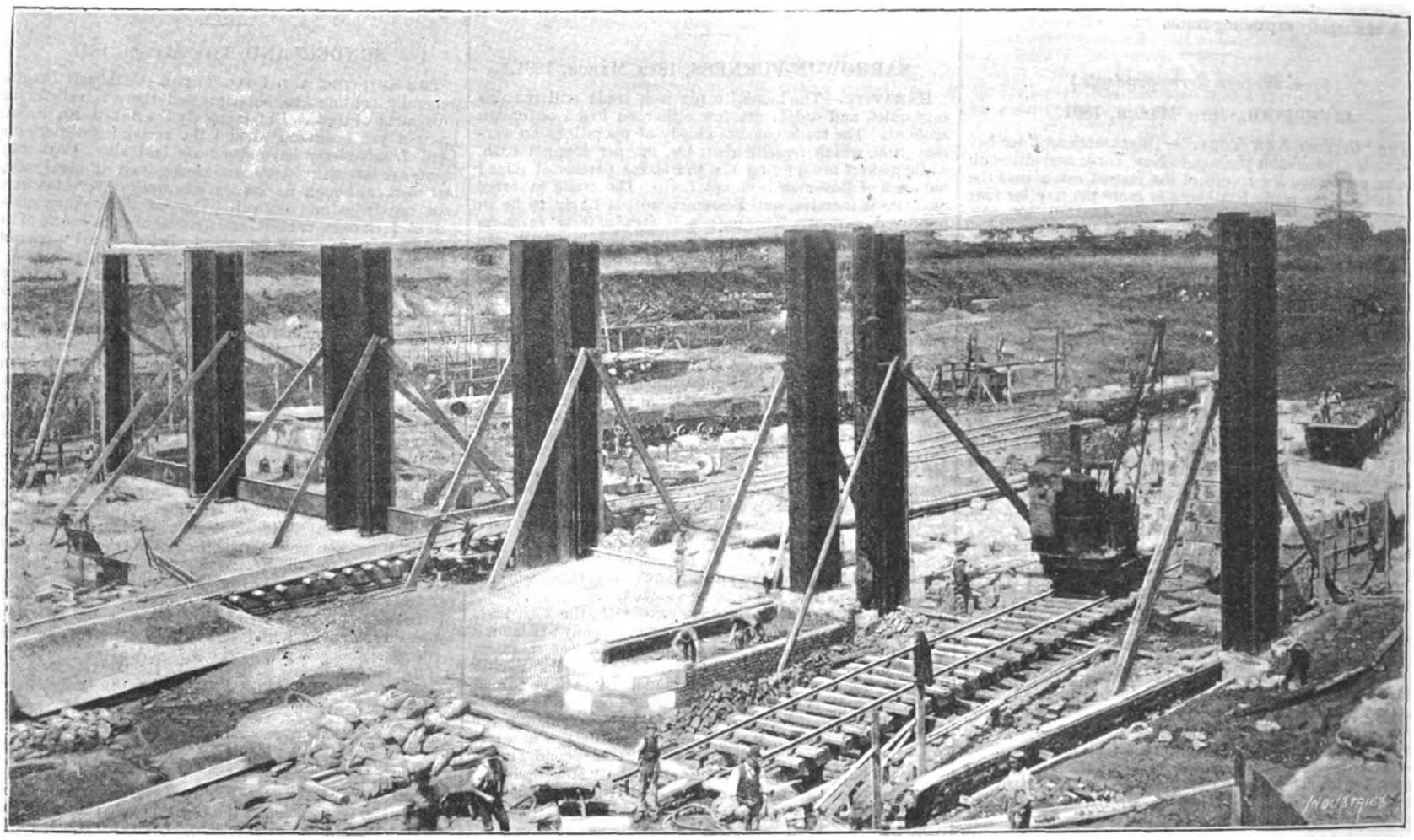


FIG. 5.—IRLAM LOCKS, SHOWING SLUICES IN THE FOREGROUND.

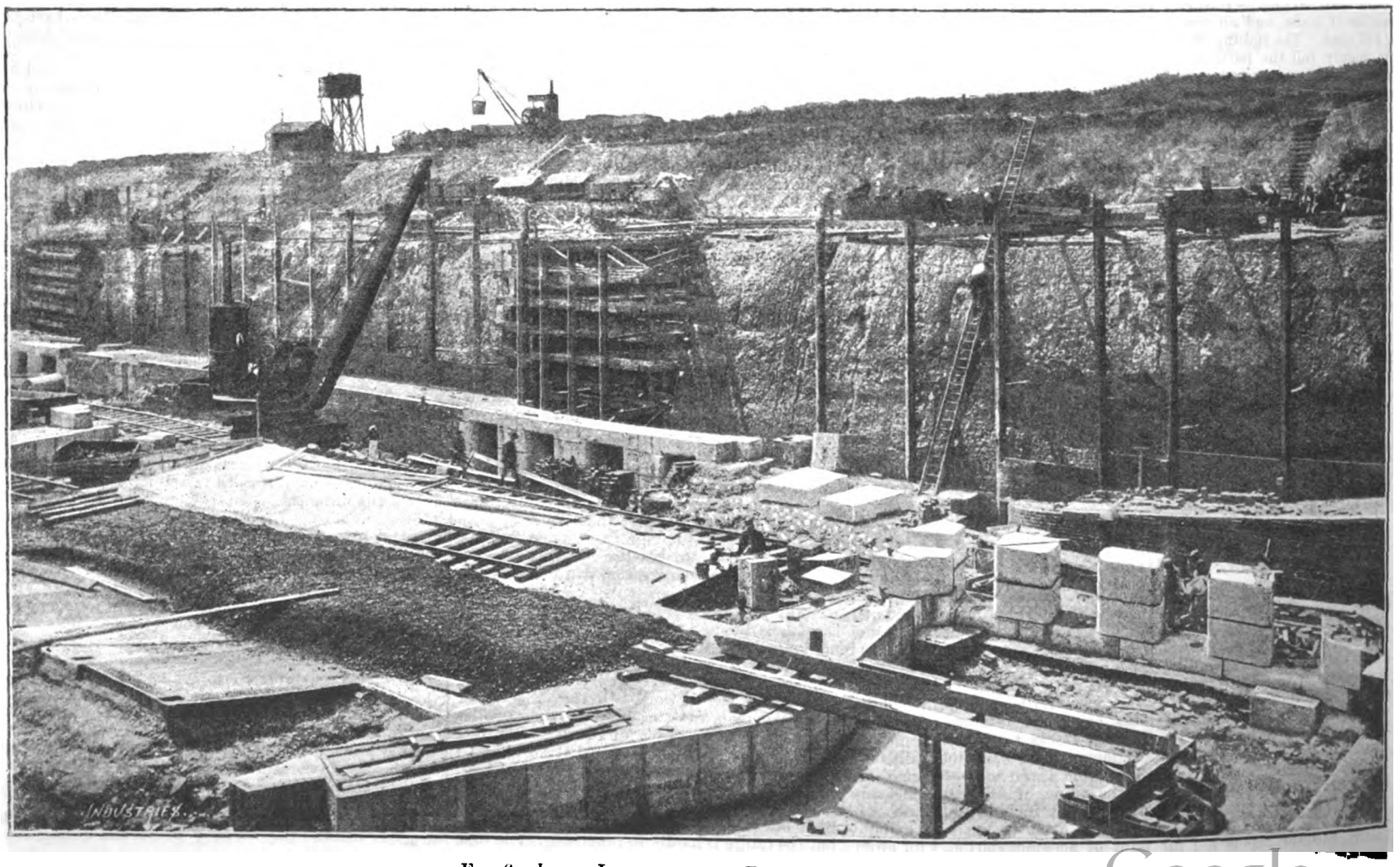


FIG. 6.—IRLAM LOCKS, SHOWING FORMATION OF BOTTOM.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 20TH MARCH, 1891.

THE LONDON WATER SUPPLY.

AT the beginning of the present session we had occasion to review the complex nature of the problem of the future water supply of this great metropolis. Although during the interval considerable progress has been made by the introduction of the Bills which are now under discussion in Parliament, and by the systematising of our information by the County Council and other bodies, the problem is still very complex. As we have already pointed out, the monopolies of the metropolitan water companies are of such a character that many debatable points must necessarily arise in dealing with this topic, and in London there are so many conflicting interests that the solution of the question is not likely to be accomplished without considerable difficulty. Although the problem in London is much more formidable than any similar conversion in our provincial towns, it must not be forgotten that it is one of precisely similar character to that which has been successfully dealt with in several places. Moreover, when the present problem is considered in relation to the wealth and administrative powers of the metropolis, the difficulties are seen to be more than counterbalanced by the special facilities which exist in London for such a step as the one contemplated.

At the present time Parliament is considering no less than six Bills which have reference to this question. The London Water Commission Bill, the Southwark and Vauxhall Water Bill, and the Croydon Water Supply Bill are all of a private nature, and are being petitioned against by the London County Council, while, on the other hand, the Metropolis Water Supply Bill, the London Water (Meter) Bill, and the Metropolitan Water Companies (Charges) Bill are of a public character, and are more likely to meet with success in their original or modified forms. On the motion for the second reading of the London Water Commission Bill, Mr. Baumann said that after twenty-five years of discussions, advocacy before Select Committees of the House, and Royal Commissions, Londoners at last seemed to be within reasonable distance of obtaining the control of their own water supply. We sincerely hope that, notwithstanding the apparent chaos, his wish may be realised. Those who are interested in the question seem to have agreed that the time is now ripe for an amalgamation of the various water companies in London into one corporate body, and the London Water Commission Bill, promoted by the Corporation, and the Metropolis Water Supply Bill, promoted on behalf of the vestries, both formulate this end as the one to be desired. The former of these two Bills only proposes the establishment of a Commission to consider and submit to Parliament Bills dealing with the subject. It will, however, if passed, practically give the power of deciding the question to the City, as the proposed constitution of the Commission is such as to prevent the County Council having a working majority thereon. Under such a Commission it is more than probable that the London water supply would be entrusted to an entirely new body of the nature of a Trust, which would be entirely independent of the existing County Council. The County Council, on the other hand, consider that they should be the body entrusted with these new duties, and hope by opposing the City Bill to obtain their wishes in this direction. The Council further urge that the Commission would be ill adapted to settle the question, not only owing to its hybrid nature, but also to its want of any definite income with which to carry out its work against the probable Parliamentary opposition of the water companies. We believe that the objections urged against it by the County Council are of sufficient weight to lead to the probable final abandonment of this Bill. The Parliamentary Committee of the County Council are likewise strongly opposed to the Metropolis Water Supply Bill of the vestries, partly on the same grounds as have been advanced in opposition to the City Bill, and partly because the Bill assumes that the existing water undertakings must be immediately purchased by arbitration. They point out that such a procedure might cost the metropolis a sum far exceeding the real value of the existing undertakings, and suggest that if powers were given for the establishment of a new supply the price to be paid for the old would at once sink to its normal value. The Committee have, therefore, come to the conclusion that the interests of the citizens will best be served by the opposition of the Council to both these Bills. In the event, however, of a Select Committee being appointed, it is prepared to undertake the question of the water supply of London, subject to the following conditions:—That powers should be conferred on the Council for the introduction into Parliament of Bills dealing with the water question, including the establishment of a new supply, and the improvement of the existing supplies, if further investigation should prove such a course to be desirable, and the Chairman of the Council is to be requested to introduce a public Bill with this object. We thus see that the complexity of the problem is to be still further increased by the County Council's Bill with the above object, and, although rather late in the day, they are to be congratulated on at last taking a forward step in this direction. We cannot help thinking that, if the London County Council had been alive to the urgency of the solution of this problem, they would have formulated their views many months ago, and thus have saved the vestries and the Corporation their labour in attempting to settle the question. The London County Council, if only they can be stimulated to work, are well adapted to undertake this new function, and the feeling which exists as to their unsuitability is mainly caused from their lethargy and tardy action in this and other matters. On previous occasions we have had occasion to criticise their apparent want of action in the reforms needed in the gas lighting of London, and we believe that if the evils of the increasing water rate, due to the quinquennial valuation, had not arisen, their sudden activity at the last moment with regard to the water question might not have taken place. Although delays are proverbially dangerous, the Council's action is better late than never, and we trust that their slow movement is also sure. It must not, however, be forgotten that the County Council were not able, before the Act of last year was passed, to inquire into the question of fresh sources of supply, and that their engineer, Mr. Binnie, has already presented a long report on

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possible new sources of water for London. In this report it is pointed out that much additional information is wanted in order to form an opinion as to the present supply and its possible extension from the River Thames, the River Lea, and the chalk. The report further states that in the event of such inquiries proving that the present sources are inadequate, the Welsh scheme from the Upper Severn, the Welsh scheme from the Upper Wye, the Cumberland Lake scheme, or the Devonshire scheme, the latter being a fresh suggestion of Mr. Binnie, are amongst the proposals for a new source of supply. It cannot be too strongly urged that the continual sinking of artesian wells in the London district is likely to cause very considerable disadvantages to the suburban districts. Moreover, according to any of the proposed schemes, the water will be brought into the metropolis at an altitude of some 240ft. above the level of the Thames, and thus reduce the enormous annual charges of pumping which attend the existing supply. The value of the work begun cannot be over-estimated, and we trust that in a short time we shall find the question, of which we have endeavoured to give a short outline, narrowed down to a definite issue. We hope that out of the confusion which at present exists a line of policy will be evolved which will bring the various conflicting elements into harmony.

THE NEW TORPEDO GUNBOATS.

In a recent article (see *Industries*, Vol. X., page 169) we drew attention to the shortcomings of the "Sharpshooter" type of first-class torpedo gunboats in the matter of speed and power, as revealed by their numerous trials. Since then the Navy Estimates for the ensuing financial year have been issued, and the policy of the Admiralty with regard to further increasing the *matériel* of the Navy by adding to the various types authorised to be constructed under the Naval Defence Act, has been made known. It appears that the first-class torpedo gunboats "Circe" and "Hebe," now on the stocks at Sheerness, and the "Antelope," building at Devonport, the construction of which has been delayed for some time pending alterations, is to be pushed forward, and that two sister vessels, to be named the "Alarm" and "Leda," will be laid down shortly at the former establishment. The engines of the "Hebe" are to be constructed in the dockyard, while contracts for the machinery of the "Circe," and also of the "Alarm" and "Leda," have been placed with Messrs. John Penn & Sons, of Greenwich.

From the close of the last financial year ten vessels of this class have passed through their machinery trials—viz., the "Sharpshooter," "Spanker," "Speedwell," "Seagull," "Salamander," "Sheldrake," "Skipjack," "Gossamer," and the colonial gunboats "Karrakatta" and "Boomerang." Not one of these vessels realised or even approached the 21-knot speed and 4,500 horse-power which were the original estimated figures. The nearest approach, however, to the official figure for horse-power was obtained with the "Karrakatta," which, with her sister the "Boomerang," was built at the Elswick shipyard of Sir William Armstrong, Mitchell, & Co., and engined by Messrs. Belliss & Co., Birmingham. On a three hours' forced draught trial, which took place off Tynemouth in July last, the engines of the "Karrakatta" developed a mean indicated horse-power of 3,840, the air pressure being 1·76in., and the revolutions per minute 270·35. Half-hourly records were taken during the trial, and the greatest horse-power was registered during the sixth half-hour, the total for the port and starboard engines being 3,896·5, a result which may be considered highly satisfactory when taken in comparison with other vessels of her class. The "Boomerang" was subjected to a three hours' trial during the same month, when, with a slightly less pressure of steam in the boilers, the following results were recorded:—Mean horse-power, 3,508; revolutions per minute, 262·3; with an average air pressure in the boiler-room of 2in. of water. With reference to the three hours trial of the "Boomerang," the Admiralty fixed 3,500 as the i.h.p. for this trial, and we believe the contractors were officially ordered not to attempt to exceed this power. The mean horse-power obtained—viz., 3,508—was the nearest approach to the official regulation.

Considering their lightness of construction, too much was expected from this type of vessel in the first instance, but after a lengthened experience, gained from the numerous speed and power trials, the Admiralty have learnt how far it is prudent to force the engines, and have finally concluded that 3,500 horse-power is all that can be safely expected. As a consequence, the estimated power for the machinery of the new vessels has been reduced to this figure, and the stipulated weight on which this power is to be developed is 204 tons, or 17 horse-power per ton. These modified conditions ought to be, and no doubt will be fulfilled without difficulty by the engineers who contract for the machinery, especially in view of what has already been accomplished in the "Karrakatta." The weight of the machinery in this vessel, as in the others of her class engined by Messrs. Belliss & Co., is 160 tons. Taking this figure in relation to the recorded horse-power of 3,840 developed in the "Karrakatta," the horse-power per ton weight of machinery reaches as high as 24. Hitherto the boilers have been a great source of trouble on account of the serious leakage of the tubes which develops after a short period of steaming under forced draught. There is no doubt that the special difficulties experienced with the "Sharpshooter" were largely due to the fact of her being the first of a class, and that a number of trials had to be made before the local vibrations in the hull had been met by special stiffening, which was subsequently introduced into all the other boats of this class. It may be understood, however, from remarks recently made by Lord George Hamilton in the House of Commons, that important improvements are to be embodied in the boilers of the new vessels with a view to realising the modified conditions on trial without fear of disappointment; and it is certain that anything which may be adopted to minimise the difficulties and risks attendant on working under forced draught will be greeted with satisfaction. In the opinion of some experts the wet bottom type of locomotive boiler as fitted in this class is not so well adapted for a forced draught performance as the usual locomotive boiler employed in some of the larger torpedo boats, unless special means are provided for circulating the water. The practice, too, of submitting boilers of this type to the severe ordeal of working at their maximum power almost "straight off the reel," without having previously been used for a considerable time under easy conditions of service, has been objected to by some authorities on the grounds that both boilers and tubes require time to settle into a good working condition. There is scarcely any doubt but that in the early vessels the boilers were worked beyond what they should have been in endeavouring to attain the official estimated results, and it is hardly possible that anything approaching a 19·5 knot speed could be again accomplished without much "puffing and groaning." It is to be hoped, however, that the changes made in the machinery and boilers of the new vessels will enable them to steam continuously at 19 knots, and, if this is realised, it will be much better than being compelled to recognise a paper speed of 21 knots, upon which a reduction of from 12 to 15 per cent. has to be made before the true speed is approached.

THE AMERICAN POSTAL SUBSIDY AND SHIPBUILDING.

The Postal Subsidy Bill, which has been passed by the American Legislature, may be described as a Bill designed to encourage American shipbuilding, for, although the proposal to give direct bounties to the shipbuilders was rejected, the Bill which was carried will have practically the same effect, as it stipulates that the subsidies paid on the miles run are only to be paid on vessels of American build. The modified proposal was accepted by the shipbuilders and shippers, who hoped to benefit by protective measures, not very willingly, and only when they saw that by insisting on more they might lose all. The steamers to be built under the subsidy are divided into four classes, the grants ranging from 66c. per mile for the lowest to $4 per mile for the highest. The latter are intended for the Atlantic trade, and are required to be of 8,000 tons burden, and to have a speed of 20 knots in ordinary weather—that is to say, to be about equal to the best steamers at present on the route. But it is reported that an enterprising syndicate proposes to go beyond this, and build steamers of 12,000 tons and capable of steaming 24 knots per hour, and thus be able to run from New York to Milford Haven at a rate which will allow their passengers to be landed in London within five days from New York. In a recent issue (see *Industries* of the 6th inst.) we gave a sketch of the development of steamer speed on the Atlantic, and stated that, while ordinary mortals were willing to be content with present accommodation, and with a speed which carried them from Liverpool to New York in a little over six days, in the new Cunard liners an attempt was to be made to excel everything that had yet been done in both of these respects. We believe that 21 knots is the speed aimed at in these steamers, but already, before their keels have been laid, we hear of a proposal to attempt 24 knots in the new American steamers. We do not by any means say that the thing is impossible, but we are afraid that in attempting to attain it our American friends may find that their subsidy is more than swallowed up, for the leap from 20 to 24 knots involves a very large proportionate increase of power and of expenditure, and American shipbuilders, who have not yet produced any steamer of a greater speed than 17 knots, should consider well what they are doing before involving their clients in what may prove to them disastrous expenditure. It is stated that it is expected that, within two years, the first four ships will be in commission, and thus be able to share in the great increase of traffic which is expected to take place in connection with the International Exhibition.

The second class of steamers provided for in the Bill are to be of smaller size and speed, being 5,000 tons and 18 knots speed, and are intended for the Pacific trade, and it is understood that the Pacific Mail Steamship Company have already ordered three new steamers, each over 5,000 tons, while the Morgan Steamship Company is building two steamers of about the same size for the South American trade. Smaller subsidies are arranged for smaller steamers for coasting trade, so that every department of the shipping industry in America will be affected. We believe that a movement has been started in the Southern States for establishing direct steam communication with Europe, which promises to lead to practical results. Conventions have recently been held at various Southern ports for the purpose of inaugurating companies, and they have received promises of a considerable amount of support, and if they are fairly launched they will doubtless claim a share of the subsidies. It is still too early even to speculate on the results of these measures on British shipping and shipbuilding, but there can be little doubt that they will have a great effect on the contest of size and speed, which has for some years been going on, and may lead to developments far beyond our present expectations.

THE INFLAMMABLE LIQUIDS BILL.

The Bill which has been introduced into the House of Commons by the Home Secretary, for the purpose of amending and consolidating the law relative to the keeping, selling, and transit of inflammable liquids, is of considerable importance, and will, no doubt, be the subject of a large amount of discussion both in and out of Parliament. Several attempts have been made to legislate on this subject, but unsuccssfully, and the present measure is an elaborate attempt to meet the requirements of all the cases likely to arise.

By the present Acts, petroleum which requires a temperature of not less than 73° Fahr., when tested in Sir F. Abel's closed apparatus, in order to give off an inflammable vapour, is not reckoned as petroleum for the purposes of the Act. The Home Secretary's Bill proposes that there should be no exemption until we reach a flashing point of 150 degrees. The old limit, however, is recognised, and all oils with a flashing point of 73 degrees and under are classed as "mineral spirit," and those above it as "mineral oil," and regulations have been made for the articles to be found in each category. What has hitherto been defined as "petroleum" will, under the proposed measure be known as "mineral spirit," and the regulations regarding it are somewhat drastic. It is only to be kept in premises specially licensed for the purpose, except in quantities not exceeding three gallons. What is defined as "mineral oil" is henceforth not to be kept, except in premises specially licensed or registered under the Act, unless the total quantity does not exceed sixty gallons. No doubt these restrictions would render explosions from inferior kinds of oil far less common, and thus no doubt would add to the public safety; but the question which will require very careful consideration is whether the limitations are not too stringent. The country shopkeepers are up in arms against the measure, and have sent many circulars and petitions to the Home Secretary against the Bill. The Bill has, moreover, raised the opposition of the Scotch mineral oil manufacturers and of the merchants who deal in the article, and, while admitting that certain restrictions and regulations may be necessary, they look upon the present measure as one which will hamper their trade and prevent the free distribution of their products in the cities, villages, and country houses of the kingdom. They point out that there has been no serious accident from the use of their oil, and that the explosions and fires which have occured in private houses have been caused not by paraffin, but by petroleum, or by the use of lamps which were unsuited for either. A clause has been inserted in the Bill which prohibits the sale of dangerous lamps, but it is doubtful whether this is a wise provision, or can be of any practical use. A lamp

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which is safe when sold may, by careless use, be soon rendered unsafe. Moreover, if people are to be guarded in all their actions by Acts of Parliament, what will be the result in every department of life?

In the official report, by Sir F. Abel and Mr. Redwood, there is sufficient evidence that in many cases the lamps used are neither properly made or designed, and that the regulations regarding storage and distribution require some modification, but we are afraid that some of the provisions of the measure would have far-reaching effects little dreamt of at present.

THE LATE SIR JOSEPH BAZALGETTE.

The late Sir Joseph Bazalgette, whose death occurred on the 15th inst., was born in the year 1819, and entered the engineering profession as a pupil of Sir John MacNeil in 1840. In 1845, during the railway mania, he was busily employed on his own account in designing schemes for the construction of railways and ship canals in various parts of the United Kingdom. In 1848 he was appointed an assistant engineer of the Metropolitan Commission of Sewers, and four years later obtained the appointment of chief engineer. In the year 1856 he became engineer to the Metropolitan Board of Works, when it was first constituted, and was called upon to devise and carry out a scheme of main drainage for the metropolis. Sir Joseph Bazalgette's scheme was executed between the years 1858 and 1865, and consists of three parallel sewers, a high level, a middle, and a low level sewer, all of which unite at Abbey Mills, not far from the Stratford Station on the Great Eastern Railway, and are thence carried down to the outfall at Barking, which is some distance below Woolwich. The high level sewer runs along the southern slopes of the Hampstead and Highgate hills; the middle level along Oxford Street, with a branch from Piccadilly; while the low level commences at Chiswick, and, striking the river alongside the railway bridge at Battersea, is carried under the Embankment and up Queen Victoria Street through the heart of the City. We may get an idea of the magnitude of this system, which already, however, has been proved inadequate to its task, from the fact that the average flow of sewage is estimated at 180,000,000 gallons per diem in dry weather. The execution of this scheme has greatly improved the sanitary condition of London, which was previously very unsatisfactory, and has added many years to the average duration of life in the metropolis. Sir Joseph Bazalgette's second important scheme was the construction of the Thames Embankment, which was carried out between the years 1863 and 1874. Before the embankment was made, as many of our readers will remember, there was a long expanse of mud along the banks of the river at low tide, which gave forth an offensive smell, and was very detrimental to health. In those days the contents of the sewers were discharged into the Thames over this mud, and this state of affairs continued until the main drainage system was carried into effect. As chief engineer of the Board of Works, Sir Joseph also had the control of all the bridges over the Thames as far as Hammersmith, with the exception of those in the City, and was responsible for the new Battersea Bridge. He also prepared designs for the new high-level bridge at the Tower, but the City claimed the right to carry out the undertaking at its own expense. On any question connected with railway, gas, or water Bills, Sir Joseph Bazalgette's opinion was of great weight when these Bills were referred to Parliamentary Committees. When the powers of the Board of Works came to an end, about two years ago, Sir Joseph Bazalgette retired, but since that date he has given evidence on several occasions on behalf of the London County Council.

THE SKILLED LABOUR MARKET.

The reports sent in to the Board of Trade by twenty-one trade unions, with a total membership of 239,909, show that of this number 6,231 were unemployed during February, as compared with 8,063 in January. The returns show that the proportion of the unemployed was 2·6 per cent. in February, as compared with 3·37 per cent. in the previous month, whilst the proportion of unemployed in February of last year was 1·4 per cent. The number of strikes was 116, or an increase of 43 on those of the previous month. Of the total number of strikes 29 were connected with coal mining, of which 14 were caused by the strike at the Silksworth Collieries, 29 occurred in the cotton trade, and there were 16 dock strikes. The condition of the skilled industries shows on the whole a distinct improvement on that of the previous two months. This improvement has been caused by the stoppage of the Scottish railway strike, which prevented the supplies of raw material from being forwarded, and by the favourable weather of February, which allowed building and other outdoor trades to resume their activity.

Letters to the Editor.

THE LONDON SMOKE AND FOG PLAGUE.

To the Editor of "Industries."

Sir,—I read with pleasure Mr. Thwaite's admirable reply in your issue of the 13th inst., and would like permission to add a few words.

It is quite true that the present form of fire-places is one which can only be radically changed by a sacrifice of prejudice, but I fail to see that there is any great necessity for altering the open grate system.

For some years I have had in use a Verity's gas stove, and a more effective fire for the purpose I have not seen, but this was attained at the cost of a considerable consumption of gas, making it more expensive than a coal fire by possibly 100 per cent. On one occasion, when it was constantly burning both day and night for six weeks, the saving of trouble in the room in which it was placed must have been very considerable, and with gas at half the price which we pay at present, it would have been a formidable competitor to the ordinary coal grate, and there is no reason to suppose this somewhat wasteful fire cannot be improved when attention is called to it.

The use of gas for cooking purposes has only to be tried in conjunction with cleanly practices to be keenly appreciated. It enables a household to undertake a much greater variety of dainties for the table, and punctuality is attained with much less anxiety to the cook. The labour and discomfort of cooking is enormously reduced.

I have recently been trying a Leeds stove, burned in competition with one of the so-called "condensing" stoves, and the effect upon the room of the former (which has no flue) is much smaller than might have been anticipated. The asbestos head or roof over the flame does not become blackened, although the burners are not atmospheric, but of the ordinary fish-tail pattern. A gasfitter recently expressed his opinion that this was because the burners were very small, and the combustion of gas was more perfect in consequence. I shall be glad to know if this is the case, as if so a solution to one of the difficulties of heating by gas is suggested.

Mr. Thwaite was good enough to refer to my proposal, but condemns the absurdity of perpetuating the wasteful carriage of coal. He is of course perfectly right, but in supporting reforms I am desirous of securing the proverbial "half loaf" when the whole one proves to be unattainable.

The treatment of this subject in our Houses of Legislature is not encouraging, but it is no new experience to see radical propositions treated with ridicule at the onset.

The remark in my first letter as to the production of residuals in the provinces is only partially answered by Mr. Thwaite, as the scheme would, I presume, involve the production of a largely increased quantity. It would be interesting to know how the market would be effected. I have some idea that this knowledge could be obtained if some correspondent would state what is the exported quantity of nitrate of ammonia, and the imported quantity of nitrates, as well as the possible requirements for agricultural and other purposes in this country.

As the project is supposed to deal with only $\frac{1}{7}$th of the fuel consumed in the metropolis, now used in the solid form, as compared with $\frac{1}{2}$th as dealt with at present by gas companies, it only provides for an increase of 40 per cent., an estimate I think very much too low, even assuming that gas firing is not appreciated for small steam boilers.

Yours, &c.,
James Armer, Assoc. M. Inst. C. E.

10 and 11, Queen Street Place, London, E.C.,
16th March, 1891.

THE INSTITUTE OF CHEMISTRY.

To the Editor of "Industries."

Sir,—The perusal of the articles appearing in your paper last month, particularly the opening paragraphs of the first one, reduced me, as a member of the Institute of Chemistry, to such a state of despondency that I was on the point of writing to our Registrar, saying: "*Peccavi*, remove my name instantly from the register, lest haply I be ejected for breaking § 15 par. 5 of our charter: 'Engaging in any occupation . . . . inconsistent with remaining a member of the Institute.'" Sir, I must confess I do not follow the "profession of analytical and consulting chemistry," nor dare I aspire to the name of *locum tenens* even to a professor's laboratory boy. I am a mere works chemist. In fear and trembling, therefore, I followed (though not for the first time) your advice and read the charter, when—joy! In § 5 I found that "chemists in technical industries" were specifically recognised, and so there has been one suicide the less.

Two things are evident from your articles: 1st, that the writer is himself an analytical and consulting chemist—*i.e.*, a public (more or less) analyst; and 2nd, that the time he spent at college was disgracefully misspent, except in so far as his "slumbering in lecture rooms" has helped him to his (probably) present proud position of a member of the Institute. Now, Sir, while I can sympathise with the desire of the analysts to increase the advantages (and incidentally the fees) of their pupils, and while I am behind no one in recognising their eminence in the profession of chemistry, I am fain to confess that, were I looking out for an assistant in my laboratory, I should prefer a professorially trained one, on the ground that eminence in a profession or art by no means postulates the ability to teach, and that of the latter it is easier to judge in the case of a professor, because of the large number of pupils turned out.

So far as I can make out, you desire to make chemistry a close profession (to which I by no means object) *so far only* as regards public analysts, thus leaving to works managers or directors no means of judging as to the competence of the men they desire to engage as chemists: a state of things that would lead to what cynics say already exists in the law—viz., that the lawyers in Parliament so draft the new Bills as to cause increased litigation, by reason of the rule-of-thumb methods into which manufacturers would gradually recede, owing to the lack of efficient technical advice.

I therefore object to the exclusion of all but analysts from the governing body of our one qualifying society.

Yours, &c.,
A Technological Associate.

London, 14th March, 1891.

THE INSTITUTION OF NAVAL ARCHITECTS.

The annual meeting of this Institution was opened on the 18th inst., at the rooms of the Society of Arts, John Street, Adelphi, London.

In moving the adoption of the report, which showed that the success of the Institution had been maintained, the President, Lord Ravensworth, referred to the great loss suffered by the deaths of Mr. Bernard Waymouth and Mr. William John. The council have determined to offer a gold medal for the best paper of the year, provided that it is not written by a member of the council. The council have also endeavoured to assist in the preliminary arrangements for this year's Royal Naval Exhibition in London, and, probably, a second session of the Institution will be held in connection with it. After referring to the papers to be read at this meeting, which he characterised as being of exceptional value, Lord Ravensworth dealt with the shipping industry of this country and its relations to the navy. About the middle of the summer of last year orders were very scarce, and ships were being built at a very low price. This attracted trade, so that the latter part of the year was marked by increased activity. In this way the total was brought up to 1,279,000 tons of shipping in the course of the year, being a decrease of 54,000 tons from the previous year. The prospects for the present year are very favourable, no less than a million tons being now in hand, so that there will be plenty of work for six months at least. The trade has been heavily handicapped by adverse conditions, such as high wages. At the present time there are more ships than there is trade for, and, owing to the high price of fuel, only ships of the newest and most economic type can be made to pay. Just in proportion to the increase of our trade so does Government obligation to provide protection for our mercantile service increase, and he felt bound to say that the activity in the royal dockyards showed that this obligation was met.

The first paper read was by Lord Brassey, on the "Future Policy of Warship Building." The author said that at the present time the reinforcement of the fleet is being pushed on with vigour, but the future programme must shortly be considered. The danger of laying down ships in batches before a single specimen has been tried at sea may be partly averted by their discussions. In considering the programme of future construction, it is essential to consider the two-fold duty of the navy—first, defence against invasion; second, protection of commerce. For the latter purpose the navy must guard the English and Irish Channels and their approaches and all the sea between Ireland and the Peninsula. As the range becomes wider protection must be given, in the open ocean by patrol, in narrower seas by convoy. In considering the programme of the future, not only naval requirements, but also political and financial considerations, must be regarded. It has been announced that the British navy is to be kept equal to the combined strength of any two other Powers, but for cruisers the measure should rather be the tonnage to be protected. The author gave a classification of the relative strength of England, France, and Russia. The following table shows the numbers of ships and their tonnage:—

	England.		France.		Russia.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
First-class battle-ships	32	354,950	14	151,682	16	57,617
Second-class battle-ships	13	89,000	13	98,101	4	21,172
Look-out ships	19	36,390	6	7,740	—	—
Torpedo gun vessels	19	13,150	15	6,501	—	—
Coast defence ships	12	47,720	23	83,727	24	58,374
Armoured cruisers	18	137,050	12	63,446	8	62,223
Protected cruisers, 1st class	11	85,550	6	29,779	1	5,000
Protected cruisers, 2nd and 3rd class	46	157,511	8	17,208	2	5,900

Passing to the consideration of types, a British fleet must go anywhere and do anything. The first-class battle-ships must not be intolerable to the crews; they must be fully sea-keeping and sea-worthy. For this ample freeboard and high bow are essential. As to speed, 17 to 18 knots on the measured mile will be

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sufficient, and coal endurance is hardly less important than speed. The armaments in future will not include the heavy guns, with their limited endurance and all their other disabilities, but will be restricted to 29-ton guns, with a penetration of 21in. at 1,000 yards. Battles will probably commence with attempts to ram, and, as the vessels approach, endeavours will be made to keep down the hostile fire by an incessant hail of bullets. Both major and minor armaments should give the greatest command of fire in the end-on position. Next, with regard to the armour, the introduction of projectiles charged with high explosives renders it indispensable to return to the system of protecting the upper works of ships with armour of limited thickness but of extreme hardness, capable of exploding the shells outboard. This armour is of great value against quick-firing guns.

The several elements which collectively constitute the fighting efficiency of a battle-ship having been dealt with, the limit of dimensions was considered. With every increase of displacement the naval architect can give more effective armament, stouter armour, a higher and more enduring speed, and a more ample coal supply. On the other hand, if dimensions can be kept within a margin of, say, 10,500 tons, as against 14,000, the same tonnage will give eight ships against six. A further argument against vessels of deep draught is their inability to enter any but deep harbours or to come inshore.

In look-out ships speed is essential, armament subordinate. There should be two of these vessels for each first-class battle-ship. As auxiliaries torpedo gun vessels are not less indispensable than look-out ships. They should have high speed and be armed with quick-firing guns. The flotilla for coast defence should include rams, monitors, and armed torpedo vessels of the "Polyphemus" type, improved. For coast and harbour defence a torpedo flotilla has been proved to be in a high degree effective. Experience has shown that the smaller torpedo boats are unseaworthy. It will probably be well to have torpedo boats of two classes. The first class, of not less than 150 tons, should be able to cruise with the fleet within a certain distance from the coast. The second-class boats, for harbour defence, may be of small size and cheap construction.

In cruisers superiority of speed and coal endurance are the primary qualities; weight of armament is subordinate. In the armament of the cruiser the heavy gun of the battle-ship should have no place. An unarmoured cruiser can never engage an ironclad on even terms. The weight absorbed in the 15-ton guns and their mountings of the "Mersey" class might possibly have been better applied in giving more protection to lighter guns. The necessity of a large reinforcement to the Navy of first-class cruisers, of the "Blake" and "Blenheim" and "Edgar" types, is strongly urged, and the necessity for the smaller class is obvious.

All suitable mercantile ships should be enrolled as auxiliary cruisers, and ships in course of construction for the merchant service should be carefully watched by the Government. With regard to expenditure, the amount to be expended during 1891 in France is £2,400,000. In England during 1890–91 the amount is £6,777,666, and for the next financial year £6,351,360. The author regretted to appear as an advocate of heavy expenditure, but it must be undergone if the defence is to bear any proportion to the increase in our mercantile service. Property exceeding £150,000,000 is always afloat under the British flag, and it must be suitably protected or attack and humiliation are invited.

The discussion on the paper was opened by a communication from Admiral Scott, who pointed out the necessity of high freeboard for accurate fire, as proved by the "Rodney." The large amount of water displaced by certain vessels, such as the "Polyphemus," when steaming, tends to render torpedoes nugatory by diverting their travel. Rams are likely to prove an important part of the vessel, though they cannot be used on the broadside of a vessel steaming rapidly, as they would be too much twisted. Simplicity of detail is of the greatest importance. He differed from Lord Brassey, in not wishing for more slow coast-defence ships, and, further, he adhered to vessels of the 14,000-ton class. The coal endurance has been much overrated in previous calculations, as it was mostly derived from the consumption in smooth-water trials, and no allowance had been made for the fuel used for auxiliary engines, search lights, or for the loss of steam in broken pipes, or other incidentals.

Admiral Colomb generally agreed with Lord Brassey's paper. A point, however, not touched on in the paper, is that there is always a sequence in naval warfare—ports cannot be protected at the same time that other ports are attacked. The history of the subject must be largely drawn on in these considerations, as he entirely disbelieved that steam alters the condition of naval warfare. At the beginning there was no classification of ships, except in the matter of size. Experience showed that medium-sized vessels were the best, and this tends to prove the author's point. Cruisers, in the same way, were restricted to 38-gun frigates and a very large number of small vessels to protect commerce. The "Blake" and "Blenheim" type, as equivalents of the 50-gun ships, will therefore tend to disappear. The necessity for two look-out ships to each line of battle-ship is supported by high authority, but does not appear to be backed up by any sound reasons or by precedent. Blockades, the speaker thought, would be an increasingly important factor in war. History, as exemplified in the American and in the Crimean wars, showed this, and also that the difficulty of breaking through has increased, and will increase.

Admiral Hopkins, the Comptroller of the Navy, thought that the paper had been read just at the proper time, when things were ripe for discussion. He proceeded to state the views of the Admiralty, and what they were doing. It is unfortunately true that the coal endurance is less than was calculated. In the new ships provision is made to carry 1,100 tons in place of the 1,000 tons called for by the author. He generally agreed that smaller guns are required. The large guns had failed in details from the first, so that people lost confidence in them. Rams, he thought, would be the chief weapons in the future, and the guns will take a very subordinate position. He did not believe in the "Monitor" type. The navy, in part, does want masts and sails, but it is difficult to apply them to double-screw vessels. It is a question whether a few single-screw ships with sails should not be built for distant stations.

Admiral Mills concurred with Admiral Colomb, and thought that the Admiralty were well advised in preferring 50-ton guns. The policy of large numbers is indubitably right. He had met the Russian officer in charge of the torpedo boat which blew up the Turkish vessel, and learned that his spar broke, but the Turks were so alarmed that they allowed him to tie his torpedo on to their stern and sink the vessel. Spar torpedoes can never be used in a tideway or current.

Captain Long thought sails good on a double-screw boat, but at the same time was of opinion that some ready means ought to be devised for instantly lowering or raising the sailing gear, as it is a pity to lose all the force of the wind. The only danger was, that in action a shot might cause the top hamper to fall and foul the screw.

Admiral Mayne did not agree with the author's classification. With regard to the last paragraph of the paper, he would point out that the navy must always be in position to take up an aggressive footing, but he thought there would be no new programme till after a general election. The fast merchant vessels in case of war would be used as blockade runners to carry food and supplies, so that only second-class vessels could be used for naval purposes. The great imperfection at present is the mixed armament. In the newest vessels there are eleven different kinds of guns, and that necessitates many sorts of ammunition, a fertile ground for mistakes. The guns should be capable of being man-handled in an emergency.

Admiral Morant did not believe in single-screw vessels with sails; they must be short if they are to sail well, and he doubted if other vessels were stable enough to carry sail.

Admiral Horsham drew attention to the fact that there are no coaling stations in the Pacific between Vancouver, Fiji, and the Falkland Islands, with the exception of the store-ship at Coquimbo, which could not be reckoned on in time of war.

Mr. Barnaby referred to the necessity of good boilers, especially for torpedo ships, so that they could get steam enough to go 18 knots. Larger and faster torpedo boats ought to be built.

Mr. Seaton dealt especially with the engineering side of the question of coal consumption. Auxiliary engines have doubtless much to do with the lowering of coal endurance, but there is another factor that had been overlooked. In the old days, ships went at 5 or 6 knots for economy, but this cannot be done with the modern triple-expansion engine. The valves in these engines are generally fixed so as to give the best results at a certain speed; when used at other speeds, no great economy is effected. The only way to remedy this is to carry two sets of valves, one set for low speeds, the other for high speeds.

Lord Brassey briefly replied, and said he was pleased to find that most of the speakers were in accord with him, so that he had practically no points to meet which had not been dealt with by one or other of the speakers.

(To be continued.)

THE LONDON-PARIS TELEPHONE.

The telephone cable between France and England is now successfully laid, and the first words ever spoken beneath the Channel were heard on Tuesday last. The proposal to connect Paris and London by telephone came originally from the French Administration about the time of the negotiations for the purchase of the submarine telegraphs, and it was favourably entertained by Mr. Jackson, Financial Secretary of the Treasury. Experiments, which proved the feasibility of the project, were made by Mr. W. H. Preece, F.R.S., Electrician-in-Chief of the Post Office. The Postmaster-General adopted it, and, finally, its execution was authorised by the French and British Governments. The scheme involved the construction of a trunk telephone line between the two cities, with a novel feature in the shape of a telephone cable across the Straits of Dover, the first ever made for the open sea. It was decided to have two separate circuits, so that if one should fail at any time the other might be in use. The route for the English land line was chosen by Mr. Edward Graves, the engineer-in-chief to the Post Office. It runs along the South-Eastern Railway to a point near Sidcup, and thence by road and rail through Swanley, Maidstone, and Ashford to the cable-house on the beach at St. Margaret's Bay, between Dover and Deal. The wire is of copper, and weighs 400lb. to the mile. It is nearly pure, and has a resistance of about 2·25 ohms a mile at 60° Fahr. It is supported on creosoted wooden poles, 70 yards apart, by means of double-shed porcelain insulators about 25ft. above the ground. The going and returning wires of each circuit are twisted spirally round each other all the way. The twist is made by attaching the wires to the insulators in a rotation, and the spiral is completed by each wire regaining its normal position at every fourth pole—that is to say, every 280 yards. The connection between the last pole on the chalk cliff at St. Margaret's Bay and the cable-hut on the beach is effected by lengths of the cable core enclosed in an iron pipe and buried in a trench down the face of the cliff. The whole line is eighty-five miles long, and its excellence is proved, not only by electrical tests, but by the wonderfully clear and loud speaking through it between the cable-hut and the General Post Office. The French land line follows the direct route of the Chemin de Fer du Nord, through Montdidier and Calais to the cable-house at Sangatte, between Calais and Boulogne. It is similar in construction to the English line, except that only one circuit is run at present, and the copper wire weighs about 600lb. a mile. Its length is about 204 miles. The connecting cable, which is the joint property of the two Governments, was designed by Mr. Preece, and contains four separate conductors, two for each circuit. It was manufactured by Messrs. Siemens Brothers. Each conductor is a strand of seven very pure copper wires, weighing 160lb. per nautical mile or knot, with a resistance of 7·478 to 7·632 ohms per knot at the testing temperature of 75° Fahr. It is covered with three alternate layers of Chatterton's compound and guttapercha, weighing 300lb. per knot. The total weight of each core is, therefore, 460lb. to the knot. The insulation resistance from the wire to the water is not less than 500 megohms per knot after lying in water at a temperature of 75° Fahr. for twenty-four hours before the test and after the conductor has been electrified for a minute. The capacity for induction between the wire and the water outside does not exceed 0·3045 microfarads per knot. The cores are twisted spirally round each other in a strand, so as to change places like the land wires; and to silence the cross talk as much as possible the opposite wires are meant to form part of the same circuit. The stranded cores are covered with tanned hemp, and on this cushion is laid a spiral sheathing of sixteen galvanised iron wires, each 0·28in. thick, with a breaking stress of 3,500lb. Clark's coating of mineral pitch and sand protects the whole.

On Wednesday complimentary speeches were exchanged on the new line between Mr. Raikes and M. Roche, the respective chiefs of the English and French postal services. The speaking was excellent, and Mr. Preece was generally congratulated on this latest triumph of international telephony.

Books Received.

Electric Light Installations and the Management of Accumulators: A Practical Handbook. By Sir David Salomons, Bart., M.A., Assoc.Inst.C.E. Sixth Edition, Revised and Enlarged. London: Whittaker & Co.

Electricity. The Science of the Nineteenth Century. A Sketch for General Readers. By E. M. Caillard. London: John Murray.

Wedding's Basic Bessemer Process. Translated from the German by W. B. Phillips, Ph.D., and Ernst Prochaska. New York: The Scientific Publishing Company.

An Introduction to the Study of Metallurgy. By W. C. Roberts-Austen, C.B., F.R.S. London: C. Griffin & Co.

Mémoires et Compte-Rendu des Travaux de la Société des Ingénieurs Civils. December, 1890.

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Mixed Metals, or Metallic Alloys. By ARTHUR H. HIORNS. London: Macmillan & Co.
Aids in Practical Geology. By GRENVILLE A. J. COLE, F.G.S. London: C. Griffin & Co.

A NEW ELECTRIC HOIST.

THE annexed illustration, for which we are indebted to our American contemporary the *Western Electrician*, represents an electrical hoist recently introduced by the Detroit Motor Company, of Detroit, Michigan, U.S.A. These hoists are made in two sizes of 5 and 10 horse-power, and are so designed that the levers for operating the friction clutch, switch, and brake are brought into such a position as to be easily accessible to the operator. A stout bar connects the two bearing standards at the top. This construction is to prevent any springing apart of the standards when the friction clutch is forced into place. All the parts are substantially made. The motor is provided with a raw-hide pinion, and all the gear wheels are cut to a standard. The switch and resistance box for regulating the speed are fastened to the iron bed-plate.

THE ST. PANCRAS ELECTRICAL EXHIBITION.

WE have had so many electrical and general exhibitions, that there would at first sight scarcely appear to be any opening for a local exhibition at St. Pancras. We believe, however, that the Electricity Committee of the Vestry have adopted one of the very best methods of popularising the electric light in their district; and there is little doubt that their energy will be successfully spent.

The Exhibition was opened for private view on Saturday night, when the committee invited a number of persons interested in electrical matters to meet Professor Crookes. The Exhibition was almost unique in being practically ready at the date of opening, as there were only one or stalls not quite complete, a fact which reflects great credit on the committee, who had only two days in which to transform the vestry hall into an attractive exhibition with electric cables running in all directions.

The formal opening by the Lord Mayor took place on Monday. Unfortunately, a steam valve on the portable engine employed for driving the dynamo got temporarily out of order, and the opening ceremony had to be got through by the aid of gaslight.

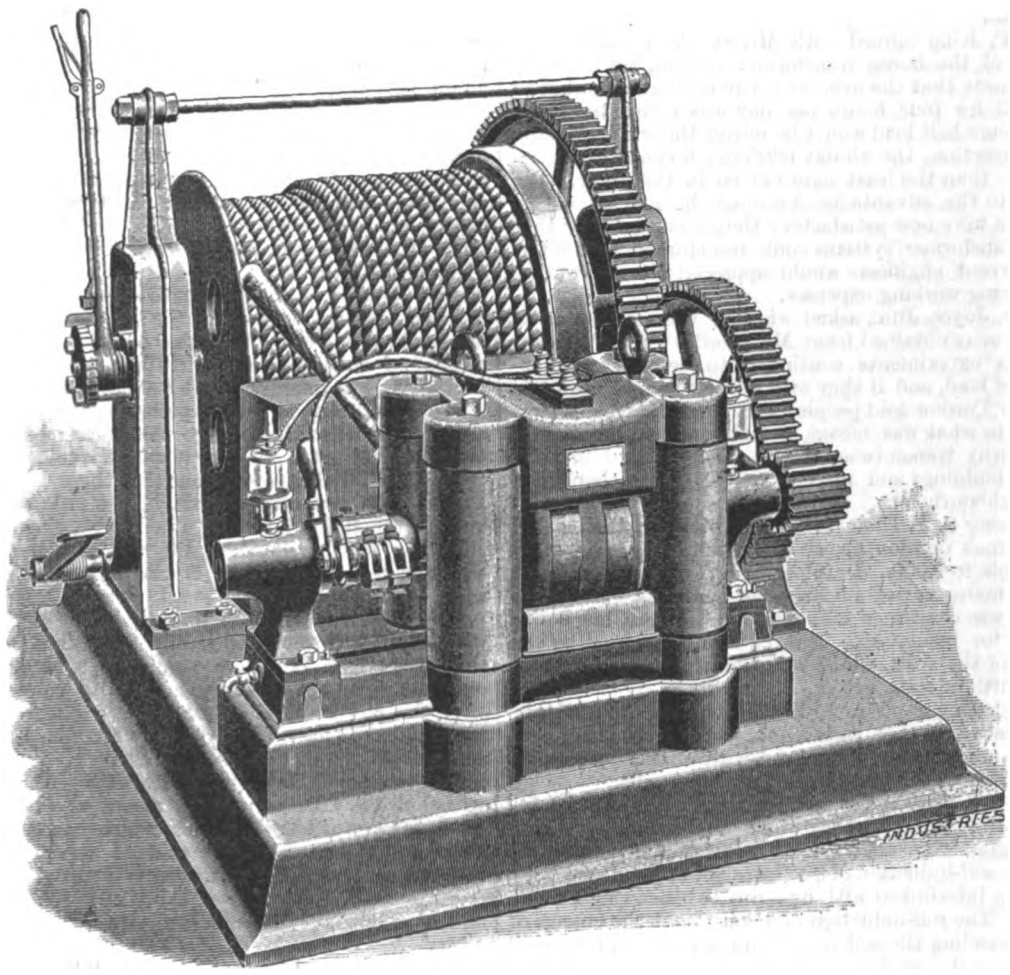
Most of the exhibits consisted chiefly of electric light fittings, many of the designs in brass, copper, and the fashionable wrought-iron work being very beautiful. A good number, however, of the exhibits were of a character specially interesting to the technical electrician. The gramophone, exhibited by the General Electric Company, excited the greatest interest. The room, crowded with people intently pressing tubes to the ears, looked very curious. It is no use now pointing out that such instruments as the phonograph and the graphophone are not electrical. It seems to be settled by general consent that if they are not they ought to be.

Messrs. Johnson & Phillips exhibit the Brockie-Pell arc lamp; and the visitor meets such old friends as Engelbert's lubricator; Ader telephones by Messrs. Miller & Woods; Cockburn fuses, Aron meters, Crocker-Wheeler motors, "Hedgehog" transformers, Schuckert voltmeters, and a host of other specialties by the General Electric Company; the Babcock & Wilcox boiler; Cardew voltmeters and earthing devices by Messrs. Drake & Gorham, Sunbeam lamps, and Planet arc lamps. Messrs. Ferranti exhibit a number of meters. Messrs. Drake & Gorham exhibit some battery plates of a new type. The Acme Company has a very interesting exhibit, including a large number of voltmeters and ammeters and a Teague meter. The General Electric Power and Traction Company exhibit several motors driving fans, drills, and other machinery. Messrs. Paterson & Cooper show a number of measuring instruments of various kinds, arc lamps, motors, &c. Messrs. Strode & Co. have an elaborate exhibit of fittings in a room by itself. The Key's Electric Company exhibit an interesting switchboard and various motors, and a stack of Dolivo instruments. Messrs. Lacombe & Co. have a very interesting exhibit of carbons of various sizes and shapes. Messrs. Caddy & Co. show their chilled face smoke-consuming fire-bars. Messrs. Latimer Clark, Muirhead, & Co. have a very elaborate exhibit of electrical measuring instruments of every sort, and of cables and mains.

The Vestry of St. Pancras intend to supply electrical energy at sixpence per kilowatt hour. This is a move in the right direction. As far as we know, Newcastle-on-Tyne has the lowest tariff of any, and it is to be hoped that St. Pancras will eventually be able to set an even better example of cheapness.

A NEW ELECTRIC HOIST.

CONSTRUCTED BY THE DETROIT MOTOR COMPANY, DETROIT, U.S.A.



GENERAL VIEW.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT a meeting of this Institution, held on the 12th inst., the discussion on Mr. Swinburne's paper, entitled "Transformer Distribution," was resumed.

Mr. A. P. Trotter said the author had been criticised for giving figures instead of facts. This criticism he considered unfair, for it was better to give figures early enough to prevent serious mistakes being made. Had Mr. Swinburne's paper on "Armature Reactions in Direct Current Dynamos" appeared sooner, it would have saved others from falling into error in making large Gramme armatures for constant current machines. On the subject of transformer tests, he said the calorimeter method, to be at all accurate, involved many troublesome corrections, and would require very large vessels. The electrostatic wattmeter methods need to be tried; "split" dynamometers neglected magnetic leakage. Mr. Mordey's thermometer method would, he thought, involve considerable trouble if anything like accurate results were to be obtained, for since the heat was in one case generated in the iron, and in the other in the copper, the fact that a thermometer on the iron gave the same reading did not necessarily show that the energy dissipated in the two cases were identical. Since the last meeting two valuable contributions to our knowledge of transformers had been read before the Physical Society. On the subject of the diminished iron losses at large loads referred to in one of these papers, he would ask whether such a result was consistent with Ewing's theory of magnetism. To him it appeared possible that the losses with rapidly alternating currents may be quite different from those existing for slow cycles. In order to illustrate the fact that physical properties of materials depend on the rapidity of the changes influencing them, he showed that a piece of pitch, which was quite soft and viscous to steady pressures, yet transmitted the rapid vibrations of a tuning fork like a rigid body.

Mr. G. C. Fricker, referring to comparisons of closed and open circuit transformers, said that in estimating the loss in a closed circuit one as 120 watts Mr. Swinburne was in full accord with writers and teachers who hold that the magnetisation is constant at all loads. This assumption was, however, challenged by Mr. Mordey at the last meeting, and he himself doubted its truth. In view of the contradictions between recognised authorities on the theory of transformers, he thought the experimental facts brought forward by Mr. Mordey should not be lightly set aside. So far as these results would affect the comparison of closed and open circuit transformers, Mr. Swinburne might say that the open form would be equally benefited if the new view be correct. He, however, could not agree to this, for the "Hedgehog" type required a very large exciting current, and hence the plant efficiency would be materially lower even during the hours of full load.

Dr. Fleming said Mr. Swinburne had ventilated his opinions against the orthodox views of parallel working, but, so far as he (Dr. Fleming) could see, he merely put forward old views under a new name. On the subject of parallel working, he thought little or no advance had been made since Mr. Mordey's paper was read. Parallel working was then shown to be quite practicable, and is now largely employed on the Continent. He could not agree with Mr. Swinburne that 1,000 volts station pressure was preferable to 2,000, for the cost of the mains in the latter case was only about half that in the former. The employment of 2,000 volts did not seem to be any more dangerous. He doubted whether the use of low-pressure alternators and step up transformers would be safer or more economical, for the waste in the transformers would be considerable, and their cost would probably far exceed the figure quoted by Mr. Swinburne. The chief claim made for the Hedgehog form of transformer was that it gave a more square-shouldered efficiency curve than the closed type. Whether this was so or not was, he said, not a question of calculation, but one on which experiment alone could decide. Such experiments should not be made by a wattmeter where a fine coil and non-inductive resistance were employed, for considerable error may be introduced. Although Mr. Swinburne admitted that the Hedgehog transformer required a large exciting current, he seemed to underrate the effect of this when a number of small transformers were connected up, for it would entail a great waste of coal and lower the plant efficiency.

Mr. Kapp thought the efficiency of the Hedgehog transformer would be increased by closing its magnetic

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circuit, for this would reduce the exciting current, and, by diminishing the magnetic resistance, the lag would be increased; therefore the power would be less, and the plant efficiency greater. He could not see how it was possible for an open circuit transformer, which required a large exciting current all the day, to be more efficient than a closed circuit one. The matter could not be settled by argument, and experiment must be appealed to.

Mr. F. King agreed with Mr. Swinburne about the defects of the house transformer system, but thought his estimate that the average consumption amounted to half load for four hours per day was rather too high; three hours half load would be nearer the truth. Making this correction, the all-day efficiency becomes considerably less than the least figure given in the paper. Referring to the advantages of storage, he said secondary batteries were now satisfactory things, and believed that when transformer systems could use storage, then alternate current engineers would appreciate its importance in reducing working expenses.

Mr. S. Joyce, Jun., asked whether the iron losses in transformers obtained from Mr. Mordey's and Professor Ayrton's experiments continued to decrease with increase of load, and if they ever became zero or negative.

Major Cardew said people's opinions differed considerably as to what was meant by sub-stations; he saw no reason why transformers should not be placed in small lean-to buildings and used to supply several houses in the neighbourhood.

Professor S. P. Thompson hailed with satisfaction Mr. Swinburne's opinion about 1,000 volts being generally preferable to 2,000. Dr. Fleming had said that the cost of the mains varied inversely as the volts. As far as copper was concerned this might be correct, but it was not so for insulation. This, he thought, varied as the square of the volts, whilst compensations, &c., might be as the fifth or sixth power.

Mr. Mordey, replying to Mr. Joyce, said the efficiency curve rises and then falls again, whereas the iron losses fall to a minimum and then rise with further increase of load. Many tests had shown the same result.

Professor Ayrton did not agree with the author's remarks on Slip 4 about the word "self-induction" being meaningless when applied to an armature, and pointed out that the self-induction of a coil was not affected merely by its being interlinked with lines due to other magnetising forces. The self-induction of a coil meant the change of lines threading the coil due to unit current in that coil, and although its value would be affected by the presence of iron, yet under given conditions its meaning was quite definite. The transformer tests made by Mr. Taylor and himself had, he said, been attacked, both because they gave a point of maximum efficiency, and because they showed the loss in iron to be small at full load. No doubt Professor Ewing and Dr. Hopkinson had shown what the losses were when iron was subjected to slow changes of magnetisation, but so far as he knew there was no proof that the same losses occur with rapid reversals.

Mr. Swinburne, in replying to Mr. Esson, said the value of the self-induction given by Dr. Hopkinson referred to the maximum control of two machines of equal e.m.f. running as dynamo and motor. He then observed that, though it was said that his representative closed circuit transformer was not good enough, he had repeatedly asked for particulars of a better one, but they had not been produced. Though he had done so in his B.A. paper, he was not now called upon to design closed circuit transformers for his opponents, and in his present paper he had taken a commercial "Hedgehog" and had compared it with a commercial closed circuit transformer. His "freezing mixture" statement, he said, was not based on Ewing's curves, for he found that, according to Ferrari's tests, the loss in the whole transformer was less than the loss by resistance, and so the iron must have actually supplied power to the circuit. The readings were taken by the split dynamometer method, and proved its worthlessness. Mr. Mordey's figures were, he said, shown to be inaccurate by their agreement with those of Professor Ayrton and Mr. Taylor, which were taken by the split dynamometer method, and thus gave too high efficiency, especially at full load. Whether the iron losses become smaller or not at full load was, he said, of little importance to his contention, for if it be admitted that they are large at no load, his point as to the superiority of the open circuit type was proved. Any wattmeter would not give accurate results in transformer measurements, and before one is used it should be carefully checked both with direct and alternating currents on resistances and choking coils. Mr. Kapp's and Mr. Esson's argument that a "Hedgehog" would be improved by closing the iron circuit was, he said, bad, for that would double the iron loss. The large exciting current was not a serious matter, for, although speakers had overlooked the fact, this could be supplied by condensers or by the arrangement of a dynamo running loose.

THE PHYSICAL SOCIETY.

At a meeting of this Society, held on the 6th inst., Professor W. E. Ayrton, F.R.S., President, being in the chair, Mr. James Swinburne read a "Note on Electrostatic Wattmeters."

After referring to the history of the electrometer method of measuring power developed by alternating currents, the author pointed out that the necessity for taking two readings from which to determine the watts might be obviated by having the quadrants separate instead of connected in pairs as in the ordinary method. Non-inductive resistances are connected to the transformer, motor, or other apparatus in which the power is to be measured, so as to be in series with the apparatus and on opposite sides of it, and the four ends of these two resistances are connected with the four quadrants. Under these circumstances the deflection of the needle is a measure of the watts. To increase the maximum deflection obtainable, so as to make an instrument capable of being read by a pointer, the needle is made in two halves, fixed one below the other on the same stem, and instead of quadrants, semi-circular boxes are employed. In this way a range of about 130 degrees is obtainable.

Professor Perry, in the discussion which followed, inquired as to what kind of *law* the instrument had, and Mr. Blakesley asked whether it was convenient to use.

Mr. E. W. Smith pointed out that there was no necessity to take two observations in the ordinary electrometer method, for by using a false zero, one deflection gave the watts. Further, the use of the false zero rendered it unnecessary to employ any other voltmeter when experimenting at constant pressure.

The President said the historical part of the paper was not quite correct, and recalled attention to the fact that when high pressures were used, a single reading obtained with the ordinary method of connecting up gave the power. For ordinary low voltages, however, the false zero method described by Mr. Smith was very convenient.

Mr. Swinburne, in reply to Mr. Smith, said the observation of the false zero really meant another reading. As to the law of his wattmeter, referred to by Professor Perry and the President, he said he never calculated a law, but calibrated the instruments directly.

Professor S. P. Thompson, D.Sc., now took the chair, and a paper on "Interference with Alternating Currents," by Professor W. E. Ayrton, F.R.S., and Dr. Sumpner, was read by the latter. The paper related to the phenomena which occur when alternating electric pressures are impressed on circuits made up of various combinations of resistances, condensers, arcs, and inductive coils; to the characteristics of alternators; to the properties of transformers; and to the peculiarities exhibited by the Ferranti mains. In one of the experiments an inductive coil and a condenser were connected in series, and a pressure of 25 volts, as measured by a Cardew voltmeter, impressed on its terminals; the pressures on the two parts, measured in the same way, were 110 and 104 volts respectively, thus showing that each of the two parts was much greater than the whole. On joining a condenser and an inductive coil in parallel, an ammeter in the main circuit indicated 5·5 amperes, whilst those in the branches showed 6·4 amperes passing through the condenser and 10 amperes through the coil. Other experiments of a similar nature were described, and it was pointed out that the ratio of the sum of the two parts to the measured total may be large, being about 8 in the case first mentioned. Theoretically this rate might be anything, depending as it does on the phases of the pressures in the two parts, and these phases are determined by the ratio of the impedance of the coil to its resistance; practically, however, it was not easy to get a coil of large self-induction and very small resistance. Alternate current arcs and condensers give results of the same general character as those above described, as also do arcs and inductive coils, such as the regulating coils of lamps; this may cause considerable error in estimating the power supplied to such lamps. The magnitude of the error was found to depend greatly on the quality of the carbons and the character of the arc. With bad carbons and a hissing arc the error was very great, but with good cored carbons, burning steadily, it was not very serious. Combinations of inductive and non-inductive coils exhibit marked peculiarities, particularly if the inductive one be a transformer coil. This last arrangement gave distinct evidence of interference, or difference of phase, when the secondary of the transformer was open, but when closed, and with a moderate load, the difference of phase disappeared, thus showing that under these circumstances the primary coil has no appreciable self-induction.

On the subject of alternator characteristics, a graphical method of drawing the e.m.f. curve from the terminal curve was described, and the dependence of the terminal curves on the character of the external circuit pointed out. Keeping the speed, exciting current, and armature current constant, the pressure between the terminals was shown to be dependent on whether the external circuit consisted of condensers, resistances, or inductive coils, the pressure being greatest in the former case and least in the latter. The true e.m.f. of the dynamo, however, was the same in all the cases, but it became less as the armature current increased. From these results the authors conclude that the drop in e.m.f. with large currents is due to reaction on the field, but that the change of terminal pressure cannot be all attributed to this cause.

Transformers, it was shown, are powerful controllers of phase, for the primary and secondary currents are nearly always circulating in opposite senses; the phase angle for a 1 to 1 Mordey transformer experimented on varying from 170° at no load to 180° at full load. The relation between the strengths of the primary and secondary currents A_p and A_s was found to be a linear one, of the form $P/S\,A_p = \alpha + \beta\,A_s$, where P and S are the numbers of turns in the primary and secondary respectively, and α and β constants, α representing the exciting current and β being nearly unity. The phase angle ϕ between the currents was given by the equation—

$$-\cos\phi = \frac{\frac{1+\beta^2}{2}A_s + \alpha\beta}{\beta A_s + \alpha}$$

The results of numerous experiments on a transformer of the Mordey type, in which coils having different numbers of turns were put in parallel with each other, were given. In some cases resistances were put in circuit with the coils, and in others one or more of these resistances were cut out. Remarkable interference effects were thus produced, for in some combinations the volts or currents were additive, whilst in others they were nearly differential. In connection with the "Ferranti effect," experiments had been made by putting a condenser on the terminals of the secondary of a transformer, and noting the resulting increases in pressure both in the primary and secondary circuits. The results obtained with a given condenser and approximately constant secondary pressure show—(1) That whether the transformation be up or down, the percentage rise in the secondary is greater than that in the primary; (2) that these percentage rises diminish as the secondary current increases; (3) that they increase with the ratio of transformation; (4) that the rise in the secondary may be considerable without that in the primary being appreciable; (5) that the rise in the secondary still persists, even when large currents are flowing.

These facts lead the authors to believe that the Ferranti effect is due to some kind of interaction between the cable condenser and the self-induction of the transformer, and that it is not wholly due to armature reactions in the dynamo.

In the discussion on the paper, Mr. Swinburne said the character of the Ferranti effect had been wrongly stated, for he understood Professor Ayrton to say that the pressure in the Ferranti mains was greater at the London end than at Deptford. This, he contended, was impossible. He also said the effects now described, of putting a condenser on the secondary of a transformer, and noticing the rise in both primary and secondary volts, were due to the waste field of the transformer. In large transformers, such as those at Deptford, the magnetic leakage was proportionately much less, and no such effects would be noticeable with them. Referring to the relation between the primary and secondary currents in transformers, he said it was convenient to look at the primary from two points of view, and consider one part of it as producing the magnetisation, and the other as neutralising the effect of the secondary current.

Mr. Mordey described an experiment on armature reactions in alternators, in which one of the armature coils of a 50 horse-power machine was isolated from the rest and connected directly to a Cardew voltmeter. On varying the load from 0 to the full output (20 amperes), the voltmeter on the isolated coil was quite stationary, thus showing that no appreciable armature reaction occurred.

Mr. E. W. Smith remarked that the formula connecting the primary and secondary currents holds true over a very wide range, for he had experimented on a Kapp transformer, which gave (α) constant and (β) = 1 for frequencies varying from 20 to 200.

Mr. Blakesley gave the following formula as applying to transformer currents generally—

$$\left(\frac{Ar}{As}\right)^2 = \frac{n^2}{m^2}\left\{(1+kr_2^2) + \frac{q r_2^2}{v}\right\}$$ where r_2 = resistance

of secondary, v is proportional to the frequency, m and n the primary and secondary turns, and k and q are constants depending on the disposition of the iron. This formula he found to very nearly represent Ferrari's results, and he hoped others would test its applicability to various types of transformers. He believed himself

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to be the first who carried out an interference experiment, when he put a condenser in parallel with an inductive coil six years ago. He mentioned the matter now, because that arrangement had been put forward by Mr. Glazebrook in explanation of the "Ferranti effect. Mr. Glazebrook, however, had made an error in stating that, under certain conditions, one of the currents may become infinite.

Dr. Thompson thought the word interference had been used in a somewhat different sense to its ordinary usage in optics, and asked for an authoritative definition of its meaning in the paper under discussion. The experiments on the alternating arc he considered very remarkable, as well as those on the dynamo, which give various terminal pressures when its e.m.f. and current were the same, but the external circuit of different character.

Professor Ayrton pointed out that the measurements on the rise of volts by putting on condensers mentioned in the paper were not strictly analogous to those made by Mr. Ferranti, for his were made by pilot transformers, one placed between the primary terminals of the Deptford transformer, and the other on the secondary of the London transformer, whereas in the cases now brought forward the volts measured were those at the primary and secondary of the same transformer. On the subject of arc lamps, he said that Messrs. Kolkhorst, Thornton, and Weekes, who made the experiments, found that great lag only occurred when the carbons were bad and the arc hissing. If the apparent and the true power spent in such an arc were measured, a great difference existed between them. Dr. Hopkinson, he said, had shown that this might be expected if the arc had a constant back e.m.f. which changed sign with the direction of the current.

A paper on "The Theory of Dissociation into Ions and its Consequences," by Professor S. U. Pickering, F.R.S., and another on "Some Points in Electrolysis," by Mr. J. Swinburne, were postponed.

Referring to the meeting held on the 27th ult., the transformer on which the tests described in Professor Ayrton's and Mr. Taylor's paper were made was of the Mordey type, having been kindly lent by the Brush Electrical Engineering Corporation.

MODERN CHEMISTRY IN ITS RELATION TO SANITATION.

Dr. Tidy, in his second lecture at the Royal Institution, on the 12th inst., proceeded to show that whereas the three natural disinfectants of air, water, and earth were adequate for primitive times, the conditions of advanced civilisation necessitated the supplementing of nature's processes by the use of disinfectants made by man, and by their employment an endeavour was made to counterbalance the unnatural conditions of life in large towns. Water, the second of the natural disinfectants, acts like air, both being mechanical and chemical agents. A good shower of rain, by washing the air, has often been the turning point in the history of an epidemic. Although the cleansing power of running water is considerable, local authorities and engineers have probably in the past relied too much on the mechanical systems of cleansing, as infection was often so subtle that chemical agents alone were capable of destroying its power. As our rivers have thus been utilised for the removal of pollution by the drainage systems of towns situated on their banks, a question of considerable importance arises as to probable pollution and infection of the water supply of towns situate lower down such streams. The efficacy of filtration is, however, very remarkable in purifying a river before use as a water supply for a town, and the enormous dilution of the sewage, the rapidity of the flow, the length of run, and the presence of vegetable life in the river are all important factors in bringing about the removal of any impurities which may be introduced.

Sewage in suspension is also considerably removed by subsidence, whilst the presence of animal life and the direct oxidation of the organic matter by the dissolved air further tend to reduce possible dangers to a minimum. In most river waters there are 2 cubic inches of oxygen dissolved in every gallon, and it is easy, by Schutzenberger's method, to estimate its amount. Running water also very rapidly absorbs oxygen from the air if any causes have been at work to remove it from the water, and thus a river acts as a carrier of the oxygen of the air to the organic matter, and brings about its oxidation. In most rivers an inspection of the condition of the bed and banks for some distance below a sewage outfall is sufficient to demonstrate the rapidity with which such pollution is removed by these agencies, and Dr. Tidy, some years ago, further showed by direct experiment that, in a run of one mile in an artificial channel, the oxygen in polluted water was reduced from 100 to 38 by the oxidation of the organic matter present, which fell from 100 to 53 by the oxidation. Fish and vegetation in a river must considerably augment this rate of removal, and, although the experiments only indicated the rapid destruction of the organic matter, there can be no doubt that the real infection due to the spores or bacteria present is at the same time removed. In conjunction with Professor Odling and Mr. Crookes, the lecturer has also established the fact that bacteria when introduced into distilled water or Thames water die in a few hours, and in no case could any living bacteria or growth be recognised after an interval of six hours. It has further been noticed that in cholera epidemics there has never been, with possibly one exception, an outbreak which followed the flow of the river, so that the self-purification of water renders it one of nature's most useful disinfectants. The disinfecting power of earth is generally acknowledged, and the outcry against graveyards is probably much exaggerated. The deodorising properties of earth are well known, its action being similar to the absorption of ammonia by charcoal, and to that of a platinum wire, which, when dry and warm, coerces the chemical union between the oxygen of the air and coal gas. Earth also contains organisms which have the special function of bringing about the destruction or oxidation of organic matter, ammonia being converted into nitrates in this way.

An artificial disinfectant may be defined as a chemical which prevents or destroys hurtful things or things which cause offence to the sense of smell. There are, however, many dangerous fallacies in their use, and the unblushing quackery which exists in the manufacture and sale of many renders it important to be able to test the efficacy and relative merits of such artificial disinfectants. They may be divided into four classes—(1) Those which prevent decay, *e.g.*, refrigeration; (2) those which assist decay, *e.g.*, Condy's fluid; (3) those which hurry it on; and (4) special agents. In concluding, Dr. Tidy sketched the changes which increase of knowledge had caused in the methods for increasing the efficacy of artificial disinfectants.

SEWAGE TREATMENT.

On the 3rd inst. a lecture was given by Mr. G. E. Davis, in the Manchester Technical Laboratory, in which he described his new process of sewage treatment. At the opening of his lecture Mr. Davis referred to the growing importance of the sewage question from a sanitary point of view. Treatment of sewage matter was easier when the storm water was kept separate from the sewage proper by the "Menzies" or "separate system" of sewers. This arrangement, however, was not generally adopted, on account of expense. Refuse from chemical and other works, together with organic matter and road detritus, were all found in sewage. The Salford sewage possessed a daily volume of 10,000,000 gallons, which would produce per day:—

Suspended matters, mineral	2·0	tons.
" " organic	3·5	"
Total soluble solids	58·0	"
Total hardness	7·7	"
Chlorine	19·9	"
Alkalinity	11·2	"
Total ammonia	0·9	"
Iron	0·4	"
Lime	5·6	"
Soluble organic matter	13·5	"

The above would give an idea of the quantities to be dealt with in a works such as Salford. The soluble organic matter was the most important impurity to be dealt with. It consisted of complex nitrogenous matters, which, however, were easily decomposed by many metallic bodies and also alkalies, to form innocuous compounds.

The complete clarification of sewage by subsidence alone was impossible on account of its glutinous nature; for the same reason continuous filtration could not be employed. The soluble organic matter of such a sewage as Salford was slowly oxidised by the atmosphere; the author calculated that 7¾ tons of oxygen, or 1,000,000 cubic feet of air daily, would be required to oxidise the sewage to a safe point. When the crude sewage of large towns passed into a river it combined with the road detritus to form a silt at the mouth of the river. The Tyne at Newcastle, the Humber at Hull, the Thames at Gravesend, the Itchen at Southampton, and the Mersey at Seacombe were quoted as examples of this. In a paper in the *Archæological Journal* for 1885 an account was given of the manufacture of Portland cement from the above river deposits after they had been mixed with chalk.

Coming to the pecuniary inducements to the treatment of sewage, the author said that most inventors had had an eye to extracting hidden wealth in the shape of ammonia and phosphates. The nitrogen contents of the Salford sewage were equal to 3 tons of ammonium sulphate daily, or a yearly value of £11,000, and yet there was no process worked which would extract that ammonia economically. The problem of extracting ¾ of a ton of ammonia from 50,000 tons of water was no easy task. The ammonia was principally found in the soluble portion of the sewage—a fact which had been in a great measure overlooked by those expectant of profits. Some inventors seemed to think that there was a mine of wealth in the sludge, but, in the author's opinion, its use as a manure had better be left out of account, as its fertilising ingredients could only be practically of use in irrigation processes. The various processes of sewage treatment in actual use might be classified as:—(1) Filtration Processes.—Irrigation was essentially the most rational of all filtration processes. He did not think that raw sewage should be applied to land, but, wherever possible, the effluent from a precipitation process should be put on land, as the value of sewage as a fertiliser lay in the effluent. As in fresh sewage more than half the albumenoids were insoluble, filtration would remove these as well as the suspended matters, but filtration was attended with many practical difficulties. (2) Oxidation and Reduction Processes.—The least expensive method was to blow air through. The Salford sewage, as he had already pointed out, required theoretically the oxygen of 1,000,000 cubic feet of air daily, but, judging from other applications of blast, he estimated that it would require sixteen times that amount in practice, and he had calculated the cost of aëration on that basis. No doubt aëration was useful, and Dr. Angus Smith had suggested that probably a combination of the lime process with aëration would be the best that could be adopted. Another method of aëration consisted in running the liquid down a packed tower against a current of air. Bleaching powder, if used as an oxidant, would cost Salford £200,000 yearly. Manganates and permanganates, if used in sufficient quantities for complete oxidation, would be far too expensive, and in insufficient quantity were of no use. (3) Precipitation Processes.—He would not attempt to deal with the large number of processes in this section, but wished to point out clearly that the action was in all cases a chemical one, and failure would result if the proper portion of precipitant was not used. Owing to the cost of chemicals, and to the difficulty of disposing of the sludge, most of these processes were failures. The chief faults of the lime process as at present carried out were that, if only a small quantity of lime was used, it was all seized upon by the carbonic acid in the water, and very little purification was effected. On the addition of more lime, say 18 cwt. per million gallons, some of the soluble organic matter was acted upon, but, as he showed by some analyses of the Leeds sewage, complete purification was not effected until 2 tons of lime had been added. The peculiar odour of the effluent was completely destroyed by aëration, and a clear liquid resulted. This, however, was highly alkaline, and, therefore, an objectionable liquid to enter a stream. The present tendency was to keep down the amount of sludge formed which was in proportion to the lime used, but if the sludge could be turned to profitable account the case would be different. He claimed that by a combined lime and aëration process he had succeeded in—

(1) Removing the whole of the insoluble albumenoids;
(2) Removing 45 per cent. of the soluble albumenoids;
(3) Completely deodorising the affluent;
(4) Restoring the neutrality of the effluent; and
(5) Utilising the sludge at a profit.

The processes were shortly as follows:—The lime is added in two lots: in the first mixer about 7 cwt. per million gallons are added to combine with the carbonic acid; in a second mixer 33 cwt. more lime is added. The mixture then flows through a series of settling tanks, a clear effluent being obtained. This now passes into a chamber, where it is treated with a current of air and carbonic acid. Here the organic odours are oxidised and the excess of lime precipitated as carbonate. If the sewage is strong in ammonia the gases from this chamber are passed through a packed scrubber moistened with sulphuric acid, and the ammonia is recovered as sulphate. The effluent from the precipitated carbonate of lime is quite neutral, free from odour, and unalterable in the air. The sludge, after being mixed with the proper proportion of silicate of alumina, is made into Portland cement. It is first dried in a chamber by the waste heat coming from the cement kiln, which is built alongside. The heat passing over the sludge dries it and takes up ammonia, which is recovered in an acid tower through which the gases pass. The gases from this chamber contain quite enough carbonic acid derived from the coke and chalk of the kiln to carbonate the lime as above described. The carbonic acid is thus obtained for nothing, and is used over and over again.

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SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

At a meeting held on the 16th inst. Mr. W. Crowder read a paper entitled "Observations made in the Working of Vitriol Chambers," in which he gave details of the actual working of his own plant, consisting of a series of four chambers, extending over a long interval of time. The paper was arranged so as to show the variation of yield of acid in the different chambers under the varying conditions of ordinary working, and illustrated the close relationship which exists between the diurnal atmospheric temperature variations and the quantity of acid produced per diem. The composition of the gases in the towers and chambers was also traced, showing the gradual diminution in the quantity of sulphurous acid in the progress of the gases through the plant, and the author confirmed in many points the observations of previous investigators on the necessary conditions required for the successful economic working of a well-equipped vitriol plant.

Mr. Tyrer, in moving a vote of thanks to the author for his paper, drew attention to the enormous amount of labour entailed in obtaining daily statistics for so long a period, and hoped that the author, by availing himself of the conclusions which his average yields indicated, would be able to compete successfully in these days of trade rivalry in the manufacture of vitriol.

Mr. A. H. Allen next read a paper on "The Chemistry of Whisky and Allied Products," in which he gave an outline of the Scotch and Irish whisky industry, and pointed out the essential chemical differences in that produced by pot stills and the silent spirit of patent stills. In Scotland pure malt only is employed in the pot stills, whilst in Ireland a mixture of malt and unmalted grain is used. No less than 1,739 illicit stills were discovered in Ireland during last year, but it is noteworthy that Scotland and England are comparatively free from seriously following this illegal industry. The one point of interest in the paper was the allusion to the utilisation of the pot ale and spent malt for agricultural purposes, regarding which Mr. Cross, in the discussion which followed, stated that in America the pot ale was being utilised for the preparation of lactic acid on a commercial scale, and that, being an alcoholic acid, it would no doubt be found a valuable substance in the dyeing and calico printing industries. The author next referred to the methods employed for the estimation of fusel oil in whiskies and allied products, with especial reference to the recent work of the House of Commons inquiry on this subject. He pointed out that although on the Continent much work had been done in this direction, in England, before the inquiry was started last year, a few analyses by Dupré were practically the only information on the amount of fusel oil in British whiskies, and that some of the more recent determinations were misleading, as the analysts had made no allowance for the ethers present in the spirit, which, if not decomposed, are absorbed by chloroform, and thus raise the apparent quantity of fusel oil returned as present in the whisky. This error gives results which in many cases do not show the gradual removal of the fusel oil from the whisky by ageing, but by treating the spirit with caustic potash before estimating the fusel oil the ethereal compounds present are broken up, and the difficulty is overcome. As a result of his recent work, he concludes that Irish and Scotch whiskies contain a much smaller quantity of fusel oil than is found in many Continental spirits, that ageing in wooden casks considerably diminishes the small quantity present, and that even as much as 2 per cent. of fusel oil has no injurious effect, although it imparts a very nauseous taste to the spirit. The author believes that the deleterious effects of new and raw whiskies is probably due to some other compound present in such spirits, and hopes shortly to communicate further information on these points.

Notes.

THE LAKE OF GENEVA.

Some researches have recently been made by M. Delebecque, a French engineer, into the physical features of the Lakes of Geneva and Annecy, and have been communicated by him to the Paris Academy of Sciences. A more complete knowledge of the Lake of Geneva has thus been obtained, according to which a map on the scale of 1-25,000th has been constructed. The lake is divided into two unequal parts by an elevation of its bed known as the bar of Nernier or Promenthoux, corresponding to the sudden contraction of width from east to west, which separates the Grand Lac, prolonged towards the Alps, from the Petit Lac, which runs in the direction of the Jura. The maximum depth of the Grand Lac, between Evian and Ouchy, is 1,017ft., and its bed forms a large plain with very little slope. Over a surface of about 18 square miles the variation in level is not more than 16½ft. The inclination of the lateral slopes varies from between 1 deg. and 2 deg. in the Bays of Rolle and Condrée to 56 deg. at the Castle of Chillon. The Petit Lac consists of four small basins, with a maximum depth of 249ft., separated by flattened bars. Opposite Bellerive, and from a depth of 82ft., rises a little hill, the top of which is only 26ft. below the surface. Other peculiarities of the lake-bed which have been noticed by previous observers are the ravine of the Rhone and the delta of the Dranse, a characteristic type of torrential deltas. The ravine of the Rhone has been traced for nearly four miles from where the river enters the lake, and is from 300ft. to 500ft. in width. The surface of the lake is 224 square miles in extent; its volume, 89 milliards of cubic metres; and its mean depth, 429ft.

THE LONDON ELECTRIC SUPPLY CORPORATION.

The report of Mr. Ferranti, the engineer to the above-named Corporation, as to the present position of the undertaking is, on the whole, very satisfactory. The mains are working well, and the difficulties in insulating 10,000 volts seem to have been illusory. In fact the Oërlikon Company now proposes to transmit power at 30,000 volts. The engines and dynamos at Deptford are working, and parallel running has been found to be possible, which is a great advantage. We also hear little of disturbances of the telephone systems, and other difficulties seem to be rapidly melting away. There are eighteen miles of concentric cable now in use, and carrying capacity enough to supply 300,000 lights, or more than three times the present output.

A CURIOUS EXPERIMENT.

During the discussion at the Institution of Electrical Engineers last Thursday, Mr. A. P. Trotter showed a very curious experiment. The vibrations of a tuning fork were transmitted by a piece of pitch without being sensibly diminished by its viscosity. The discussion on loss by hysteresis in iron must not be extended indefinitely, but, without going into Mr. Trotter's deductions from his experiment, a curious phenomenon that can be observed in "Willoughby Smith" may be mentioned. If a stick of this compound be bent, it will gradually straighten itself again. If it is first bent in one direction, say to the right, and is then quickly bent to the left, it will first unbend its last bend by moving to the right, and will then stop, and finally move to the left to undo the effects of the first bending. Of course "Willoughby Smith," or as it is generally erroneously called, "Chatterton," is not really viscous like pitch or marine glue; the rubber or gutta percha in its composition seems to retain its properties to a great extent.

THE PRINCE OF MONACO'S YACHT.

The electric lighting of the Prince of Monaco's yacht "Princess Alice" has been placed in the hands of Messrs. Woodhouse & Rawson United, Limited, electrical and mechanical engineers, 88, Queen Victoria Street, London, E.C. The engine is of the single-cylinder vertical type, running at from 200 to 250 revolutions per minute, according to the e.m.f. required, with a steam pressure of 150lb., and is provided with an extended bed-plate for receiving the dynamo, which is coupled direct to the engine, and gives, when running at 250 revolutions per minute, current for 100 16 c.p. lamps at an e.m.f. of 135 volts, this particular e.m.f. being provided to allow of charging the accumulators. The number of lamps installed throughout the yacht will be about 100, the fittings being of an elaborate description, and designed specially for this installation. The whole of the arrangements are not yet completed, but in all probability there will be provided a set of accumulators, a projector, and also a powerful submarine arc lamp for carrying on scientific observations at night.

COAL MINING IN CHINA.

The supply of coal from Japan, which is obtained for the use of foreign steamers, is now an important factor in Eastern trade, while the quantities exported to China and the Australian colonies are very considerable. The Chinese have done something in the way of supplying themselves with coal from their own resources, but only in a small and very imperfect manner. Attention is now, however, being paid to the subject, and in various districts attempts are being made to develop the coal supplies. The Viceroy of Liang Hu Provinces has issued a proclamation in which after pointing out the great uses of coal to manufacturers he announces his attention of using no foreign coal in future for any of the schemes which the Government have in hand, but to depend entirely on the native supply. He has evidently been prospecting and experimenting, and also making calculations as to the probable amount to be required in the near future in the private and Government factories, and by the steamship companies. In his proclamation he says, "I will take all the coal, whether hard or soft, you can bring me, and, in case I cannot use it myself, I will guarantee to find a market for the surplus. Hitherto the mines have not been properly or profitably worked. You only got at the surface coal, and could not keep the water out of the shafts when they were sunk to any depth. To remedy this you must purchase foreign pumps, which you can work yourselves, as the gear and working are very simple."

PRODUCTION OF PRECIOUS METALS IN THE UNITED STATES.

The Director of the United States Mint, in his annual report, states that during 1890 the gold product of the country was 1,588,880oz., of the value of £6,569,000, an increase of £9,000 over the product of the preceding year. The silver produced from the mines was about 54,500,000oz., an increase of 4,500,000oz. At the average price of silver during the year the product would be worth £11,445,000. The amount of silver offered to the Government was 68,130,457oz., and the amount purchased 37,594,373oz., at a cost of £7,998,300. The amount of precious metals used in the arts in the United States is returned as:—Gold, £3,621,100; silver, £1,846,200. The coinage of the year was:—Gold, £4,093,000; silver, £7,608,000. The metallic stock of the country was approximately on January 1, 1891:—Gold, £140,919,800; silver, £97,309,000.

CULTIVATION OF TOBACCO IN NEW SOUTH WALES.

The following information as to the cultivation of tobacco in New South Wales has recently been supplied to the London Chamber of Commerce by the Newcastle (N.S.W.) Chamber of Commerce:—"Both the soil and climate of New South Wales are admirably adapted for the growth of tobacco leaf. Special knowledge, however, is required on the part of the growers, in order that proper cultivation may result, and probably for this reason a larger quantity is not grown. From reliable statistics we ascertain that in the year 1862 there were only 224 acres under cultivation, which produced 2,467 cwt. of leaf tobacco, but in the year 1888 the area had increased to 2,371 acres, yielding 23,465 cwt. of leaf tobacco. The growth of tobacco leaf seems confined principally to the agricultural districts of Argyle, the Hunter Valley, and Tumut, a very large quantity being grown in the latter district, chiefly by Chinese, who seem to be well skilled in its cultivation and the preparation of the leaf. It may be observed that the quantity of colonial-grown leaf used in the colony now amounts to about three-fourths of the total consumption."

FERROID, A NEW ARTIFICIAL STONE.

Mr. Herman Poole describes in the *Journal of the Association of Engineering Societies* a new artificial stone, which is a compound, partly chemical and partly mechanical, of iron, sulphur, and silicon, with more or less foreign matter. It is mainly a supersaturated solution of iron, the sulphur with the silica acting as a binder and hardener. Its normal colour is a dark slate, varying somewhat with the manner in which it is dressed, but the colour can be somewhat modified by the introduction of pigments. Successful imitations of various coloured brick and sandstone have been made. It is about the hardness of ordinary bluestone and can be worked by the usual stone cutting tools, turned in a lathe or planed. The tensile strength is from 650lb. to 1,200lb. per square inch, and under compression it endures from 9,000lb. to 12,000lb. Its specific gravity is about 2·6. It melts at about 300° Fahr. very slowly. It does not deteriorate under exposure to the weather. As it can be melted and moulded, it is applicable to a great variety of uses to which stone cannot be put, and particularly so for large castings, such as pipes for sewage, &c. Architectural forms can be very conveniently made from it in position if needed. For culverts and bridge foundations, the perfect smoothness, of which the surface is susceptible is advantageous in lessening water friction.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

2nd March, 1891.

3695. Higginson, J., Jun. ..... Apparatus for grinding the flats of revolving flat carding engines.
3697. Laidlaw, J. ..... Machine for forming solid bars into helices.
3698. Garforth, W. ..... Air pump.
3700. Reynolds, W. F. ..... Gearing brackets employed in spinning, twisting, doubling, preparing, and similar frames.
3706. Muckley, D. ..... Process and machinery for the manufacture of tubes.
3710. Melichar, J. ..... Steam ploughing machine.
3712. Webb, F. W. ..... Locomotive boilers.
3714. Swayne, G. ..... Feed slide clearing machine.
3717. McNaught & McNaught Valve mechanism for steam engines.
3723. Smith & Baker ..... Box binding and staying machines.
3729. Hora & Hora ..... Machinery for bending metal bars for tyres.
3733. Tully, W. ..... Steam engine governors.
3735. Perry & Armstrong ... Apparatus for indicating the steering course of vessels.
3736. Blake & Barclay ..... Sugar-cane mills.
3738. Marx, J. ..... Apparatus for electrolysing and bleaching.
3744. Snell, H. S. ..... Hydraulic traps.
3752. Attenborough, E. ..... Straight-bar knitting machines.

3rd March, 1891.

3767. Marsily, W. E. ..... Constant and continuous pressure and velocity generator for fluids.
3773. Wiseman, E. ..... Railway signalling apparatus.
3787. Harris, C. ..... Screw steamship.
3788. Robinson, S. W. ..... Apparatus for producing and inserting metallic nails.
3793. Braurach, E. A. ..... Steam boilers.
3795. Cunliffe & Barlow ... Rotary fans.
3803. Hussey, McCann, & Hatch ..... Grease separator for steam engines.
3808. Tooth, Harris, & Harris Mowing and reaping machines.
3811. Taylor & Lowe ..... Gas-fired steam boilers.
3815. Acland & Holmström ... Breech mechanism of quick-firing guns.
3830. Priestman & Priestman Hydrocarburetted air engines.
3836. Newton, H. E. ..... Surface condensers (*Worthington*).
3840. Massey, A. P. ..... Automatic valves for air brakes.
3850. Walker & Theerman ... Direct-acting steam pumping machinery.
3851. Sponsel, C. W. ..... Breechloading ordnance.

4th March, 1891.

3852. Chadwick, L. ..... Steam engine pistons.
3865. Jefferson, W. ..... Davits for lowering ships' boats.
3872. Fielding & Fielding ... Apparatus for winding back the warp beam in looms and for maintaining the tension of the warp.
3885. Craig, G. ..... Coal-washing machine.
3897. Pickup, Byrom, & Dransfield ..... Fans.
3913. Blackman, A. E. ..... Rotary engines.
3914. Hall-Brown, E. ..... Feed water and heating apparatus for steam boilers.
3918. Lane & Lane ..... Punching machines.
3922. Horn, W. W. ..... Grinding mill (*Poulin*).
3927. Basset, W. B. ..... Apparatus for controlling power-operated steering gear.

5th March, 1891.

3934. Bell, W. ..... Lowering, raising, and detaching gear for ships' boats.
3943. Menzies, J. ..... Piston packing rings.
3948. Trewhella, J. ..... Gas engines.
3959. Cracknell, R. J. ..... Ice-making machines.
3981. Duesberg-Delrez, M. ... Manufacture of card teeth and apparatus therefor.
3983. Clarke, E. F. ..... Rotary fluid meter.
3988. Lake, H. H. ..... Presses (*Hull*).
3990. Stevenson, A. ..... Boiler furnaces.
3994. Clarke, E. F. ..... Rotary engine.
3999. Barton, J. B. ..... Machinery for making seamless tubular lining for hose pipes (*Foote*).

6th March, 1891.

4004. Dawes, A. ..... Starting apparatus for gas engines.
4024. Fenby, H. P. ..... Hydraulic valves.
4035. Booth & Pickersgill ... Apparatus for drilling the flanges of boiler flues.
4039. Hookham, G. ..... Tools for forging steel shells.
4050. Mannesmann, M. ..... Apparatus for forming, rolling, and calibrating metals.
4051. Blaxton, W. J. ..... Frictional speed reducing gear.
4056. Woodward & Shaw ..... Straight bar knitting machines.
4066. Rothwell, F. ..... Screw down taps.
4073. Wild, E. J. ..... Rotary fans.

7th March, 1891.

4078. Moorhouse, S. ..... Water gauges.
4079. Fleming, Ferguson, & Dixon ..... Motive power engines.
4085. Norman, R. A. ..... Grinding mills.
4089. Munns, W. H. ..... Crushing mill (*Olsen*).
4109. Burton, W. ..... Presses for drawing through and forming up sheet metals.
4112. Combe, A. ..... Twisting frames.
4122. Wilson & Vogel ..... Excavating machinery.
4125. Lycett, E. ..... Crushing and grinding mills.
4132. Johnson, T. W. ..... Apparatus for annealing copper wire and sheets.
4139. Bonne, C. R. ..... Warp looms (*Kreissig, Sonntag, Jun., & Hartig*).
4141. Schmitz, J. ..... Carding engines.
4142. Priestman & Priestman Hydrocarburetted air engines.
4143. Lux, F. ..... Gas engines.

ELECTRICITY.

2nd March, 1891.

3694. Webb & Thompson ..... Switches.
3740. Koechlin, M. ..... Electric meters.
3755. Dukes, B. ..... Automatic switches (*Heil*).

3rd March, 1891.

3765. Buchanan, L. H. ..... Arc lamps.
3799. Clark, A. ..... Electric battery solution.

4th March, 1891.

3867. Kennedy, R. ..... Electricity meters.
3895. Corning, F. G. ..... Apparatus for transferring electric car batteries. (5th August, 1890.)
3904. Richards, T. P. ..... Switches.

5th March, 1891.

3957. Miller & Woods ..... Electricity meters.
3967. Coad, T. ..... Electric safety lamps.
3984. Patin, O. ..... Arc lamps.

6th March, 1891.

4005. Bryan, F. ..... Dynamos.
4044. Simpson, R. H. ..... Accumulators.
4064. Hookham, G. ..... Electricity meters.

7th March, 1891.

4099. Akester, W. H. ..... Arc lamps.
4120. Fryer, W. J. ..... Incandescent lamps.

CHEMISTRY.

5th March, 1891.

19942A. Thompson, W. P. ..... Electro-chemical formation of chlorine and chlorine compounds (*Marx*). (6th December, 1890.)

3rd March, 1891.

3832. Noad, J. H. ..... Manufacture of white lead.

4th March, 1891.

3887. Hedley, G. H. ..... Manufacture of red oxide of iron.
3925. Ellershausen, F. ..... Treatment of soda waste.

6th March, 1891.

4068. Lyte, F. M. ..... Production of chlorine.

MISCELLANEOUS.

3rd March, 1891.

3771. Harvey, H. N. ..... Shaft couplings.
3819. Pollard, T. P. ..... Nut lock.

4th March, 1891.

3886. Nasmith, J. ..... Method of cutting the teeth of wheels.

5th March, 1891.

3992. Vautin, C. T. J. ..... Hydro-metallurgical method of extracting gold or platinum from their ores.
3993. Ibbotson, A. B. ..... Railway fish plates.

7th March, 1891.

4146. Hansell, R. B. ..... Casting ingots for the manufacture of weldless tyres, bars, &c.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

3304. Greenhill.
3503. Williams.
3632. Taylor.
3434. Mayer.
3583. Lindner.
3661. Jones.
3752. Thomson.
3790. Laumann.
3802. Jaensch.
3883. Whitfield.
3994. Anderson.
4037. Clarkson & Spurge.
4062. Charles Graham Grant.
4118. Shaw.
4216. Tipping.
4337. Bolton.
4376. Young & Young.
4394. Ricard.
4764. Gastbiger.
4927. Siddall.
4956. Greene & Varley.
5022. Deans & Foster.
5093. Poetsch.
5118. Besson.
5135. Belfield (*The Westinghouse Electric Company, partly*).
5368. Kellogg.
5416. Horn (*Stanton*).
5587. Strahl.
5830. Sharman & Oldham.
5925. Kellogg.
5937. Loe.
6109. M. Foster & Co., Ld. (*Pfaff*).
6207. Cameron (*Sterrit*).
6221. Lovibond.
6256. Rock.
6297. Gillespie.
6393. Milovanovitch-Koka.
6416. Davis & Davis.
6443. Pett.
6484. Fletcher.
6538. Woods & Woods.
6591. Lake (*Maxim*).
6621. Brown.
6643. Gebsant.
6662. Brophy.
6674. Kent.
6696. Darrah.
6703. Jeffrey & Cockburn.
6735. Silverlock.
6748. Ramsden & Turner.
6759. Barnes.
6767. Hewetson.
6781. Groombridge & South.
6816. Toope.
6832. Maitland.
6882. Coleman & Morton.
6892. Stidder.
6898. Whitfield.
6910. Dorrington & Coates.
6916. Marle.
6945. Appleton.
6946. Pitt (*L. Cassella & Co.*).
6963. Davage & Taylor.
7019. Serre.
7052. Kiddier, Kiddier, & Kiddier.
7074. Wilson.
7076. Morris.
7136. Henn.
7163. Partington.
7182. Gilbert.
7230. Lannigan.
7288. Downing (*Souty*).
7377. Imray (*The Carl Spiegel Company*).
7652. Swalwell.
7737. Niemoller.
7798. Simpson.
8029. Steiger, Schulze, & Auer.
8285. Plaford.
8501. Hawley & Dickinson.
9333. Stone.
9531. Mackinlay & Darwin.
9851. Wilson.
9891. Mackay.
11595. Mead.
11984. Carlisle.
12488. Kimber.
12795. Wilkinson.
13127. Young.
13791. Lake (*Hobby*).
14475. Wahl.
14860. Roger.
15413. Grant.
17092. Melling.
17255. Baggaley.
17421. Noakes.
17762. Smith.
17955. Lake (*The Sangerhäuser Actien Maschinenfakrik & Eisen giesserei vorm. Hornung & Rabe, & Schulze*).
18890. Johnson (*The Automatic Electric Exchange Company*).
19443. Nash.
19964. Horn (*The Felt and Tarrant Manufacturing Company*).
20464. Curran.
20628. Waymouth.
20690. Van Winkle & Todd. (6th June, 1890.)
20990. Dasher. (14th August, 1890.)
21012. Rockwood.
3766. Jameson.
3798. Cammiss.
3833. Hart.
3886. Thompson (*Edmonds*).
4005. Yeomans.
4045. Paterson.
4076. Hearn & Donne.
4100. Chatwood, Chatwood, & Chatwood.
4326. Sahlström & Hill.
4340. Phillips.
4391. Edwards.
4624. Hudson.
4874. Brown & Davis.
4932. Bateman & Sellers.
4987. Cooper.
5045. Haigh, Walker, & Mitchell.
5124. Saunders.
5208. Latham.
5265. Koch.
5354. Groom.
5369. Kellogg.
5568. Nerdham.
5633. Stratton.
5888. Helme.
5935. Thirion.
5971. Dewar & Redwood.
6195. Bromhead (*Die Chemische Fabrik Grünau Landshoff & Meyer*).
6252. Longshaw.
6257. Röell.
6365. Jones.
6408. Rothschild.
6434. Wood & Bracewell.
6466. Pirlsticker.
6531. Edgar & Crerar.
6575. Stringfellow.
6619. Dart.
6630. Potter.
6646. Heron-Maxwell.
6665. Lafone.
6686. Ashworth, Ashworth, & Ashworth.
6725. Morris
6736. Edwards (*Adam*).
6753. Lyon.
6763. Hatton.
6778. Cheer.
6792. Simon.
6831. Davis & Davis
6881. Mohrdieck & Siegelberg.
6894. Low.
6909. Riley.
6912. Fielding.
6932. Abel (*Die Actiengesellschaft für Anilin Fabrikation*).
6991. Dunn, Patson, Riley, & Wilding.
7073. Phillips, Waterhouse, Phillips, & Phillips.
7075. Hunt & Mackey.
7127. Hoffmann.
7153. Stock.
7177. Mewburn (*Proell, O. L. Kummer & Co., & Fischinger*).
7369. Kiddier.
7488. Cleverdon.
7599. Belfield (*Lange*).
7701. Lilljeqvist.
7783. Green.
7987. Thompson (*Horliry & Scheinpflug*).
8102. Schmidt.
8311. Webb.
9271. Fletcher & Fletcher.
9483. Williams.
9692. Hewetson.
9861. Boult (*Tommasi & Therye*).
11927. Morton.
12147. Easton.
12765. Gregory.
12807. Arnold.
13694. König.
14246. Gantillon.
14699. Townsend.
15024. Morgenstern.
17006. Harmer.
17202. Moore.
17346. Haake.
17705. Behncke & Frank. (12th April, 1890.)
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18406. Eaton.
18517. Caen.
18674. Norman.
18726. Ramos-Garcia.
19063. Recknell.
19171. Kasselowsky.
19191. Wheless & Wheatley.
19626. Carey & Young.
20196. Ménestré & Pasquier.
20457. Barlow (*Richards & Cooley*).
20521. Voss.
20634. Stevenson (*Tron*).
20700. Lake (*Williams & Carson*).
21005. Fairweather (*Pratt & the Babcock and Wilcox Company*).

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21045. Walton.
21081. Buckles.
21210. Boult (*The Milwaukee Carving Company*).
21220. Essig.

1891.

119. Jepson.
131. Pullmann & Smith.
132. Lecky.
167. Popp.
276. Thompson (*Chapleau*).
281. Monroe.
282. Monroe.
324. Dahlgren & Svensson.
369. House.
400. Bottome.
431. Perkins.
589. Gajardo.
615. Allison (*The Transatlantic Machine Company*).
645. Greenamyer.
648. Martin.
652. Peck.
674. Peck.
697. Smith.
740. Brookes (*Gregory*).
741. Adams.
834. Miller.
845. Cowan.
989. Linker.
1030. Lake (*Erskine*).
1032. Jesson, Wood, Ladd, & Ladd.
1066. Burton & Angell.
1088. Steiner.
1263. Ward.
1497. Flohr.
1592. Johansson.
1664. Heinemann.
1666. Mädler.
1674. Tyer & Tweedy.
1687. Pullar.
1723. Weckauf.
1731. Adley & Burton.
1739. Bradbury.
1747. Bowles.
1765. Nall.
1791. Richardson.
1798. Upton & Stephens.
1796. Mitchell.
1807. Lawson.
1813. Menier.
1859. Roe.
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1986. Sparr & Sparr.
1990. Imray (*Bertenshaw*).
2027. Blassberg.
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2071. Blanks & Lefebure.
2161. Ritchie.
2172. Leedham.
2173. Hartung.
2218. Rawlings.
2274. Roberts.
2287. Whitehead, Whitehead, & Whitehead.
2364. Ghosh.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Drilling Machines.—*J. J. Weatherburn, Gateshead, Durham.*—The inventor's aim is to provide an automatic feed motion for advancing the drill or other tool of a drilling machine whilst drilling, or tapping holes. An apparatus of this description is shown in the accompanying illustrations, of which Fig. 1 is a side elevation and Fig. 2 a front sectional elevation. A is a friction clutch into which the tapered end of the hollow screw B fits. C is a spindle, the lower end of which is secured to the tool box D, and between the said box and the hollow screw B is a spring E of suitable strength. F are washers separating the spring E from the screw and drill box. The upper end of the spindle in which is the slot G is square, so that the friction clutch revolves with the spindle. H is a set bolt and I a key, arranged as shown, so that by tightening up the set bolt the friction clutch can engage with the coned end of screw B, and also compress the spring E. The screw B works in a nut J, arranged in any suitable position, as on the end of the arm of an ordinary drill stand K. The action is as follows:—The set bolt

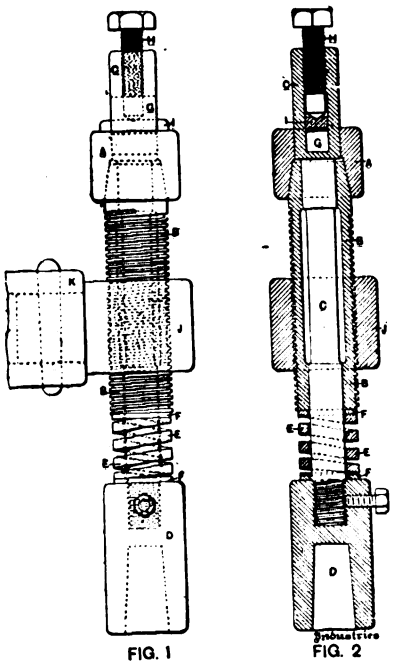


FIG. 1

FIG. 2

H being set so as to give the required amount of pressure to the spring, the spindle C, and with it the screw B, is rotated. The tool running light under these conditions advances a distance equal to the pitch of the screw B per revolution. Suppose the screw has ten threads per inch, and revolves 100 revolutions per minute, and the tool advances $\frac{1}{100}$in. per revolution to its work, then the difference in advance of the tool and screw per revolution tends to equal $\frac{1}{10}$in. minus $\frac{1}{100}$in., which difference takes effect in relieving the pressure of the set bolt H on the key I, which in turn relieves the pressure between the coned end of the screw B and friction clutch, and the instant this pressure is thus relieved the spring E with the lower end of screw B as an abutment continues the forward motion of the tool box and tool, thus affecting the automatic feed required, and causing the clutch and screw to again engage, when the above operations are repeated. The invention also comprises a structural modification of the above. In four claims the inventor embraces the general arrangement of an automatic spring feed motion as described, with modifications. —No. 12,449. August 9th, 1890. 8*d*.

Machinery for Finishing Splayed Cotters.—*A. F. Busby, Birmingham.*—The present invention relates to machinery for forming the ends of splayed cotters with an inclined portion, and also bending said ends towards their rounded sides. In the accompanying illustrations, Figs. 1 and 2 show respectively a side sectional elevation and a plan of a machine for the above purpose, and Fig. 3 the front and side elevation of a finished cotter. Formed in the face of a stationary die A fixed in the tool box B, secured to the table C, is a deep groove, the back of which is shaped to the form the cotter is to be pressed. Sliding in the tool box B, one above the other, are the slide D for holding the cotter in the groove in A and a second slide E for pressing the end of the cotter so as to force it against the end of said slot, so bevelling and bending the end thereof at one operation. These slides, held in D by a plate D^1, are actuated as shown (Fig. 1) from a crank-shaft F, the return motion being caused by springs

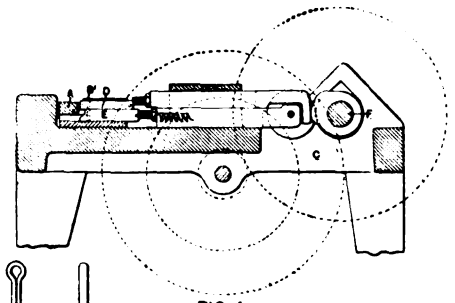


FIG. 1

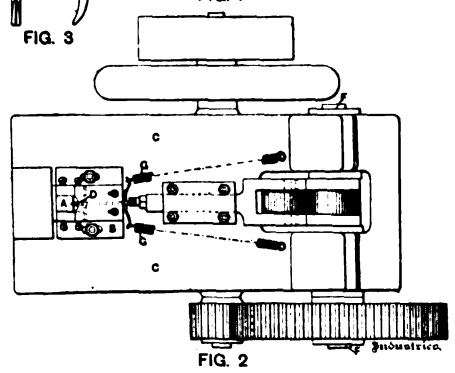


FIG. 3

FIG. 2

G (Fig. 2). The operation is as follows:—The cotter is formed with a straight shank, and is then placed in the groove in A; the slide D then advances, so holding the cotter in place. The slide E is then forced forward, so lengthening, bending, and bevelling the end of the cotter at one operation. Two claims are made, embracing the machine as described, with several modifications. —No. 4632. March 25th, 1890. 11*d*.

Gas Engines.—*J. P. Binns, Halifax.*—The inventor's object is to dispense with the use of inlet valves now employed for the introduction of the explosive mixture into the ignition chamber. To this end two cylinders are used, arranged side by side, one being of a much smaller diameter than the other. Through a port in or about the centre of the smaller cylinder the explosive mixture is supplied from the ordinary pump cylinder operated in the usual way. A similar port is formed in about the centre of the larger cylinder for the escape of the waste gases. One end of both the cylinders is in communication with the ignition chamber, and, as the pistons of both cylinders advance at the same time, both ports are closed simultaneously, and as the said pistons continue to advance, the explosive mixture is compressed within the common ignition chamber. After having reached the extent of their forward stroke, the pistons are forced back by the explosion of the combustible mixture, and the ports simultaneously opened. Another part of the invention consists in providing more efficient means of igniting the explosive charge at the proper time. To effect this the inventor forms a small passage leading out of the igniting chamber, and also a second small passage leading out of the larger cylinder on the opposite side to that to which the smaller cylinder is attached, which two passages are connected together by a tube maintained in a state of incandescence. A chamber is formed in the piston of the larger cylinder, from which a port in the side of the piston communicates with the exterior thereof. This port, when the piston is at the end of its forward stroke, comes opposite the port in the cylinder leading to the incandescent tube, so that the products of the previous combustion is forced, by the compressed gases, through the incandescent tube into the chamber in the larger piston when the said ports are opposite. Claims: (1) In gas engines, the use of an additional cylinder and piston, and an outlet port in combination with the explosive chamber arranged and operated as described; (2) the arrangement of ports or passages for forming a communication through the ignition tube in combination with said ports and a chamber in the larger piston for conveying away the spent gases as described.—No. 4362. March 20th, 1890. 8*d*.

Precipitators.—*C. A. MacDonald, Chicago, Illinois, U.S.A.*—The invention relates to an apparatus for precipitating oil and other impurities from exhaust steam. This apparatus consists of a cylindrical vessel with holes formed centrally in the end coverings. Passing up through the lower hole is the supply pipe, around the upper end of which is fixed a perforated diaphragm. Fixed to the outer edges of this diaphragm is a second and smaller cylinder, the upper end of which is closed. Fixed to the interior of the lower end of the inner cylinder is one edge of an annular perforated diaphragm, the other edge of which is connected to the bottom of the outer cylindrical casing in close proximity with the exterior of the supply pipe. Two other perforated annular diaphragms are connected at one edge to the upper and lower parts of the exterior of the inner cylinder and at their other edges respectively to the upper and lower ends of the outer casing. All these diaphragms, which are perforated, are so connected that they occupy a diagonal position. The exhaust steam on entering strikes the top of the inner cylindrical casing, and is so diverted as to travel downwards, and, passing through the first two diaphragms, it there strikes the bottom of the outer casing and is then caused to travel upwards through the last two diaphragms and escapes through the opening in the top of the outer casing. Three claims are made.—No. 18739. November 19th, 1890. 6*d*.

File Cutting Machines.—*J. Erlenwein, Edenkoben, Rhenish Bararia.*—In the accompanying illustratrations Fig. 1 is a side elevation, and Fig. 2 a front elevation of a machine constructed according to this invention. The operating hammer A, carried on a suitable spindle running in slide-ways in the upper part of

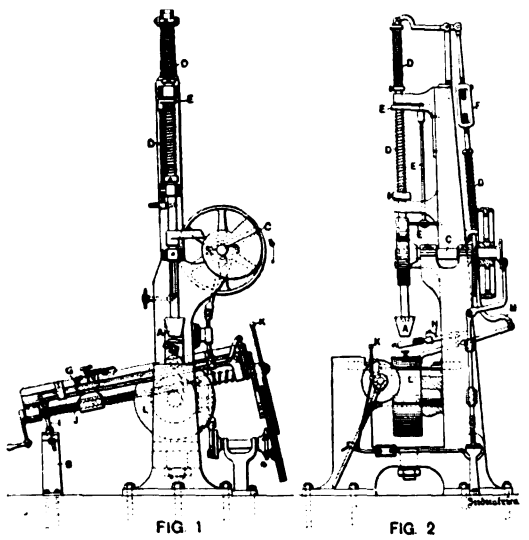


FIG. 1

FIG. 2

the frame work B, is raised by means of the cam on the main driving shaft C, and when released is forced quickly downwards by means of springs D, which had previously been compressed by its upward motion, the tension of said springs being made adjustable by means of arrangements E and F. The file is carried by means of a slide G in a frame H, the position of which may be altered by means of a screw I actuated by a screw J operated by suitably-arranged intermediate gearing from C, the gearing being so arranged that by raising or lowering the rod K, the travel, and so the pitch of the serration of the file may be increased or diminished. The screw J is divided into two parts, which may be connected or disconnected by a suitable frictional appliance, so that the gearing connecting it to C may be disengaged when desired to move the slide by hand. The file is moved over a stationary block L, having a zinc surface, by the slide G, and is held on said block by a lever M operated from

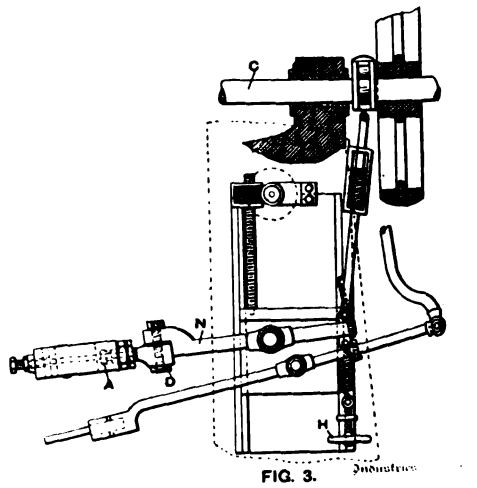


FIG. 3.

C. A second lever N, operated from C, as shown in the enlarged detail (Fig. 3), carries the chisel for cutting the file, and which is operated upon by the hammer H, and after being so operated upon is raised by the mechanism shown to clear it of the file. Three claims are made.—No. 13106. August 20th, 1890. 11*d*.

Steam Boiler Attachment.—*H. J. Haddan, London.* (*F. J. Haut, Floreffe, Belgium.*)—The invention relates to an attachment whereby the rise or fall of water in steam boilers above or below the normal level causes an alarm to be sounded. A suitable casing inside the boiler is screwed into the lower part of a steam whistle situated outside the boiler of the ordinary construction. The rod of the valve of said whistle passes down through the casing, and is normally forced upwards so as to keep the valve of the whistle on its seating by the combined action of the steam pressure and of a helical spring held between a suitable projection on the said spindle and the lower end of the casing. The valve spindle is provided in its lower part with a cross-bar, with a roller at each end. Above this cross-bar is pivoted to the casing a rod, to the longer end of which is fixed a float, which floats on the surface of the water. It will thus be seen that should the float rise or fall beyond a limited distance one part of the pivoted lever will strike one of the rollers on the cross-bar of

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the valve spindle, so forcing the latter down and opening the valve of the whistle, so giving an alarm. Claim: The boiler attachment substantially as described.—No. 3088. February 26th, 1890. 6*d*.

Glass Bottle Machinery.—*D. Rylands, Shepcote, near Barnsley, & B. Stoner, Stairford, Barnsley, Yorkshire.*—In the annexed illustrations is shown an apparatus for the above purpose, Fig. 1 being a side elevation, Fig. 2 a front elevation, and Fig. 3 a sectional plan thereof. The pillar and stand A carries fixed and movable discs B B¹, in the latter of which are carried suitable shafts; on the inner ends of these are carried the friction wheels

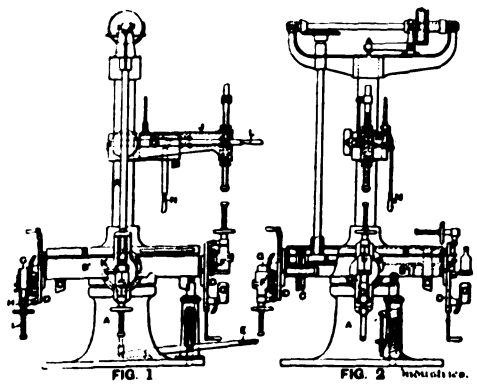


FIG. 1 FIG. 2

C in contact with the under surface of B, and on the outer end of which is the plate D carrying the dies. The disc B¹ is revolved as shown, the motion thereof being governed from a treadle E. The dies consist of the hinged body parts F, core G, and stopper H of a screwed or other suitable form, through which works the plunger I. The body F, reversed as shown to the left (Figs. 1 and 2), and with the stopper H and cone G inserted, is filled with glass and the disc B¹ then revolved, so reversing the position of the dies, bringing them under the pressing or blowing point J. The plunger I is then forced through H by means of the hand lever L. The core G is then removed, and a table K takes the place thereof. After I has been withdrawn a current of air from a reservoir M, the valves of which are operated by lever N, is then passed through or down the sides of the plug H and plunger I, and the bottle blown to the full size and shape. The plug H is then removed and the die opened, leaving the bottle in a finished condition. Claims: (1) In a machine for the manufacture of glass bottles or other glassware, the combination of a fixed or revolving table, having on the outer edge one or more brackets or plates carrying an outer and inner mould, and capable of being reversed in the manner described; (2) the combination with a bottle-making machine where the moulds are worked in a vertical position, of a special mechanical device or arrangement for the purpose of forming the bottle mouths with internal screw threads, with annular groove or grooves, with inclines, or of taper shape in the inside; (3) in combination with a bottle-making machine the use of an intermediate air-vessel having taps and levers substantially as shown and described for the purpose of blowing the bottles more equally and shapely; (4) a bottle-making machine having a screw-shaped split movable plug which is fixed in the mouth end of bottle-blowing mould

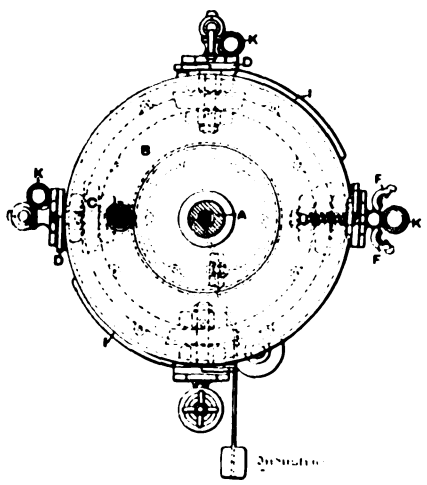


FIG. 3.

before the molten glass is poured into the pressing or inner mould, such plug being capable of forming any special internal shape or configuration of bottle-mouth, while the moulds are either in an inverted or in an upright position, the said plug being secured to mould, and operated by any suitable mechanical means.—No. 4599. March 22nd, 1890. 8*d*.

Apparatus for Lowering Ships' Boats.—*W. McGlashan & J. P. Rawlings, both of Leith, Midlothian, N.B.*—The apparatus for the above purpose is constructed as follows:—Supported in two suitable brackets fixed to the ship is a horizontal shaft, in the centre of which is keyed a worm-wheel actuated by means of a worm, the shaft of which is supported in a third bracket. Fixed to each end of said horizontal shaft is a radial arm, the outer end of which is connected by a link of suitable length to a projection on the davit, the lower end of which is pivoted to the end bracket, but at some distance in front of and slightly above the bearing of the horizontal shaft. The davits are of an L-shape, with the upper end of the vertical arm, however, inclined somewhat to the horizontal arm. The parts are so arranged that, by revolving the horizontal shaft, the davits will be moved forward around their pivots, so carrying the boat forward and lowering it at the same time. Four claims are made.—No. 5578. April 12th, 1890. 6*d*.

Spinning Machinery.—*J. Longmore & W. L. Watson, both of London.*—Instead of using a stationary ring for effecting the opening and twisting, the inventors use one that is positively rotated, and in which the fibres are carried in a circular path by passing through a hole or equivalent yarn-guide formed eccentrically on the ring. The bobbin on which the yarn is wound is driven merely by the tension on the yarn between the ring and bobbin or may be driven positively if desired. To enable the yarn to be evenly wound on the bobbin, the latter is reciprocated through the central opening of the ring. The ring is grooved at its periphery, in which groove and a corresponding groove in the interior of the bearing are held a suitable number of metal balls. Claims: (1) Spinning or twisting fibres by means of a revolving ring which carries the yarn in a circular path and winds it on a bobbin which is longitudinally reciprocated through the central opening of the ring; (2) a ring mounted as described and having an eccentric yarn carrier and a driving pulley; (3) a revolvable ring provided with a yarn carrier, the circular path travelled by which is of less diameter than that of the bearing within which the ring rotates and less than the diameter of the driving pulley; (4) the arrangement of a ball bearing of the ring as described.—No. 5709. April 15th, 1890. 8*d*.

Grinding Machines.—*J. G. Freeman, Frindsbury, Strood, Kent.*—The invention relates to the construction of grinding machines wherein the rolls are pressed upon their race by hydraulic pressure. A machine of this description is shown in sectional elevation at Fig. 1, and sectional plan at Fig. 2, of the annexed illustrations. The spindles A of the rolls B run in suitable bearings in the casing C, the inner set of bearings being formed in the central boss D, held in the opening E, through which the material to be crushed is fed, by suitable webbing. The boss D also receives the end of the driving shaft F and the piston rod G of the hydraulic cylinder H, formed in a cross-piece I. The pressure of the rolls upon the race J is thus

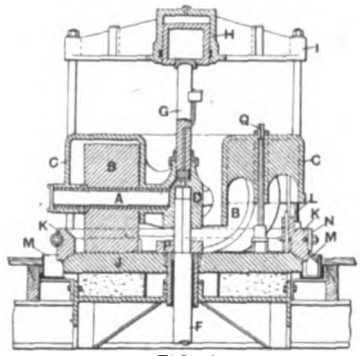


FIG. 1

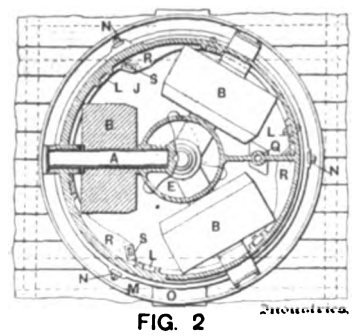


FIG. 2

augmented from the cylinder H. The edge of J and the underside of the curb K, attached to the frame C by slings L, are bevelled as shown, and have let into their bevelled edges strips of soft metal, which, wearing more rapidly than the said edges, which are made of hard steel, form ridges, which pulverise the material as it passes through them to the annular trough M, from which it is swept by plates N into the opening O. The material to be crushed is fed through E and distributed over J by disperser P, fixed to the driving spindle. The further progress of the material towards the periphery of J is governed by plough Q, carried in C, and formed of diamond-shaped plates set horizontally, and having formed on two opposite edges vertical deflecting plates. That material which is not sufficiently crushed when it reaches the periphery of J is swept back under the rolls by means of plates R fixed to K, the other material being carried between the edge of J and K by scrapers S carried in R. Five claims are made.—No. 5950. April 19th, 1890. 8*d*.

Slide-gate Valves.—*H. H. Lake, London. (The Ross Valve Company, New York, U.S.A.)*—The valve casing is of the ordinary construction, having a socket in its upper part in which a collar on the gate spindle is allowed to revolve, but is prevented from moving longitudinally therein. Screwed on to the lower end of the actuating spindle is the gate carrier which has trunnions on each side of it, on which the gates are held by said trunnions fitting loosely into sockets in the back thereof. Formed at each side of the carrier block are two slots, the open sides of which face the back of the gates. The upper ends of these slots are wedge shaped, so that balls pressed on the face thereof will be forced outwards. One arm of a bifurcated plunger is adapted to slide in said slots, the ends of said arms being also of a wedge shape. Between the ends of the slots and the heads or the arms of the plunger are first two metal balls placed side by side, then a roller, and again two metal balls placed side by side. It will thus be seen that as the carrier is forced downwards the lower end of the plunger in striking against the lower parts of the valve casing will force the two pairs of balls from one another against the backs of the gates, so pressing the latter against their seatings. Claims: (1) In a slide-gate valve the combination with an enclosing case of a slide-gate, a gate carrier having bearing-block-engaging abutment, and a carrier stem projecting exteriorly of the case of a seating plunger, a nest of bearing blocks interposed between such gate and a resisting medium comprising two pairs of bearing blocks, one pair bearing upon the gate and the other pair upon the resisting medium, and a mobile block interposed between the pairs; (2) in combination with the parts above mentioned a seating plunger provided with a laterally yielding foot.—No. 20108. December 9th, 1890. 8*d*.

Platen Printing Machines.—*W. Mackenzie, Chorlton-on-Medlock, Manchester.*—The invention relates to improvements in platen printing machines whereby it is possible to print in two colours in exact register upon the same printing sheet. The machine for this purpose is shown in the annexed illustrations, of which Fig. 1 is a front elevation (with the inking rollers and

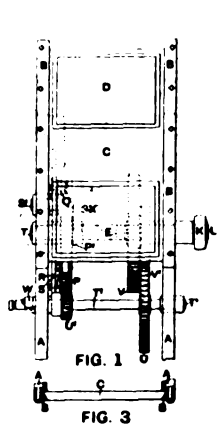


FIG. 1

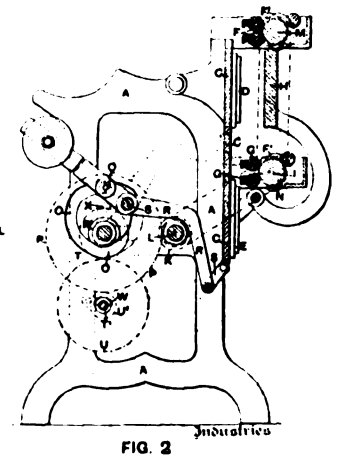


FIG. 2

FIG. 3

platen removed), Fig. 2 a side sectional elevation, and Fig. 3 a detail horizontal section. Sliding in grooves in the front of the framework A is the plate C carrying two chases of type D E. Two sets of inking rollers F and G are arranged to ink their respective printing surfaces, and are driven by frictional rollers M N and belts from the shaft L. These inking rollers are pressed slightly forward at suitable intervals so as to come in contact with the type by means of cams F¹ F². A single platen common to both printing surfaces is used, on which the paper to be printed is placed. The slide C is given a reciprocating motion, with two pauses, so as to allow of the impressions being taken by means of the weighted lever R pivoted at S, one end of which is connected by a link to C, and the other end carrying a friction bowl Q adapted to run in a cam groove O, formed, as shown, in the surface of a gear wheel P driven from the shaft P¹. Claims: (1) The construction of platen printing machines for printing in two distinct colours, or printing two impressions alternately in the same colours, as described; (2) the improved printing machine provided with a movable table carrying two chases and actuated by a cam groove and lever arrangement mounted and operating as described; (3) in the improved platen printing machine the employment of two sets of inking rollers and corresponding sets of type as described.—No. 8978. March 13th, 1890. 8*d*.

Evaporator.—*R. Harvey, Glasgow, N.B.*—The apparatus for the above purpose is shown in the annexed illustrations, of which Fig. 1 is a vertical sectional elevation and Fig. 2 a transverse section. The circular casing A has fixed in its lower part the two tube plates B, carrying between them the set of smaller tubes C and the large tube C¹, all forming a communication between the upper and lower parts of A. The steam, or hot gases, are supplied through the branch pipes D, the supply being governed by means of suitable sluice valves E, and circulate amongst the tubes C through perforations in the central deflecting plate F, and escape with the water of condensation through D¹. The liquid to be evaporated is supplied at G (shown in dotted lines) and passes down the tube C¹, striking the bottom of A, and travelling upwards through C, but is again carried downwards through C¹ by means of the current caused by the liquid

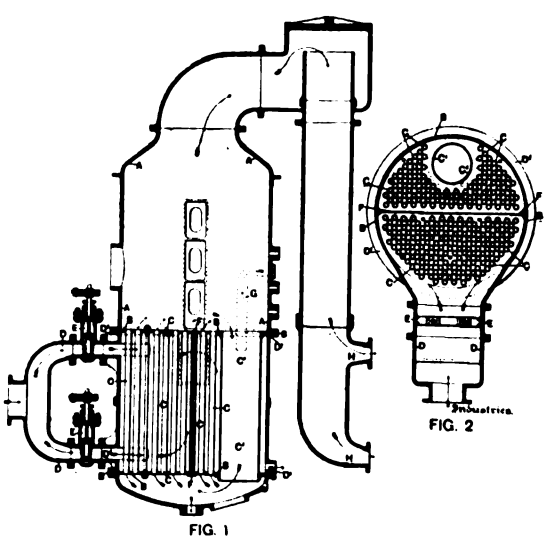


FIG. 2

FIG. 1

supplied from G. The vapour evaporated from the liquid escapes upwards as shown by the arrows, and escapes through openings H. If desired, several evaporating apparatus can be used together, being connected in series. The inventor claims: (1) The construction and use of single or multiple effect evaporating vessels for sugar juice and other liquors with duplex expanding branches which lead the steam or vapour from a single branch to the upper and lower parts, and to the full size of the tubular heating vessel or vessels; (2) the construction and use of duplex expanding steam or vapour inlet branches in the tubular heating

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vessel, in combination with one or more intercepting vapour vertical deflecting plates within the tubular vessel; (3) the fitting and use of sluice or other valves on both the upper and lower branches of the heating vessel as described.—No. 3907. March 12th, 1890. 8*d.*

UNIVERSAL JOINT.—*F. Y. Wolseley, London, & P. P. Craven, Forest Gate, Essex.*—A short cylindrical tube of a suitable diameter has formed internally at one end one part of a hollow spherical bearing to receive a ball fixed to one end of one of the shafts to be connected. The other end of this tube is screw-threaded, and receives a plug, the inner end of which is hollowed out to form the other part of the spherical bearing. One end of the second shaft of the pair to be connected is connected to this plug. The ball or sphere which fits into the spherical bearing has formed around it, preferably in the same plane as the rod connected to it, an annular groove, into which groove project the ends of two set screws screwed into and through the cylindrical tube at diametrically opposite points. Four claims are made, embracing the universal joint, constructed substantially as described, with modifications.—No. 3956. March 13th, 1890. 8*d.*

WOOD WORKING MACHINERY.—*T. N. Robinson, Rochdale.*—The invention relates to those wood-planing and moulding machines in which stationary knives are employed either with or without revolving cutters. An apparatus embraced by this invention is shown in the annexed illustrations, Fig. 1 being a side elevation and Fig. 2 a plan thereof. A fixed vertical frame A is secured to the machine bed B behind the knives C; in slideways on this bracket A is mounted an adjustable carriage D for carrying the pressure rollers. This carriage is arranged so that it can be raised and lowered by a hand-wheel E actuating a screw F in the fixed frame A, and it is further capable of a short transverse movement for adjusting its position laterally by means of two adjusting screws G working in lugs H on the bracket A. The adjustable carriage D consists of an open framework with suitable recesses to receive and carry a number of open bridles I, in each of which are mounted a pair of pressure rollers J when two knives are used. The recesses in the adjustable carriage D allow the pressure rollers J to be placed at suitable distances apart for holding down varying widths of boards, and when necessary, one, two, or more of the bridles I and rollers J can be removed from the carriage D. Pressure is given to the pressure rollers by means of weighted levers K pivoted to frame D carrying a link L, the lower end of which presses on the bridle I. The levers K may be raised to relieve the pressure rollers by means of an eccentric rod M pivoted in D. Claims: (1) The combination with a wood planing and moulding machine of the improved pressure apparatus

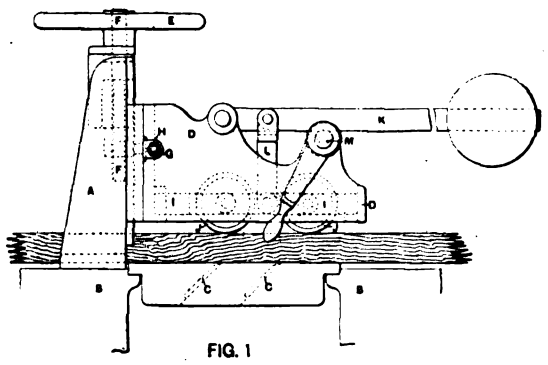


FIG. 1

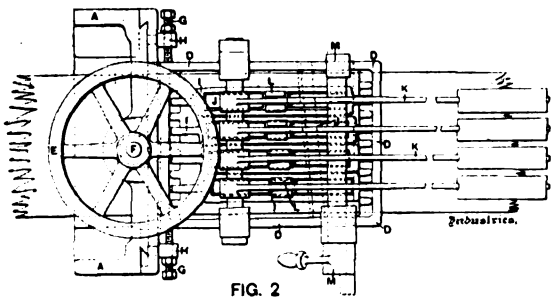


FIG. 2

consisting essentially of an adjustable carriage or open framework in which are mounted any suitable number of pressure rollers weighted by fulcrumed weighted bars or equivalent means. (2) The combination of the bracket A, the adjustable carriage D, bridles I, pressure rollers J, fulcrumed weight bars K, and eccentric shaft M, all for the purposes described.—No. 5899. April 18th, 1890. 6*d.*

GAS RETORTS AND CHARGING APPARATUS THEREFOR.—*C. Hunt, Birmingham.*—The inventor's object is to prevent the tendency on the part of inclined retorts to slide upon their bearings, and so endanger their structure, and to charge said retorts with facility. To effect the first object the inventor moulds on either or both the upper and lower surfaces of the retorts snugs so shaped and placed that those on the underside of the retort take a vertical bearing upon the supporting walls, so converting a side into a vertical thrust, while upon the upper snugs the cross walls may be supported. The charging apparatus is constructed as follows;—Upon a suitable horizontal carriage arranged to run on a tramway laid longitudinally in front of the retort benches is carried a second carriage rectangular in front elevation and plan, but of a right-angled triangular form in side elevation, the vertical side being next to the retort benches. This framework or carriage is also mounted on wheels, and runs on short transverse rails on the horizontal carriage. Between the uprights of this framework a triangular or other shaped hopper is suspended by chains passing over pulleys at the top of the framework, and operated by means of a suitable winch. The hopper can thus be raised or lowered or moved horizontally so as to allow it to be brought into position, and its end, which is suitably shaped to fit the ends of the retorts, inserted in the latter. The lower end of the shoot is also provided with a door, which can be opened or closed by means of a suitable lever by the attendant, by means of which the contents of the hopper may be allowed to pass into the retort. The hopper receives its coal from a trough or continuous hopper furnished with shoots at convenient intervals, and running through the retort-house. Claims: (1) The construction and application of inclined gas retorts with snugs on their outer surfaces as described; (2) the construction and application of movable apparatus in combination with inclined gas retorts for charging the said retorts as described.—No. 5078. April 1st, 1890. 8*d.*

ELECTRICITY.

TELEGRAPHIC RECEIVING APPARATUS.—*P. B. Delany, South Orange, New Jersey State, U.S.A.*—The receiving apparatus as constructed according to the present invention is shown in plan and part sectional elevation at Figs. 1 and 2 respectively of the annexed illustrations. A magnet A, supported on a base B, as

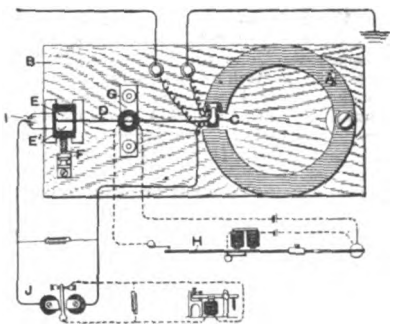


FIG. 1.

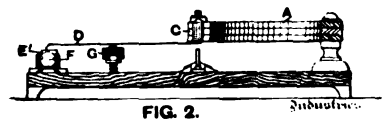


FIG. 2.

shown, has pivoted between the poles a coil C, fixed to which is an aluminium arm D. The point of this arm is bent and tipped with platinum, and is arranged, normally, to oscillate in a vertical direction between the two plates E E¹, made adjustable to or from one another by means of an insulated screw F. The oscillation of D in the vertical plane is caused by an electromagnet G, placed beneath it intermediately between coil C and plates E E¹, the circuit around which is interrupted by an automatic vibrator H (Fig. 1). The contact plates E E¹ are connected to the poles of a local split battery I, the middle of which is connected to D through a polarised relay J, controlling a local circuit in which is placed a sounder of ordinary construction. The contacts of the polarised relay and contacts E E¹ are shunted by condensers as usual. The line wire is connected in series with the winding on C. If the distant operator closes his key and quickly opens it a positive and then a negative current will be sent into the cable and through the trailer of the transmitter, so causing the pointer D to first swing to the right and then to the left, so first closing and then opening the sounder circuit. If sending a dash the key is held down, so that there is no reverse or negative impulse. Seven claims are made.—No. 3839. March 11th, 1890. 8*d.*

DYNAMOS AND MOTORS.—*J. Radcliffe, East Retford, Nottinghamshire.*—The invention embraces means for automatically (1) changing the angular position of the segments of the commutator to enable the machine to run in either direction without altering the position of the brushes and (2) adjusting the lead to suit all speeds, (3) and an arrangement in combination with the above for cutting a resistance in any part of the circuit for regulating the strength of the current. To accomplish these ends, the commutator is fixed to the hub of the driving pulley, the said hub being free to move within certain limits in a circular direction on a second hub or sleeve, the latter being also free to move within certain limits on the armature shaft, the amount of motion in each case being limited by projections on the armature shaft and second hub respectively engaging in slots in the second and first hubs. One of these slots is a segmental one, but the second is a double helical slot, so that as the hub wherein it is formed revolves independently said hub will be moved longitudinally, which movement actuates a suitable lever of a regulating switch. Between the outer and inner hubs a pair of differential springs are arranged so as to be equally balanced when the projection on the inner hub is in the centre of the segmental slot in the outer hub. Three claims are made, embracing the arrangements as described.—No. 5836. April 17th, 1890. 8*d.*

ELECTRICAL RAILWAY SIGNALS.—*A. Siemens, London.*—The invention embraces an apparatus which may be combined with the apparatus described in a prior patent, No. 15921 of 1888, in such a manner that two or more signals require to be brought into "danger" position before another signal can be brought into "line clear" position. The apparatus for this purpose is constructed as follows:—Pivoted to an axis held in the upper end of a suitable support fixed to a base of insulating material is a rod carrying on its upper end a semicircular core formed of a bar of soft iron, the ends of which project into the interior of two solenoids fixed at opposite sides of the base. On the axis is fixed a rotary switch or commutator, against which bear two springs. The action is as follows:—When one of the solenoids is excited by a current passing through its coil, one end of the core is attracted, and as in the movement its centre of gravity passes the vertical line of its axis, it remains in the position to which it is attracted after the solenoid ceases to be excited. But when the other solenoid is excited, the other end of the bar is attracted and tumbles to the other side and there remains. In the first-named position of the core it effects the closing of a local circuit which starts from a contact made by a train when this is about to enter the section protected by the signal; thence passes through certain other conflicting signals, provided they are in the danger position, in which they make the requisite contacts; then through the second solenoid and into the above-mentioned signal, effecting the lowering of the same to "line clear." The winding of the solenoids of this special apparatus is arranged in connection with the circular switch and springs pressing thereon in such a manner that when the core tumbles in one direction the current of the solenoid which attracted it is opened. Claim: The auxiliary signal apparatus as described.—No. 4242. March 18th, 1890. 8*d.*

CHEMISTRY.

EXPLOSIVES.—*H. H. Lake, London.* (*S. H. Emmens, Emmens, Westmoreland, Pennsylvania, U.S.A.*).—The invention relates to explosives of the gun-cotton class. In a bath of mixed sulphuric and nitric acids of a strength ordinarily employed for the manufacture of gun-cotton, unsized paper is steeped for about two minutes. The paper is then removed from the acid and washed one or more times, after which it is immersed in a cold aqueous solution of carbonate of ammonia, and kept therein until all effervescence ceases. It is then removed to another bath containing a strong solution of picric acid heated to 100° C. or thereabouts. The paper, after remaining in the vessel about ten minutes, is then suspended in another vessel containing ammoniacal water until the adhering picric acid is converted into picrate of ammonia; it is then dried, and is ready for use as an explosive. Claim: An explosive substance consisting of paper, or paper-stock, converted into a nitro-compound, and impregnated with ammonia and picric acid substantially as described.—No. 3852. March 11th, 1890. 4*d.*

CLEANING COTTON.—*J. Saleha, Beckenham, Kent.*—The invention embraces a method of cleaning and separating cotton from cotton seeds. For this purpose the inventor either uses an acid or basic treatment. In the first case the cotton seeds are subjected to the action of a solution of hydrochloric acid or nitric acid, or a mixture of both; and, in the second case, the seeds are subjected to the action of a solution of caustic soda or caustic potash, or a mixture of both. The seeds are subsequently dried, and the cotton may then be easily brushed off. The quantity of water added as a solvent of the above acids or bases is about 10 per cent. or thereabouts. The seeds are placed in an air-tight chamber, together with the acid or alkaline solution, and heated, the steam or vapour given off being allowed to pass to a suitable condenser. Claims: (1) The method of separating cotton from cotton seeds by means of a solution of hydrochloric or nitric acid, or a mixture of both, as described; (2) the method of separating cotton from cotton seed by means of a solution of a caustic alkaline base; (3) in the process of separating cotton from cotton seeds the use of a heated chamber connected with a condenser as described.—No. 5271. April 5th, 1890. 4*d.*

MISCELLANEOUS.

EXTRACTION OF TIN FROM TIN SLAG.—*T. Teague, Pinewood, Devoran, Cornwall.*—According to this invention, tin slag in fragments is charged into pots, together with suitable fluxes, preferably in fragments, and in cases where there is little or no reducing material in the slag, coal dust or other pulverulent carbonaceous matter is used. The fluxes for the above purpose are fluor or other spars, Elvan blue, or mixtures of these from 10–25 per cent. of the weight of the slag. The slag fluxes and reducing material are well mixed in the pot, and are melted in any suitable furnace. The molten material is then poured into a mould of a coned shape of iron or sand and, after cooling, the tin collects in a button at the bottom. Claims: The hereindescribed process for extraction of tin from slag or refuse of tin smelting, by melting the slag mixed with suitable fluxes and casting the molten mass in moulds suitable for subsidence of the tin.—No. 5638. April 14th, 1890. 4*d.*

TREATMENT OF COPPER-NICKEL MATTE.—*The Electric Construction Corporation, Limited, London, & S. Parker & A. E. Robinson, both of Wolverhampton.*—The object of this invention is to improve and cheapen the treatment of copper-nickel matte in such a manner as to obtain the metals without the roasting process. The matte is treated directly with dilute sulphuric acid, preferably after being previously pulverised. By this means the nickel and iron are dissolved, but the principal part of the copper remains undissolved. The residue (consisting of metallic copper and sulphide of copper) can be melted and cast into pigs, and may be used at the anodes in an electrolyte of sulphate of copper with a copper cathode. The solution containing the iron and nickel is treated with a precipitant such as carbonate of barium to precipitate the iron. Claims: In the treatment of copper-nickel matte the use of dilute sulphuric acid as a solvent for the nickel and iron as described.—No. 5199. April 3rd, 1890. 4*d.*

MANUFACTURE OF BAR IRON.—*W. P. Hopkins, Catasauqua, Pennsylvania, U.S.A.*—In the manufacture of bar iron, instead of first rolling the scrap or puddle-ball after leaving the squeezer into flat scrap bars, then cutting the said bars into shorter bars, then piling, reheating, and rolling into the desired shape, the inventor proceeds as follows:—The puddle-ball is rolled directly into channel iron, and these channels are piled upon one another to a suitable height to suit the size of bar to be made, each channel iron being filled with waste scrap iron. The pile thus formed is then reheated and rolled to the desired shape. Claims: (1) The method of manufacturing bar iron as described; (2) the pile as described.—No. 19572. December 1st, 1890. 6d.

Copies of the British specifications may be obtained on application to H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE NICARAGUA CANAL.

I.

HISTORICAL SKETCH.

In 1513 Vasco Nuñez de Balboa discovered the Pacific Ocean, and the fact that only a comparatively narrow isthmus separated this ocean from its neighbour—the Atlantic—was established. Even before this date, however, as early as 1502, the great Columbus himself had explored the entire coast from Cape Gracias á Dios, the north-easterly point of Nicaragua, to the Isthmus of Panama, in search of a passage by which he hoped to reach Zipangu and the kingdom of the Great Khan, supposed to be the sources of fabulous wealth. For many years after the discovery of the Pacific Ocean it was hoped and expected that a natural waterway across the isthmus would be found, and the search for this strait was diligently prosecuted by various adventurers, including Cortez and the Cabots.

In Spain, engineers at Madrid proposed, as far back as 1528, the establishment of water communication between the Atlantic and Pacific Oceans by way of the River Chagres. Antonio Galvao, a Portuguese navigator, in 1550 published a memoir in which four different routes for a passage across the isthmus were suggested, including those by Lake Nicaragua, and by the Isthmus of Panama.

According to José de Aosta, the historian, in 1590 the project for cutting a canal to unite the two oceans appears still to have been contemplated, but was subsequent to this date opposed rather than promoted, by Spain, from motives of national jealousy, inspired by the desire to maintain a monopoly of her South American trade.

Up to 1771 the scheme appears to have been practically forgotten, but at that date, by the order of Antonio Bucareli, Viceroy of Mexico, a survey was undertaken by the engineers, Antonio Cramer and Miguel del Corral, in order to ascertain whether it would be feasible to cut a canal joining the rivers Chimalapa and Huascualco. The report made by them advocated the construction of a canal of small dimensions. This report was of sufficient value to be afterwards utilised by Baron Humboldt in making his map of the isthmus. In a further report in 1779, by Cramer, Ysasi, and Muestro, on the Nicaragua route, the latter was stated to be impracticable.

During the war between England and Spain, which broke out in 1779, Fort St. Juan was captured by the English, with a view to obtaining possession of the Desaguadero and Lake Nicaragua and the cities of Granada and Leon, cutting in two the Spanish possessions in Central America, and securing the route for an interoceanic canal. Owing to the severe sufferings of the troops, in consequence of the climate, the expedition was eventually abandoned.

Baron Alexander von Humboldt discusses the practicability of a waterway connecting the Atlantic and Pacific Oceans in his "Personal Narrative of Travels" (Vol. VI., pp. 239 to 300), and the following quotation from his writings on this subject is of interest:—"The Isthmus of Nicaragua and that of Cupica have always appeared to me the most favourable for the formation of canals of large dimensions, similar to the Caledonian Canal, which is 103ft. (French measure) broad at the water's edge, exclusive of the raised way which stops the falling in of the earth; 47ft. broad at the bottom, and 18½ft. deep. In considering a communication between two seas, capable of producing a reduction in the commercial world, we must not limit our attention to such means as only serve to establish a system of inland navigation by small locks, as in the canals of Languedoc, Briare, or in the Grand Junction, and the Forth and Clyde Canals." Humboldt, it must be remembered, had spent ten years, from 1798, in exploring the Spanish-American States and the isthmus, and therefore spoke with a thorough knowledge of his subject.

From 1824 to 1839 several surveys of various parts of the isthmus were made on behalf of the Central American States, and a concession was granted, in 1838, by the Government of New Granada to Solomon & Co., a French firm, for the construction of either canals, roads, or railroads across the isthmus. In the latter scheme the French Government took so much interest that M. Guizot, the Prime Minister under Louis Philippe, commissioned M. Garella to make a survey.

The Government of the United States first began to take a serious interest in the question of an interoceanic canal through Central America in the year 1825, and this interest has been more or less continuously maintained ever since. It is worthy of notice that, from the very first, the American Government favoured the Nicaraguan route, the superiority of which over others proposed seems to have been considered established almost beyond doubt. A proposal was made to the United States Government by the new Republic of

THE NICARAGUA CANAL.

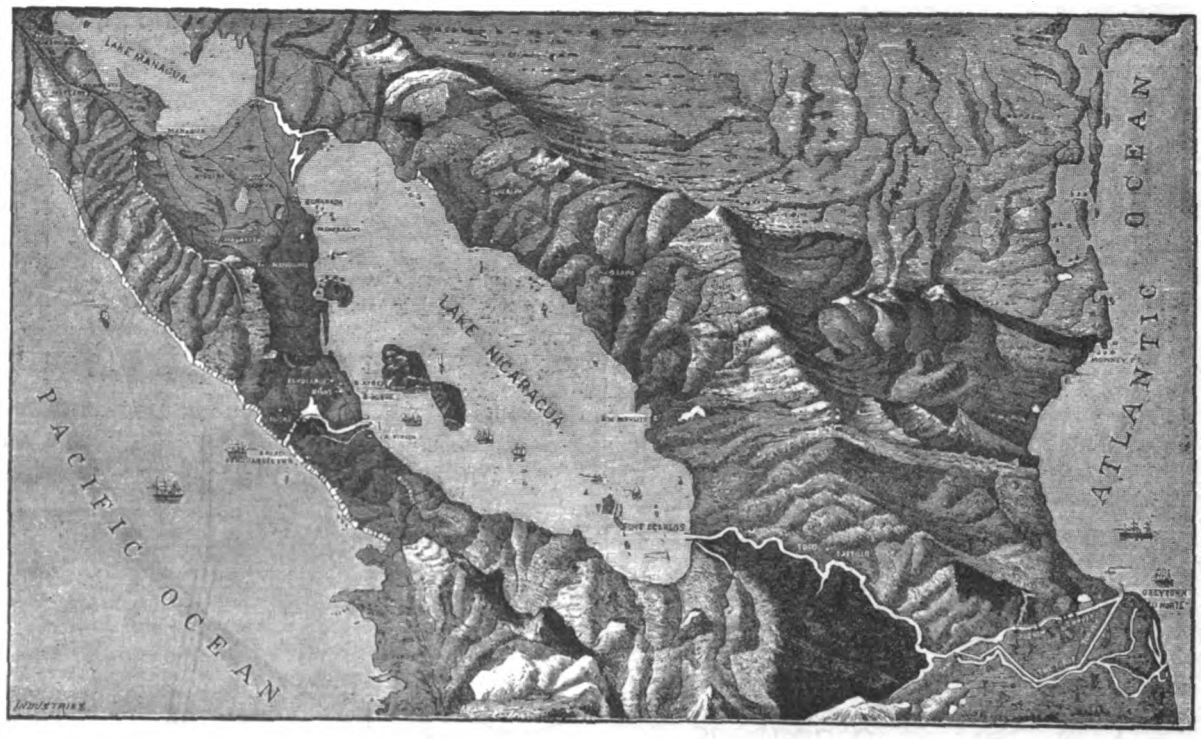


Fig. 1.—Bird's-eye View of Canal.

Central America, in 1825, to the effect that the former should co-operate with the latter to promote the opening of a canal through the province of Nicaragua to unite the Atlantic with the Pacific Ocean, and that the advantages resulting from the canal should be perpetually secured by treaty to the two nations. This proposal was favourably entertained by the President of the United States, John Quincy Adams, acting through the Secretary of State, the Hon. Henry Clay, and Mr. Williams, the then Chargé d'Affaires in Central America, was instructed to investigate the merits of the scheme, and obtain information as to the surveys already made, the facilities afforded by the country, and the state of its population, for making the canal, and the estimated cost. Soon afterwards a contract was entered into between the Central American Government and Mr. A. H. Palmer, of New York, for the construction of a canal through Nicaragua of sufficient capacity "for vessels of the largest burden possible." The undertaking proved abortive, owing to the inability of the promoters to raise the capital considered necessary, estimated at only $5,000,000, a sum which, in the light of recent knowledge, was obviously totally inadequate, and shows that the surveys and estimates must have been very imperfect. The evident merits of the project induced the King of the Netherlands to take up the matter on his own personal account, and also as patron of an association of capitalists. An envoy, General Ver Veer, was sent to Nicaragua to treat with the Central American Government in March, 1829, but, owing to political disturbances, action was delayed until 1830, when the construction of the canal was authorised, with the object of offering it to the association already formed for the purpose in the Netherlands. At this point the United States thought it time to put in a word, and the Chargé d'Affaires in Central America was instructed to claim for the United States their rights, under treaty terms, to whatever privileges were granted to others. The political revolution in the Netherlands, which terminated in the independence of Belgium, put an end to this enterprise also.

At short intervals, under various Presidents, the United States Government continued to manifest its interest in the canal question, by appointing special agents to report on the subject, passing resolutions, and concluding treaties with the Central American States. In a treaty with New Granada (now the United States of Columbia), ratified in 1848, the United States went so far as to guarantee the integrity of the territory of New Granada in return for participation in all the exemptions, privileges, and immunities concerning commerce and navigation "which are now or may hereafter be enjoyed by Granadian citizens," and for the right of way across the isthmus by any means of communication then existing or subsequently constructed.

In 1837 and 1838 an Englishman, Lieutenant John Bailey, of the Royal Marines, had, on behalf of the Central American Government, surveyed a proposed canal route, *viâ* Lake Nicaragua, and of the results of this survey one of the confidential agents, Mr. J. L. Stephens, sent out by the United States, was able to avail himself in framing his report. He characterised Lieutenant Bailey's results as "the most reliable data that have ever been published" on the subject. About the year 1848 the seizure of San Juan de Nicaragua, afterwards named Greytown, by the British Government, ostensibly for the protection of a savage ally, the King of the Mosquitos, caused considerable excitement in the United States, which were repeatedly requested by the Government of Nicaragua to interfere on its behalf. It was thought, probably not without reason, that the real purpose of this annexation by Great Britain was to obtain control of the prospective interoceanic canal. The negotiations which followed resulted in the conclusion of the Clayton-Bulwer Treaty, on April 19th, 1850, which eventually put an end to the Mosquito protectorate. A few months previous to this date a concession was granted by Nicaragua to the American Atlantic and Pacific Ship Canal Company, and a survey, to which we shall again have occasion to refer, was carried out by Colonel O. W. Childs, which tended to confirm the advantages of the Nicaraguan route as compared with others proposed. In a treaty of commerce and friendship negotiated at the same time between the United States and Nicaragua, it was stipulated that, "if by any contingency the above-named American Atlantic and Pacific Ship Canal Company shall fail to comply with the terms of their contract," then "all the rights and privileges which said contract confers shall accrue to any company of citizens of the United States which shall, within one year after the official declaration of failure, undertake to comply with its provisions."

We have given a somewhat full account of the transactions just recorded, chiefly with a view to showing the serious interest taken in the matter by the United States, as demonstrated by their very evident anxiety to have a hand in any prospective undertaking of the kind in question. Between 1850 and the outbreak of the great Civil War several surveys for interoceanic canal routes were undertaken, both as the result of private enterprise and at the instance of the United States Government, including explorations of the Isthmus of Darien, which ended in proving the latter unsuited for the purpose of a canal. After the war, which for many years put a stop to all engineering enterprise not immediately connected with it, General Grant interested himself in the subject of a ship canal through the isthmus, and during his presidency official surveys were undertaken of the various suggested routes, including the lines through Honduras, Tehuantepec, Nicaragua, Panama, Atrato, and Darien. On the Nicaraguan survey Mr. A. G. Menocal, the present chief engineer of the Nicaragua Canal Construction Company, was appointed chief engineer. When all the reports of the various surveying parties had been sent in, they were submitted, in 1876, to a commission appointed for the purpose by the President, which, after a careful study of the infor-

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CARSON'S IMPROVED MARINE BOILER.

CONSTRUCTED BY EARLE'S SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, HULL.

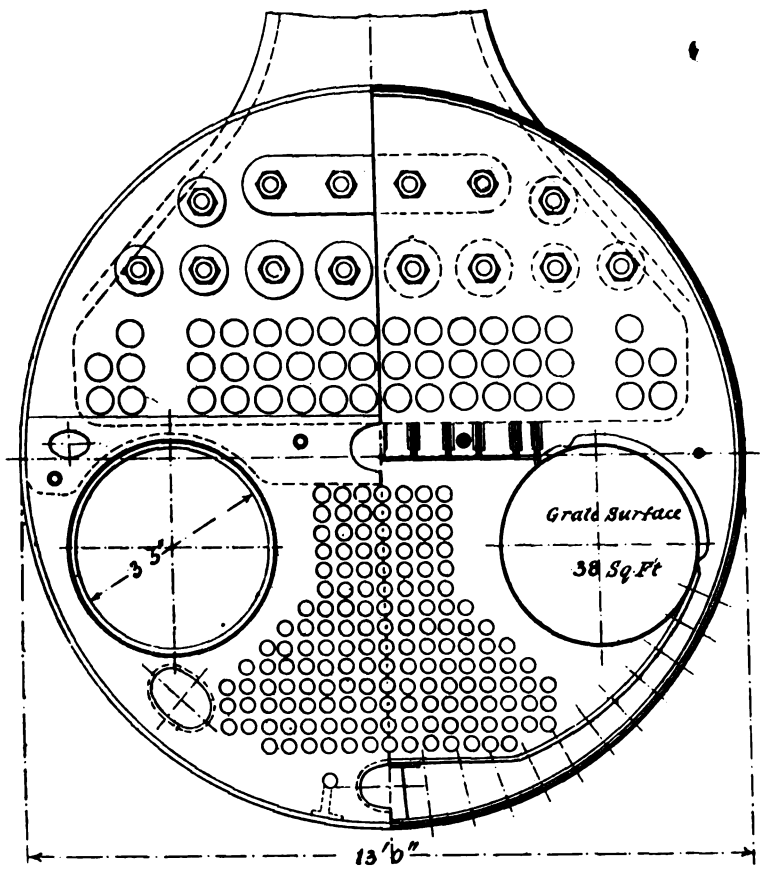


FIG. 1.—FRONT PART SECTIONAL ELEVATION.

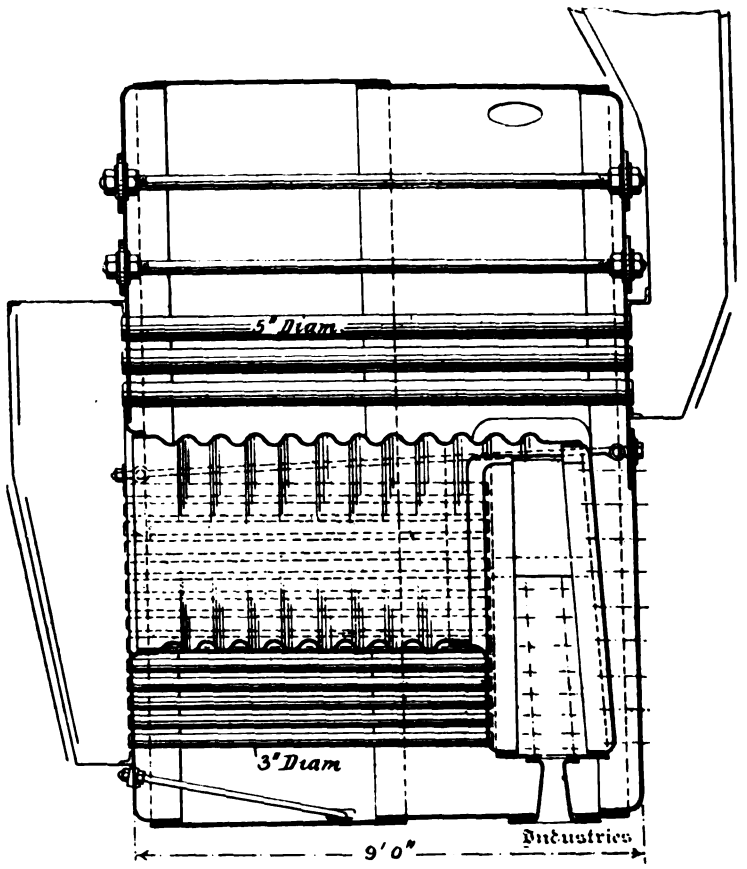


FIG. 2.—SIDE SECTIONAL ELEVATION.

mation laid before them, unanimously reported in favour of the Nicaraguan route. After this the matter was again allowed to drop until the year 1879, when the news of the concession granted to Lieut. Wyse for the construction of the Panama Canal seems to have roused the United States to further action. In 1880 a concession was obtained from Nicaragua by the Provisional Interoceanic Canal Society, of which concession, owing to the delay caused by the opposition of M. de Lesseps and Captain Eads, a renewal eventually became necessary, and the Provisional Society was merged into the Maritime Canal Company of Nicaragua. During this period it appears that the Secretary of State, Mr. Frelinghuysen, was actively engaged in preparing the way for a treaty regarding the construction of the canal by the United States Government itself, and in December, 1884, the limit of time allowed to the Maritime Canal Company for commencing work having expired, Mr. Frelinghuysen's treaty was submitted to the Senate. The Senate, however, rejected the treaty, and it was withdrawn and not again presented to Congress.

Private enterprise once more returned to the charge, and after many delays and much opposition a Maritime Canal Company of Nicaragua was finally incorporated, on February 20th, 1889, under whose auspices the canal is now in course of construction. At an earlier period, when first formed, the association had taken care to inform themselves as to the attitude of the Government towards the enterprise, and elicited a statement from President Cleveland, in which he repudiated the proposed treaty with Nicaragua, already referred to, drawn up under his predecessor. In this statement the following passage occurs:—"I am unable to recommend propositions involving paramount privileges of ownership or right outside of our own territory, *when coupled with absolute and unlimited engagements to defend the territorial integrity of the States where such interests lie.* While the general project to connect the two oceans by means of a canal is to be encouraged, I am of the opinion that any scheme to that end, to be considered with favour, should be free from the features alluded to."

We have thus far dealt only with the historical aspect of our subject, which is of considerable interest and importance, more especially in so far as it indicates the attitude of the United States Government with regard to the construction of an interoceanic waterway. In our next article we shall proceed to consider in greater detail the merits of the Nicaragua route in connection with the results of recent surveys and explorations. Our illustration on page 300 (Fig. 2) shows, on a chart of the world, the relative distances which will be saved by the use of the proposed canal, while Fig. 1, on page 289, gives a bird's-eye view of the canal.

(To be continued.)

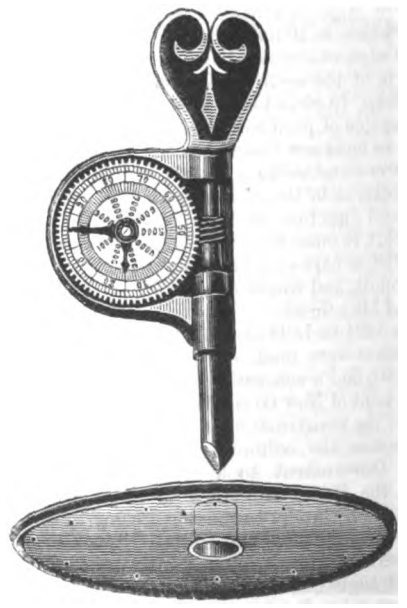
CARSON'S IMPROVED MARINE BOILER.

THERE is very little variety in the designs of modern marine boilers. From time to time new designs are proposed, but little or nothing is practically accomplished. Mr. R. Carson, Marine Superintendent, Hull, has, however, not only invented what appears to be a considerable improvement as regards multitubular boilers for marine and other purposes, but has also had his invention put to a practical test. The improvement consists in the boiler being provided with "double-return" tubes. In Figs. 1 and 2 we give a front elevation partly in section and a side sectional elevation of one of these boilers, as recently fitted in the steamship "European," a vessel built in 1850 by Messrs. Smith & Rodger, of Glasgow, and which has recently had her compound engines converted into the quadruple-expansion type, and this new boiler supplied by Earle's Shipbuilding and Engineering Company, Limited, Hull.

It will be seen that the principal feature of Carson's improved multitubular boiler consists in the provision of two distinct set of tubes, the lower ones being 3in. in diameter, and the upper ones 5in. in diameter. The gases first pass from the combustion chamber to the lower tubes, and then through the upper ones on their way to the funnel. It is therefore likely that by this arrangement the temperature of the escaping gases will be considerably lower than in the ordinary marine multitubular boiler, and thus economy of fuel will be effected. Careful experimental trials and actual practice in ordinary working confirm this conclusion. The boiler, which is 13ft. in diameter and 9ft. long, has two corrugated furnaces 3ft. 5in. diameter, with a grate surface of 38 square feet and a total heating surface of 1,500 square feet. This boiler burns 20·3lb. of coal per square foot of fire grate, and is said to evaporate 10·1lb. of water per lb. of coal, calculated at an absolute pressure of 195lb. These results, if correct, are very satisfactory. Apart from economy of fuel, this design of boiler has an important advantage—viz., in equalising the temperature of the boiler when steam is being raised. The circulation of the water is ensured by the gases at their maximum heat passing through the lower set of tubes, and it will be seen that these tubes are so arranged that there is scarcely any water in the lower part of the boiler which does not have heat directly transmitted to it.

A HANDY MEASURER.

THE illustration given below shows an ingenious little instrument brought out by Messrs. O. Berend & Co., of 61, Fore Street, London, E.C., which will no doubt prove useful to engineers and others as a substitute for the



ordinary measuring tape, especially for long distances. By running the edge of the disc or distance wheel along the article to be measured, the number of revolutions are registered by the counter. As the distance wheel has a circumference of 8in., two-thirds of the number of revolutions are the number of feet measured.

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THE INSTITUTION OF NAVAL ARCHITECTS.

(*Continued from page 280.*)

THE first paper read on the 19th inst. was by Mr. J. H. Biles, on

SOME RECENT WARSHIP DESIGNS FOR THE AMERICAN NAVY.

This paper gave an excellent idea of what was being done by the Americans in warship building. The keel of the first modern American warship was laid in 1883, and it was not until the end of 1889 that any considerable further additions were arranged for; but there are now under construction seven cruisers and seven armoured ships. With the aid of well-drawn diagrams and carefully prepared tables, the author gave the principal particulars of the "Chicago," the "Boston," the "Atalanta," the "Baltimore," the "Charleston," the U.S. cruiser "Philadelphia," the armour battle-ship "Texas," the armoured cruiser "Maine," the armoured coast defence vessel "Monterey," and the coast-line battle-ships, "No. 1," "No. 2," "No. 3," "Indiana," "Massachusetts," and "Oregon." Some particulars given of these vessels are as follows:—

	Length.	Breadth.	Draught.	Displacement.	I.H.P.	Speed.
	Ft.	Ft.	Ft.	Tons.		Knots.
Chicago ...	315	48	19	4,500	5,000	15½
Boston ... Atalanta ...	270	42	17	3,189	3,500	15½
Baltimore...	310	48½	19½	4,392	10,064	20·1
Charleston..	300	46	19⅞	4,010	6,666	18·2
Philadelphia	310	48½	19¼	4,324	8,815	19·7
Indiana ... Massachusetts..... Maine.....	348	69¼	24	10,200	9,000	15

The "Texas," "Maine," and "Monterey" have machinery of 7,600, 9,000, and 5,400 i.h.p. respectively, and the speed expected in each case is 17, 17, and 16 knots.

The author also described several other interesting vessels built or intended to be built for the United States Navy, clearly showing that the American ship designers and builders can produce vessels equal to the best European practice.

Sir Nathaniel Barnaby commenced the discussion by referring to the United States warships of twenty years ago. Though they were not successful in getting the expected speed, yet they were nevertheless formidable antagonists. At the present time we can discuss their proposed armament in a friendly manner. In the proposed coast-line battle-ships the turrets are so low that there will be great difficulty in working the guns at sea. They have adopted thin armour, but here, he thought, it had proved disappointing. The "No. 12" ship is said to have a coal capacity on designed draught of 750 tons, but a total capacity of 1,500 tons, and he wished to know the draught when she was fully loaded. He argued that it was doubtful policy to build ships of this class in this country.

Sir John Hay said that the United States had dropped out of the first-class naval Powers, but were likely to retrieve their position. Lord Brassey ought to reconsider his position with regard to the Atlantic trade now that the other side is making such advances. As they seem to beat us in speed, we ought to build more speedy and powerful ships. We must consider our navy by the light of American advance as well as with regard to Europe, especially as our North American possessions ought to influence us in the same way as Australasia did in the time of the Russian scare.

Admiral De Horsey had two points to comment upon. The author showed that water-line armour was retained in spite of Lord Brassey's opinions. The first thing was to float, and the water-line must therefore be protected. Even if ships are rolling, repairs may be done above that line. With regard to the coal endurance, he wished to know if the central screw working at low speeds while the side screws run idle would not conduce to great economy.

Mr. W. H. White, the Director of Naval Construction to the Admiralty, was averse to saying much because of his official position, which debarred him from deeply criticising foreign ships, especially when they were built more or less from his designs. The United States have been acquiring for years the most detailed information as to European practice, and he was proud to say, they did not adopt rival designs, but followed our lead. They not only have begun to build the ships themselves, but they also produce all the necessities for their manufacture, and will produce results that will compare with or even rival ours. They have gone on the policy of entire publicity, and Mr. Biles has summarised all that is known. Passing to the consideration of the designs, he first dealt with the armament. In some of their vessels the 8in. guns were arranged to fire over the turrets of the 13in. guns. He would be sorry to be in the lower turrets in the heat of action. In these vessels a moderate freeboard is associated with high speed. They have a coal capacity that would sink the belt armour below the water-line when they were fully loaded. This might be all right as long as the bunkers gave protection against shot. The speed is associated with the loading, and their coal capacity on designed draught is very little. Our coal loading for maximum speed is very much greater, so that we have a decided advantage. The speed also depends on the development of power, and that depends on the draught. In our recent trials we obtained a speed that would require much greater pressure of draught in the American vessels. The difficulties in reckoning the coal endurance depend on the method of calculating the weight of coal burnt per horse-power. This amount has considerably exceeded that derived from mercantile practice in every warship in the world. We want experience, and experiments are now being made to clear this up. This feature is especially notable in comparing "No. 2" and "New York" and our "Blake" and "Edgar." The sustained sea speed of the latter vessels is taken at 17⅓ knots, being some 2½ to 3 knots less than trial speeds. In a similar way the American officials will have to be more moderate in their estimates. At the present we have preferred twin-screw ships. The American ships are armed on a very lavish scale. To carry the necessary ammunition great reduction must be made in other ways.

Admiral Colomb remarked that a large part of the stem of the fore foot of the coast-line battle-ships had been cut away with the idea of increasing the manœuvring power. According to his experiments this would rather tend in the opposite direction, especially when the ship has headway, since the pivot point is moved further aft and the leverage is reduced. The object might be attained when the vessel moves from a stationary position. As for the increase in rudder area, it must be enlarged by increasing the depth of the rudder, as horizontal extension soon attains a limit of usefulness.

Mr. Hughes described his experience on board the "Huascar" on a certain memorable occasion. After mentioning the disasters in the turrets he spoke of the water-line. Not a single shot struck them there, and all the plugs of various shapes that had been prepared were useless. It was the fighting position that was most important.

Mr. Martell desired to have some information about the scantlings in these ships. Did they save weight and space by reducing them below the size used in our own ships?

Captain Long asked what was the difference in weight between the three engines for three screws and the engines for twin-screw ships.

Mr. MacFarlane Gray discussed the economy of triple and twin screw ships, and of triple-expansion. He thought that as less power was used to drive the central screw when proceeding at low speeds, less coal would probably be consumed. In new designs for ships with triple-expansion cylinders the high-pressure cylinder should be placed aft, and the low-pressure cylinder forward, so that the latter could be thrown out of gear when steaming at low speeds. This would give a great advantage, as the back pressure in that cylinder would be eliminated. It is just as economical to discard the low-pressure cylinder if the reduction in speed be the same as the ratio between the diameters (not the areas) of the high and low pressure cylinders. An example was given by the speaker to prove this.

Mr. Sidney W. Barnaby stated that in torpedo boat trials he let one screw run idle at low speeds, and found a decided economy in coal. In a trial lasting five and a half hours the consumption of coal was 1⅔lb. to 1¼lb. of coal per horse-power. There would certainly, he thought, be an economy in triple-screw vessels.

Mr. White explained that they preferred twin-screws, because in the latest designs they had two engines on each shaft, so that, at low speeds, one engine of each could be shut off.

Mr. Howes did not think that "No. 12" ship could overtake the "City of Paris." The vessels can get up very high horse-power, but cannot maintain it, as the engines cannot endure it for long. Further, it would require much training and skill in getting up and keeping steam. The engines were only designed to maintain half-power.

Admiral De Horsey thought it might be advisable to thicken the armour above the water-line instead of below, as shown in some of the diagrams. This remark he threw out as derived from what Mr. Hughes had told them of the "Huascar."

In reply, Mr. Biles stated that the extra draught in "No. 12" ship was 3ft. when her coal bunkers were full. This vessel, he said, in answer to Mr. White, was longer than the "Edgar," and has 13 per cent. more heating surface; this was equivalent to endurance in speed, and the vessel is faster. Otherwise, the displacement is about the same. He had given particulars of the coal endurance as estimated by the Americans, and he had not attempted to verify them, but had simply trusted to the particulars given him. The scantlings, he informed Mr. Martell, were about the same as in our own ships, according to what he had seen.

The President commented shortly on this paper. It was fortunate, he observed, that the Institution was able to obtain and publish this information. If it had been done by Parliament there would at once be cries that the legislature was acting the part of an alarmist, whilst the course that had been adopted would cause fair and impartial consideration. The whole matter reminded him of the old song, "We don't want to fight, but, by Jingo, if we do." The United States had acted in a most frank and friendly manner, so that we should know what we had to meet in case of hostilities, though he hoped they might never come. He hoped that the most cordial thanks would be conveyed to Mr. Secretary Tracey, and to the United States Bureaus of Construction and Engineering.

The second paper read on Thursday was by Professor Vivian B. Lewes, on

BOILER DEPOSITS.

The author gave several examples of explosions or collapse due to a new form of deposit which originated with the introduction of high-pressure steam. Analyses were given of the oil used, and of the scale and deposit. The scale from the tubes contained 21·06 per cent. of organic matter, whilst the deposit over it contained 50·20 per cent., and quite half of this was "valvoline," the oil used, in an unchanged condition. It was found that the valvoline was carried over by steam at temperatures far below its boiling point. It is therefore carried by the condenser water into the boiler, where it floats as a scum, which gradually becomes weighted by small particles of the salts that separate from the water. When the scum attains the same specific gravity as the water, it is circulated by convection currents till it meets with and sticks to some surface, which is quite as often on the underside of a tube as on the top. In this it differs from other incrustations. This deposit is an effective non-conductor of heat, especially when it becomes blown up into a spongy mass by overheating. During the last stages of overheating, when the boiler collapses, the organic matter is burnt away, and the comparatively harmless-looking calcic and other salts are left. It is curious to note that this deposit contains a large percentage of copper. Some experiments were performed by the author before an appreciative audience, to show the non-conducting power of this deposit. Two vessels containing equal amounts of water were heated by a blowpipe flame. The one, a clean vessel, quickly boiled, but the bottom of the other, which was coated with the deposit, was raised to a bright red heat before the water boiled. In some cases, the experimenter said, a hole was melted in the bottom before the water was even warmed. Reference was made to the use of sodic fluoride as a precipitant. Professor Doremus advocates its use, as being small in weight and having a rapid and perfect action.

The discussion on Professor Lewes' paper was opened by a controversy as to whether Mr. Ward should be permitted to read extracts from a paper presented to another society. As it was against the rules, and as the extracts were from a paper read by Professor Rogers in 1884 before the American Association for the Advancement of Science, and dealt generally with the subject of boiler deposits, this addition to the paper was not heard.

Mr. Corry said that the author had explained a probable cause of many explosions otherwise inexplicable, as the water was well above the furnace crowns. The idea was not quite new, but it had been clearly demonstrated. It was best to avoid oil in the boilers, and for that purpose no oil should be used in the cylinders, only the piston rods being swabbed with oil occasionally. In his experience the cylinders thus treated were as good as ever. It is best to use fresh water.

Mr. Birt had had a similar experience to the author, and his design for the exploded boilers had been called in question. It was proved that the design was good, and that oil was probably the cause of the damage.

Mr. J. T. Milton cited a case in which the boilers were filled with fresh water and the oily deposits took place very slowly. In the hottest part, near the fire-bridge, the plates buckled, whilst elsewhere they remained sound. This seemed to show that the greatest danger was where there was the greatest heat. Destruction of the plates, he thought, would take place quicker with salt water, as the deposit would form faster.

Mr. Wilson took exception to the author's statement that lubricating power of mineral oils increased with their specific gravity.

Mr. Fothergill thought the paper took the chemist's standpoint too much, and that very few explosions could be attributed to oily deposits. It was no wonder that the furnaces came down when an excessive amount of oil was used in the cylinders, but he thought that some must be used. It is no use to look for scale after the boilers have come down, as it peels off. The experi-

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ments were performed at too high a temperature. He would like oil merchants to give the vaporising point of oil or the lowest temperature at which it gave off vapour. The flashing point and other details they give is of no use to engineers. His point was that excess of oil must not be used in the engine, and then no mechanical appliances are required to keep it out of the boiler.

In reply to the discussion, Professor Lewes wished them to understand that he did not claim originality, but that he had endeavoured to explain a somewhat obscure point and to add an appendix to his previous paper. The statement about specific gravity certainly required correction, but it was specially stated that his paper was subject to revision. In reply to Mr. Fothergill, he said that he based his opinion on thick scaling and the absence of scaling tool marks, so that the peeling off did not affect the question.

The third paper that was on the list for Thursday afternoon was by Monsieur M. Marchal, on a

Study of Certain Phenomena of Compression.

This was taken as read, but Mr. White stated that it was an attempt to form a theory of the behaviour of projectiles when under compression. The experiments on which the theory is founded were carried out under static conditions, and also by firing projectiles against armour plating. The author had given a summary of conclusions, and these tend to show that his theory is confirmed by his experiments. The paper was of such a nature that it could not be profitably read or discussed at the meeting, but was nevertheless extremely valuable. The paper is divided into sections, which deal with:—The general form of bodies considered; distinctive character of the effects observed; theoretical considerations on fracture by crushing, and examples of their application; influence of curvature on direction of fracture; observations on the deformation of cylinders under compression; mode of deformation of cylindrical projectiles; form of fractured fragments of projectiles; ogival headed projectiles show two forms of fracture; production of longitudinal cracks require less force than that of oblique cracks; relation of height and diameter to fracture; relation of force of impact to direction of rupture; form after crushing; crushing of spherical and cylindrical projectiles; curves showing effects; distinction between compression and crushing; and conclusions.

On Thursday evening Mr. A. F. Yarrow read a paper, entitled

Boiler Construction Suitable for Withstanding the Strains of Forced Draught, &c.

For the consideration of this paper the whole evening was set apart. It was a long one, and was copiously illustrated by specimens of the tubes, plates, and boilers referred to, as well as by the actual apparatus by means of which Mr. Yarrow performed his experiments. We shall publish the paper *in extenso* in a later issue, and will therefore only give now a brief abstract of it.

The quality and best material for boiler tubes was first dealt with, samples being shown of tubes flattened and bent without cracking, these being tests to which all tubes should be subjected to show sufficient ductility and elasticity. Expanding by a taper drift was condemned, the drifts used being parallel with rollers having slightly enlarged ends to cause a shoulder inside the plate and a bead outside, care being taken to ensure uniform expanding. Screwing the tubes in position had been tried and abandoned, likewise the use of ferrules. Stay tubes had also been given up for many years on account of their rigidity. The holding power of the ordinary tubes from experiments made showed a margin of safety of 20 in holding the plates together. Stays in water space should allow a free movement to the box and allow for change of temperature. Experiments showed that when the stays were fixed to pass through stuffing-boxes in the shell plate, they moved in and out with every reduction or forcing of the fire. A leaky boiler, after failing eight times, had held tight on adopting this arrangement. Experiments were described for testing the distortion of tubes during heating, by means of rods fixed in the tubes with their free ends through the smoke-box. These ends moved considerably, showing bending of the tubes until about 15lb. of steam was formed, when a back movement showed straightening due to curvature of the tube plates. The distortion of other parts of the boiler was also demonstrated. Respecting air pressure in forced draught, locomotive practice was cited where an equivalent of 10in. of water pressure was used. Limiting the pressure involved a rigid boiler, and this was bad. It was important to steam a new boiler gradually, and never to "rush" steaming at any time, but to light up slowly, with plenty of water, and blow out the surplus as the temperature rose. The result of investigations with thin tubes in thick plates and in thin plates was then given. Proof had been found that after much expansion and contraction the tube end became permanently smaller than the hole, this effect being greater with a thick tube plate than with a thin one. A $\frac{1}{16}$in. tube in a 2in. plate leaked beyond use after eighteen heatings, but a $\frac{5}{8}$in. tube in a $\frac{7}{16}$in. plate held tight after forty heatings; hence it was believed that for iron and steel plates it was better to keep the plate as thin as possible. Further experiments were undertaken to show the curvature of a tube plate in consequence of unequal heating of opposite sides of the plate due to their respective contact with fire and water. This curvature was as much as $1\frac{3}{8}$in. from the flat position. The change of shape produced in round holes after repeated heating and cooling had been measured. The holes became distinctly oval and distorted, thus showing the existence of severe internal strains. This was less with thin plates than with thick, showing other reasons for the adoption of thin elastic plates when of steel. In order to illustrate the advantage of copper over steel plating, an experiment was performed before the meeting with two plates of these materials, each 24in. long, 2in. wide, and 1in. thick. They were gas-heated on one side, water being kept over the other, and the distortion was magnified by levers and shown by pointers. As the pointers moved curves were plotted out—first, as the temperature increased; secondly, as it decreased, due to currents of air fanned across their surfaces. The distortion was very much greater with the steel than with the copper plate, and it was concluded that copper was altogether about four times as good as steel. Galvanic action when copper was used had never been serious, and the final conclusions drawn were that boiler evils, especially that of leaky tubes, would be overcome by "copper" and "elasticity."

Mr. Durston, Engineer-in-Chief of the Navy, rose to open the discussion. He first pointed out that Mr. Yarrow's experience had been limited to torpedo boats, with a single boiler, and not to the working of a group of boilers, where there was a difficulty in ensuring that each boiler should receive its proper share of feed-water or give out the same volume of steam. He soon made it evident that, although he agreed with Mr. Yarrow's reasoning and experiments, he dissented from the conclusions drawn. He believed the whole trouble of leaky tubes was in the overheating of the tube plate, caused by imperfect water circulation, owing to the close pitching of the tubes. There was too much heating surface and insufficient water space; hence, in spite of all possible precautions, overheating must take place, and leakage ensue. The Admiralty practice in fixing tubes was to make the ends a driving fit in tube plates, to expand the fire-box ends with a taper drift, working against rollers with an equal taper opposite in direction, thereby ensuring uniform and parallel fixing, the end of the rollers being pushed to about $\frac{1}{4}$in. beyond the water-side of the plate to form a small shoulder; while at the smoke-box end no shoulder was formed, and the tubes were not drifted tight, in order to allow some freedom for longitudinal expansion. The drift with enlarged ends had been used in the dockyards, but given up. It necessitated destroying the tubes before they could be removed, and during a steam trial a boiler tubed in this way had leaked worse than a similar boiler where plain rollers had been used. Screwing the ends of the tubes into the plates had also been tried, and with similar results. Stay tubes were necessary to meet the large forces set up when the tube plates and tubes became unduly heated. It should not be overlooked, when making comparisons, that a locomotive boiler worked for much shorter lengths of time than marine boilers, and were more easily kept in good repair. In speaking of working under air pressure, Mr. Durston pointed out that with badly worked fires, such as they were always subject to, a high pressure of air caused more mischief than a low one. He considered a draught vacuum in the smoke-box would do less harm than an excess pressure in the stokehold, since in the former case the air and gases were drawn through the tubes, while in the latter they rushed through them. The Admiralty followed the practice of filling the boilers to a high water level before lighting fires, and then blowing out as the temperature rises, while they also considered uniform heating was increased by taking in the feed-water above the furnaces. As far as possible, boilers were always steamed slowly, and in new machinery no condenser water was used for the first three or four hours. In some recent experiments at Portsmouth, they had taken an old locomotive type of boiler from a ship fitted with ten such boilers, and which had failed to work satisfactorily, and had steamed the boiler on shore, using fresh water, without any trouble. It was found that the tubes became as dirty and choked with twelve hours forced draught as with thirty-six hours natural draught. The speaker did not consider the experiments of Mr. Yarrow on thick and thin tube plates, and the curving of tube plates, came within practical limits or represented practical conditions. In the trial of the "Nile" boilers, there was scarcely a leaky tube under a 2in. air pressure, although the boilers were 16ft. diameter, with four furnaces having a common combustion chamber. It was true they had tried the effect of plastering the tube plate and ends, but the experiments were performed, not, as had been suggested, with a view to its adoption, but to discover if the boiler would continue to work so long as the tube plate and ends were kept cool. The result confirmed his opinion that, by avoiding overheating, all difficulty would be overcome. In concluding, the speaker referred to the increasing confidence of naval officers in the use of forced draught and its efficacy to maintain a cool stokehold, otherwise impossible, and to aid combustion. He also related some Admiralty experience with a boiler where the vertical centre row of tubes over each furnace had been removed, and the furnace crown covered with brick, causing a very satisfactory and tight working. The same practice, followed in a locomotive type of boiler, caused a removal of 10 per cent. of the tubes, but gave a good working result and avoided leaks.

Mr. Fothergill criticised the arrangement of Mr. Yarrow's boiler, and gave some account of his experience with forced draught. He did not consider it a mistake to have a rigid tube plate; hence he should not abolish stay tubes, but would keep the tube plate stiff and the tubes flexible. In the boiler described by the author it was evident that the heated gases passed straight to the top rows of tubes only, thus causing unequal heating and expansion. A deflector at the furnace back would prevent this by causing more equal distribution and destroying the disastrous direct impact of the heated gases. It should be remembered that the difference in air pressure in the stokehold and funnel was caused by the resistance to be overcome by the air in its passage through the boiler; this varied a great deal, and gave apparently misleading results. His six years' experience had taught him that with a moderate air pressure of $\frac{3}{4}$in. no damage was done, but he did not believe any boiler would stand prolonged working with such pressures as $1\frac{1}{2}$in.

Mr. Martin concurred with the views expressed by Mr. Durston as to overheating being at the root of the trouble, and declared himself as a "hot tube plate man." His first experience with the locomotive type of boiler had been in some trials of one of Thornycroft's first-class torpedo boats at Portsmouth. The run had been satisfactory, when the boiler suddenly ran short of water, became overheated, and an outburst of water and flame caused severe injury to the stokers. Yet, by keeping up a plentiful supply of feed-water, they magaged to work the boiler back without serious leakage at the tubes. In another case, with a vessel of the "Sharpshooter" class, they had run a good two and a half hours' trial, when, on increasing the air pressure, the boiler suddenly became over-heated, and in an instant nearly emptied itself of water through spaces formed between the tubes and the tube plates. He had recently heard of some experiments made thirty years ago on the Dublin Main Railway Line, when it was found, by means of tubes through the boiler back, that there was often no water, but steam only, near the tube plate, thus showing bad circulation. In his own practice he had placed a propeller inside a tube passing into the boiler, and propelled the water towards the front tube plate. While the arrangement worked no leaking was seen, but as soon as it stopped, due to a breakdown, the plate became overheated, and the tube at once began to leak. He had found that brass rings, tightly fitted in cast-iron safety valve casings when new, had become free after some service. This would serve as another illustration of how a space could be formed between a tube and plate by a constant crushing and consequent reduction of the tube section. Plaster had occasionally been used, and had been found to prevent leakage when about $\frac{3}{8}$in. thick over the plate. He considered the crowding of tubes, and the resulting bad water circulation, was the chief cause of the evil.

Mr. Thornycroft said that much as he admired the skill of Mr. Yarrow in overcoming present difficulties, he considered there was even something to regret in it, since, by patching up an old type of boiler, it only served to delay the day when a really good boiler would be used. His own experiments had shown that forcing a boiler caused leaky tubes and hot tube plates.

M. Normand had in France tried to protect tube ends by reducing their diameter and covering them for a short length with cement, thus causing the heat to strike the tubes beyond the tube plate. His own firm had inserted short copper tubes into the ends for the same purpose, and, although they were found to protect and keep tight the tubes, the copper ends themselves fused, and the arrangement was abandoned.

Mr. Marshall gave the weight of his opinion to the importance of the spacing of the tubes. When the rows of tubes were arranged diagonally it was much better to have the greatest space in a vertical line, rather than in a horizontal one as in Mr. Yarrow's boiler. He had found that of two similar boilers working in group with others, the one having the vertical arrangement held tighter than the other. The reason why so much leakage took place in Admiralty boilers, as compared with the mercantile marine, was due to attempting to force too much heat through insufficient surface. With a single combustion chamber to four or six furnaces all the heat

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had to pass through one plate pierced with many holes, while a number of combustion chambers increased the absorbing surfaces, as a result of which the plates were less heated. Dr. F. Siemens had recently pointed to the disastrous effect of the impact of hot gases upon steel plates; the plates absorbed carbon and altered their characteristics. A proper arrangement of flame boxes such as Mr. Inglis, of Glasgow, used would prevent this. It was probable that the first foot of the tube length did most of the work, hence shorter tubes should be used. M. Normand's plan of a falling water bridge for throwing the gases down had effected useful results, and what we really wanted was a larger surface for heat absorption.

Mr. Manuel thought we should not hear so much of leaky tubes in future. Marine engineers were asked to do impossible things, since they were required to put too much power in too little space. This produced excessive fire-grates, which, together with neglect of proper circulation and scantling, were the chief causes of leakage. Mr. Manuel then drew upon the blackboard a form of double-ended boiler with long fire-grates, the evils of which he pointed out. He also made some remarks, evidently intended for the Admiralty engineers present, with reference to the safety of the stokers in closed stokeholds, and the change of policy in the Navy by the reduction of the air pressure. The sketch and criticisms brought Mr. White to his feet with an indignant denial of the assumptions and conclusions Mr. Manuel had made, and an explanation that the difficulties in the boiler referred to were inherent to its special type. The incident did not close until further emphatic remarks had been made by the speakers.

Mr. Martell, as a naval architect, desired to protest warmly against the growing demands of boiler constructors. The time was when boilers were made for ships, but now ships were made for boilers, and, as a result, shipbuilders had been forced to give up their scantlings and stringers to make boiler space. This policy could be carried too far.

Admiral De Horsey wished to draw attention to some experience with a tube plate covered with a non-conductor, which had worked well while the coating remained. He wondered Mr. Yarrow did not use a hanging bridge to deflect the hot gases. In a small steam launch he possessed, the tubes had required renewing every month until the adoption of a bridge, when they lasted ten months.

Professor Lambert desired to point out that no attempt had been made to measure the forces producing the distortion of the tubes and plates in Mr. Yarrow's experiments, but only to measure their effects. It was evident the disturbing forces would be very great, and could not be neglected. He heartily congratulated Mr. Yarrow on the way he had faced the question.

Mr. Yarrow made his reply somewhat brief owing to the lateness of the hour. He could not, he said, fully agree with the criticisms of Mr. Durston, but felt sure all would be taken in good part. The method of measuring air pressure in forced draught was a misleading one, since one boiler could be more forced with a 2in. air pressure than another boiler with 3in.; it was a question of resistance to passage through the boiler. He could not believe tubes could keep as tight with thick plates as with thin ones, and he had found steel boxes give endless trouble while copper boxes worked quite successfully. He considered the 3in. tube plate referred to by Mr. Martin, and the $\frac{9}{16}$in. plate of Mr. Marshall, too thick; they should not be above $\frac{1}{2}$in. He never worked a new boiler to full power at first steaming, but only at the second trial. The use of copper in place of steel would give the greater absorbing surface wanted by Mr. Marshall, and he could only believe that its greater use, in spite of its large cost, would do very much to overcome the difficulties he had dealt with in his paper.

A very warm vote of thanks was accorded to Mr. Yarrow by an audience evidently much edified by his experiments and illustrations, and grateful for the large amount of trouble and expense he had incurred.

(To be continued.)

AN IMPROVED BAND SAW GUIDE.

Notwithstanding the continual increase in the uses of band saws, a great deal of dissatisfaction is caused by their frequent breaking. A large proportion of such breakages are attributable to the unsatisfactory methods of guiding the saws, a favourite method being to use a stationary piece of wood or metal, to take the back thrust. It is obvious that this must engender a considerable degree of heating through friction, and cause the saw to expand and crystallise at the back. This action after a time brings about the breaking of the saw. The use of oil or grease between the rubbing surfaces is not desirable, as it tends to destroy the rubber on the saw

AN IMPROVED BAND SAW GUIDE.

Constructed by Messrs. J. Sagar & Co., Wood-working Machinists, Halifax.

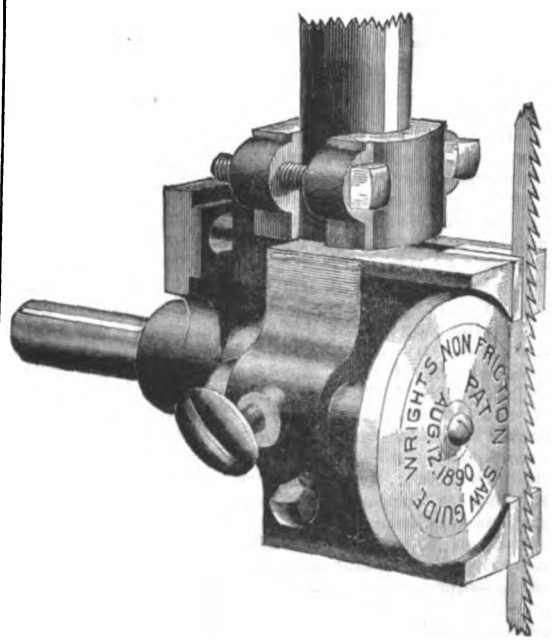


Fig. 1.—Showing Guide Complete.

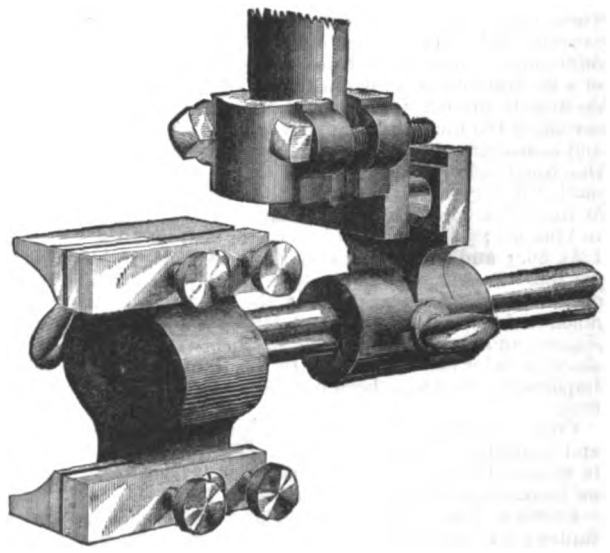


Fig. 2.—Showing Guide with Anti-friction Disc Removed.

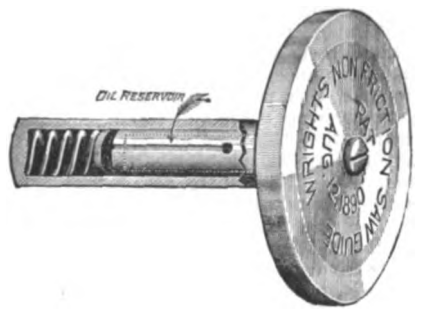


Fig. 3.—Showing Anti-friction Disc.

wheels. More recent attempts at guiding the saws, such as the use of metal pulleys or runners to take the back thrust, have been steps in the right direction, but none of these provided any side support for the saw. In the "Wright" band saw guide, which we illustrate herewith, Figs. 1, 2, and 3 represent respectively the complete guide, the guide with anti-friction disc removed, and the anti-friction disc partly in section. In this invention the above-mentioned defects would appear to have been successfully and simply remedied, for, as will be seen, this guide consists of a metal body, having two pairs of steel guide plates and a steel disc respectively for guiding the saw laterally and for taking the back thrust. The disc is mounted upon a spindle capable of revolving in an oil reservoir, and is caused to revolve by slight frictional contact with the saw itself, at the same speed as the saw is moving. The disc, which is the only wearing part, will, we are informed, last for a considerable time, and can be easily replaced when worn out. The makers of this guide are Messrs. J. Sagar & Co., wood-working machinists, of Halifax.

ENGINEERS IN THE ROYAL NAVY.

We understand that the increasing difficulty of obtaining, not only engineers (in the official sense of that term), but also engine-room artificers, for service in the Royal Navy is beginning to cause serious alarm at the Admiralty. We are told that the attempt made last year to obtain fifteen assistant engineers from approved engineering establishments and technical colleges was a failure, and yet, undeterred by this, the Admiralty propose to advertise twenty-six similar appointments to be open for competition in May next on the same conditions. Advertisements are also to be found in the newspapers for engine-room artificers, coppersmiths, boilermakers, and fitters, and agents seem to be appointed all over the country for the purpose of trying to engage suitable men. These efforts, however, do not seem to be successful, as we recently heard of a commission going over the country, and spending a considerable amount on travelling expenses, and on their return to the Admiralty were only able to report that they had captured two candidates. When every other class of occupation is overcrowded by applicants, and when all the lines of steamers in the mercantile marine have long lists of fully qualified men waiting for vacancies, there must be something wrong in the arrangements of the Navy when there is so much difficulty in obtaining sufficient men to meet the requirements of the service.

Let us consider, in the first place, the cases of the engine-room artificers. These men find that when they enter the engine-rooms of the Royal Navy they must abandon all hope of promotion. They are "artificers," and can never become "engineers." When we remember that all those who enter the mercantile marine are at first exactly like themselves, but that if they conduct themselves properly, and take advantage of what opportunities they may have for self-improvement, they may rise through all the grades, and become superintendent engineers or managers of engineering establishments, it is not to be wondered at that the more hopeful and the freer career proves the more attractive. Any position which gives no hope of improvement must always be depressing.

With regard to the engineer officers even, they are in a very depressed condition. The pay is small, and the status is inferior to that of the naval officers, and consequently it is found that the best of them prefer to enter private service. We recently, indeed, had the curious spectacle of the Engineer-in-Chief of the Navy resigning his post and entering a private firm. Under proper conditions this would have been impossible. The present conditions must be so modified as to attract really good men. The recent free competition for the positions of assistant engineers was, no doubt, a step in the right direction, but the theoretical examinations seemed far too difficult; in fact, that is the fault of all the examinations connected with the Admiralty. They are conducted by men who are good mathematicians, but who, as a rule, are not engineers, and who consequently have little idea of the requirements of engineers. When we consider how little mathematical knowledge is required by sea-going engineers, we think a test might be devised which would secure the best men for the work to be done. We do not think that this is likely to be the case if a knowledge of pure mathematics, or even physics, is to be preferred to good workshop practice.

With regard to the engine-room artificers, some avenue ought to be opened up whereby at least the best of them might be able to obtain the position of engineer officers; in fact, in every service we believe that unless men get the chance of rising there will be discontent and difficulty. When so many things are being inquired into we think that some Member of Parliament ought to suggest that a special committee be appointed to inquire into the conditions of service in the engineering department of the navy with a view to devising some means of improvement.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 24th March, 1891.

Iron.—The situation here is improving, and orders continue to come in plentifully. The prospect is good, but there is no change in prices for the present. The quotations fixed by the Paris Syndicate were 136s. 6d. per ton for bars, and 144s. 6d. for joists. The commercial prices were 124s. 6d. per ton for bars, and 132s. 6d. per ton for joists. These rates do not leave much profit for the iron merchants, as producers' quotations are high and have a tendency to rise on account of the continued dearness of fuel and the prospect of a general miners' strike in the spring. In the Meurthe-et-Moselle district the wrought iron market is dull, but several of the foundries are fairly busy, and the steel works and constructors' shops have plenty of work on hand. In the North affairs have a much brighter aspect and the market is very firm. Last week the best bars were quoted at from 112s. 6d. to 116s. 6d.; ordinary joists, from 116s. 6d. to 120s. 6d.; joists with wide flanges, at from 132s. 6d. to 136s. 6d.; and those over 12in., from 144s. 8d. to 148s. 6d. per ton. It seems probable that these prices will be increased 4s. or 5s. per ton. In the Pas-de-Calais district much activity is being shown. A large steel works has been started, and the establishment of tool works and boiler shops is under consideration. In the Haute-Marne several important orders have been booked, and the prices are very firm.

Coal.—Great activity still continues in mining operations and quotations are generally firm. The production of fuel in France during the year 1890 was 26,327,008 tons, being an increase of 2,423,799 tons on that of 1889.

Copper, Tin, and Lead.—There has been a general falling off in the prices of these metals, and the market is very weak. Best Chilian copper in bars is quoted at £56 8s., ordinary Chilian bars at £54 10s., and "best selected" ore at £59 2s. per ton. Billiton tin has decreased in value 10s. per ton. Lead is officially quoted at £13 2s. per ton.

Exportation of Cast Iron.—The following statistics, which have been taken from the documents of the French Custom House, show a considerable decrease in the exportations of cast iron from France during the month of January of this year as compared with the same period of 1890:—

	1891. Tons.	1890. Tons.
Total importation of cast iron	1,973	385
Total exportation of cast iron	5,693	15,908
Temporarily exported (to be re-imported)—		
Forge pig	3,566	3,726
Foundry pig	2,938	6,121
Re-exported (after being manufactured)—		
Forge pig	1,808	2,900
Foundry pig	3,146	2,176
	17,151	30,831

Launch.—La Société des Forges et Chantiers de la Méditerranée has recently launched from its yards at La Seyne a large steamer, "L'Espagne," built for La Société Générale des Transports Maritimes. This vessel is 397ft. in length over all, with a beam of 42ft. She is built of steel, and has a displacement of 6,600 tons; her engines, of 3,000 horse-power, are on the triple-expansion system, and the speed calculated upon should be 15 knots at the trials and 14 when running in ordinary service.

BERLIN, 23rd March, 1891.

Trade at Stettin.—According to the recently published statistics of the maritime trade of Stettin, the total import of Stettin has increased from 1,384,040 tons in 1889 to 1,424,970 tons in 1890, the export from 568,268 tons in 1889 to 617,961 tons in 1890. The import from the harbours belonging to the German Commercial Union, Sweden and the United States showed a considerable increase, and a corresponding decrease from Russia, Great Britain, Italy, Norway, and British Australia. The principal articles of import were:—Oats, timber, pig iron, iron ores, coal, herrings, and petroleum. The export to Great Britain, North America, Spain, Italy, Russia, and the harbours of the Union increased considerably, and decreased considerably to Belgium, France, Holland, Portugal, the Brazils, and Denmark. The principal articles of export were:—Raw sugar, loaf sugar, cement, flour, potato-flour, timber, zinc, coal, spirits, and wheat.

German National Exhibition in Berlin.—There appears to be a general desire in industrial circles to have a large exhibition of national industry here as soon as possible, and a movement has been started by the Osnabrück Chamber of Commerce to create the necessary interest in the matter. It appears, however, that the associations of the larger industrial establishments in Germany are not entirely in favour of the project. It is probable, therefore, that, unless the Government takes the matter up, it will be indefinitely postponed. The town of Berlin itself would, no doubt, be pleased to have such an exhibition, and would in due time be quite willing to grant a liberal subsidy.

Professor Helmholtz.—Professor Helmholtz will celebrate his seventieth birthday on August 31st. In honour of the anniversary a marble bust of Professor Helmholtz will be prepared, and it is proposed that there shall be a Helmholtz Medal, to be bestowed on the most eminent German and foreign physicists. An international committee has been formed for the purpose of carrying out these schemes.

VIENNA, 23rd March, 1891.

The Iron Market.—Little alteration has taken place in the iron market since last week. Prices generally are scarcely maintained, and there is a general stagnation of trade, which will only disappear when building operations resume their full activity. Hopes of such an increase of trade have prevailed for some time without fulfilment. Machine works are busily employed, and are well provided with raw material. Electrical industries are at the present time giving good employment to machine works. The Brünn Machine Works Company has recently received an order from Messrs. Ganz & Co. for steam engines, with a total output of more than 1,500 h.p.—The large refining works and rolling mills of the Austrian Hungarian State Railways Company have made an output during the past year of 29,109 tons of rails, 4,998 tons of girders, 4,772 tons of iron for constructive purposes, 7,659 tons of merchant iron, 3,546 tons of thick sheets and boiler plates, 2,113 tons of fishplates, 1,977 tons of thin sheets, 1,632 tons of axles, and 3,623 tons of tyres. The total production amounted to 50,000 tons of refined iron, and 15,187 workmen were employed.—A company has been formed with a capital of 800,000fl., which is afterwards to be increased to 1,000,000fl., for the purpose of working the antimony and gold mines of Mileschau.

The Coal Market.—Business has become more active in every department, and, with the resumption of traffic on the Elbe, orders are continually increasing, both in number and amount. The West Bohemian Miners' Union held its general meeting last week, and the balance sheet for the past year was produced. The net profits for the year amounted to 321,719fl., an excess of 20,000fl. over those of the previous year. A dividend of 5½ per cent. was announced.

Electrical Engineering.—The Department of Public Works in Budapest has submitted to the town council a plan for the electric lighting of the city. The city has in consequence announced its wish to receive plans in open competition for this project. It is rumoured, however, that this announcement is merely formal, and that an order for the installation has been already entrusted to one of the largest firms in the kingdom.—The electrical railway which ascends the Mönchsberg, near Salzburg, has carried 66,712 passengers and more than 1,000,000kgr. of goods up to the end of last year. The net profits amounted to 417,411fl. It has been decided to enlarge the central station at Salzburg. The Electrical Works Company at their recent general meeting determined to pay a dividend of 7 per cent.—Messrs. Ganz & Co., of Budapest, have received the second prize for their plan for the utilisation of the water power at Niagara.—Messrs. Siemens & Halske have recently opened a fine installation for the electric lighting of the Lintz Railway Station. The installation consists of 100 arc lamps and 200 incandescent lamps.—The electric lighting of the imperial palace at Vienna is to be extended, so as to include all the rooms in the palace. The installation now consists of 2,000 incandescent lamps, and the proposed extension will add 2,000 lamps to the present number.

BRUSSELS, 24th March, 1891.

The Metal Market.—The situation becomes worse every day in consequence of railway rates, which favour the carriage of raw material, to the detriment of home production. There are at present few hopeful signs. The rolling stock of the Belgian railways is in a poor condition, and accidents happen daily which might be avoided by the renewal of the stock. Belgian manufacturers have shown energy in overcoming many difficulties, but will scarcely be able to continue their efforts with success, unless the condition of the market should improve, especially as regards the price of raw material. The market on the whole is inactive, but there is some business in sheet iron. Messrs. Dyle Baculan have an order for turntables for the Belgian Government at a cost of 200,000fr., and also an important order for vessels for Brazil.—It has been proposed in Belgian commercial circles to form a company in order to find markets for Belgian products in foreign countries. Prices are as follow:—No. 1 quality, 13·50fr.; sheet iron, 16fr.

The Coal Market.—The coal market is rather inactive. Orders for household sorts are slack, and prices of industrial sorts are weak. Reductions are made in the prices of coals for iron and glass works. Some large contracts for fuel are to be placed by the Belgian Government on the 7th of April. It will include 75 lots of 2,000 tons each of small coals, 2 lots of 2,500 tons of coal for foundry purposes, 1 lot of 1,500 tons of nuts, and 1 lot of 600 tons of coke. The placing of these contracts is awaited with some attention, as it will serve as a basis for the renewal of contracts which are on the point of expiry. The coke market is weak, and offers have been made at 17fr. to 17·50fr. per ton. Fortnightly prices are as follow:—Best *demi-grasses*, 11fr.; ordinary, 10fr.; lump coal, 15fr.; small coal, 10fr.; and patent fuel, 16fr. to 17fr. A quantity of patent fuel has been ordered for Germany, and German agents have effected some important purchases in several coal districts.

Ostend as a Port.—A proposal has recently been made to convert Ostend into a large seaport town, and to construct docks to accommodate the largest trading vessels, &c. This proposal, which is not a new one, has been brought to the front again, owing to the blocking up by ice of the River Scheld during the recent severe winter, thus closing the port of Antwerp and causing great inconvenience in commercial circles.

Electric Lighting.—The Town Council has determined to undertake the electric lighting of the city, and not to grant the concession to any company. The Town Council has been induced to carry out the work by the consideration that it would otherwise be obliged to take over the installation at a largely increased price on the expiry of the concession at the end of twenty-five years.

Hygienic Exhibition in Brussels.—It is proposed to hold an Hygienic Exhibition at the Musée Castan, Passage du Nord, Brussels, from April 15th to the 31st May next. Full particulars can be obtained by applying to the Secretary of the Exhibition, 160, Boulevard Anspach.

The Extended Use of Gas for Heating at Brussels.—A lowering of the price of gas at Brussels has tended to increase its use for heating purposes, and the consumption has now become very large, chiefly owing to the efforts of M. H. Aerts, director of the lighting department of the town. The gas authorities have determined to charge a certain price for the rent of stoves, and a list of those which are permitted to be used is given to applicants on their applying at the central offices. The stoves most in demand are those for cooking purposes, and the charge for hiring is about 10 per cent. per annum of the total value. During the hot weather the use of gas for cooking has many advantages. A large number of different kinds of cooking stoves have been invented. The Belgian Gasfitters' Association has re-appointed the committee who superintend their exhibition of appliances. This exhibition has become of increasing importance, owing to the generosity of the town authorities and to the efforts of M. Aerts and M. Pettré. Monthly lectures are given by the members of the association, and lessons in cookery by means of gas stoves are given weekly. The increased use of gas in Brussels could scarcely have been foretold some few years ago, and in view of the improvements recently effected in gas cooking stoves the extension of electrical lighting may be regarded without alarm by those interested in the use of gas.

DÜSSELDORF, 24th March, 1891.

Pig Iron.—The production of pig iron in Germany, including Luxemburg, during last month was 331,660 metric tons, as compared with 362,026 tons in February, 1890, and 348,355 tons in January, 1891. These figures show a decrease, which will probably become greater if the high price of fuel is maintained. The Rhenish-Westphalian makers of pig iron have again reduced their prices, and they now quote best foundry pig iron at 71 marks, No. 3 at 60 marks, Bessemer pig at 62 marks, Thomas pig at 48 marks, the reductions being from 1 to 4 marks. White and grey puddling pig of first quality is quoted at from 53 to 54 marks, while the ordinary brands are quoted at 45 marks.

Iron and Steel.—Steelworks in general are in a satisfactory condition, but they are hoping for new orders for the summer months. The demand for bar iron has rather increased, but the makers of girders find a deficiency of orders. Building operations have been decidedly kept back by the long and cold winter. Makers of plates of all kinds and of wire are looking for new orders.

The Late Professor R. Werner.—Professor R. Werner, a well-known lecturer at the Polytechnical School in Darmstadt, died a few days ago.

AMSTERDAM, 23rd March, 1891.

Railways.—The Minister for the Means of Communication has stated in the Legislature that he recognises the present inadequacy of the great central railway station at Amsterdam. Steps will consequently be taken to improve the accommodation in such a manner as shall do away with the numerous complaints of the companies and of the public.

A New Petroleum Company.—The American Petroleum Company has been formed in Holland under Dutch law, and has obtained the Royal sanction for its articles of association. Its capital is five million guilders. It is the outcome of a combination between the Standard Oil Company and Messrs. Herrmann, Stursberg, & Co. (both of New York), Messrs. Horstmann & Co. (of Rotterdam), and Messrs. Fr. Speth & Co. (of Antwerp), whose business will be merged into the company as from the 1st of April next, the new company taking over all their tanks and steamers.

Street Asphalte in Amsterdam.—The Corporation of Amsterdam proposes to cover several of the main streets of the capital with asphalte pavements.

Tramways in Rotterdam.—The Rotterdam Tramways Company, working a system of about 30 kilometres, under an exclusive concession from the Corporation, has done well in 1890. The directors' report shows that the receipts were 627,242 guilders, the working expenses 452,277 guilders, and the available net profit 174,964 guilders, out of which a dividend of 8 per cent. has been declared upon the ordinary shares. The company works with a staff of 386 persons, and its stud comprises 454 horses. It also has 9 locomotive engines and 116 cars. The number of passengers carried last year was over six millions.

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NETHERLAND-AMERICAN STEAMSHIP COMPANY.—The company opens, as from April 1st, a new line of steamers from Amsterdam and Rotterdam, alternately every fortnight, to Baltimore. The first steamer to leave will be the "Edam." The fares will be 100 guilders first-class, and 54 guilders steerage. The demand for steerage passage is just now very great, and many applicants have to be disappointed. The company will discontinue its weekly service from Amsterdam. The steamers from that port will leave every alternate Wednesday, and Rotterdam every Saturday.

STOCKHOLM, 21st March, 1891.

EXPORTS OF WOOD PULP.—During the first two months of the present year the exports amounted to 11,708,088kgr., against 8,695,000kgr. for the same period last year and 6,646,000kgr. for the same period of 1889. The shipments during January and February comprise 4,150,683kgr. of dry and 1,163,775kgr. of wet chemical wood pulp, 3,516,520kgr. dry and 2,977,050kgr. wet mechanical wood pulp. The principal exports of all four kinds took place from the Gothenburg district.

INSURANCE OF MEN AGAINST ACCIDENTS.—The insurance of factory hands and workmen against accidents is becoming very frequent in Sweden, either at the instance of the employers or of the men themselves. The men at the Ala Saw Mills have recently been insured against accidents for a sum of 350,000kr.

NEW RAILWAYS.—The development of new railways may lead to unpleasant results for older railways. As an instance may be mentioned the Siljan Railway in Dolarne, where the receipts have been steadily declining every month since the neighbouring Falu-Röttviks Railway was opened last August.

LARGE SALVAGE UNDERTAKING.—The salvage steamer "Belos," which belongs to the "Neptun" Salvage Company, in Stockholm, and which is stationed in or about the Mediterranean, is engaged in raising the Russian passenger steamer "Grand Duke Constantin," which was stranded at Alupka, in the Black Sea, some time ago. The value of the steamer is about £60,000.

CHRISTIANIA, 21st March, 1891.

MILK CONDENSING MANUFACTORY.—Milk has gradually become an important industry in Norway. The works at the Sannesund Manufactory are now progressing, and the vital question of a good supply of fresh water will also be taken in hand shortly. The water will be conveyed from the Tunevand to the works.

THE FISHING INDUSTRY.—Questions connected with the development of the fishing industry are being much discussed at present. In the Christiania Technical Society an interesting paper was read on this subject. The author said that the treatment should commence with perfectly fresh fish, the character of which should be preserved as far as possible. Various methods were discussed, including hermetic preservation, and a new process for the drying of cod. Drawings were shown of a manufactory in which the fish were converted into dry, flat cakes, which could afterwards be given any desired shape. The capacity was about 10 tons of fish per diem. Drawings of railway carriages for the transport of live fish were also shown.

NEW HORSE-SHOES.—Lieutenant Coo, of the Royal Cavalry, has constructed a new horse-shoe, which is to be submitted to numerous practical tests. The special feature of the new shoe is the fact that its calks and clips are changeable. Tests will also be applied to shoes from the Adde horse-shoe manufactory in Sweden, for which somewhat similar advantages are claimed.

NEW RAILWAYS.—With the approach of spring the various new railways, both those already passed and those only projected, are attracting more and more attention. Uncertainty seems, however, to prevail in various directions, and even works which are in a fairly advanced condition have in places been countermanded.

COPENHAGEN, 21st March, 1891.

PROJECTED HARBOUR FOR FISHING VESSELS.—The opinion generally prevails that some steps should be taken for the advancement of the Danish fishing industries, which will not bear comparison with those of Sweden or England. An important question is that of a harbour, and some preliminary surveys have already been made. From these it appears that the various plans would entail the following expenditure:—A harbour at Klitmöller, 15½ million kr.; at Houstholm, 14½ million kr.; at Sandneshage, 11⅞ million kr.; at Hirtshals, 10¾ million kr. The possibility of providing accommodation for the North Sea fishermen at the entrance to the Limfjord at Thyborön has also been considered. An efficient dredger would cost about 320,000kr., and its annual working and maintenance would amount to about 40,000kr. Of other schemes there is the opening out of a new exit from the Ringkjöbing Firth, and of a fishing harbour at the Scaw, which is estimated to cost 2,100,000kr. As far as the Kattegat is concerned, there are two different plans for a harbour at the island of Anhalt, at a cost respectively of 465,000kr. and 590,000kr., and also for a harbour at Lessö. There are thus many alternatives, and no doubt some of them will be taken in hand before long.

MADRID, 23rd March, 1891.

THE NEW OFFICES OF THE BANK OF SPAIN.—The offices of the Bank of Spain are about to be transferred to the new and magnificent building which has been in course of construction during the past seven years. The building, which is of granite and marble, is, perhaps, the finest in Madrid, with the exception of the Royal Palace. Its principal frontage is 162 metres in length, and faces the public walk El Prado. The sum spent on its construction amounts to £600,000. Lifts and telephones have been erected, and the heating and lighting arrangements are of the most improved description. The building, if not architecturally beautiful, is at any rate free from the monotony which is not easily avoided in a long building of only three stories.

ANNIVERSARY OF THE DISCOVERY OF AMERICA.—Much activity prevails in those centres which are engaged in work connected with the celebration of this anniversary. An exhibition of antiquities relating to the discovery of America will be held in the large building which has been in course of construction for the past twenty-five years as a national library and museum.

SHIPMENT OF ORES.—The shipments of ores from Bilbao continue to decrease, but there has been no change in prices since the commencement of the year. There is a general conviction that a small diminution in prices would have no influence in increasing the demand. The statistics of shipments from the south are not so exactly given as of those from Bilbao, but it is reported that they continue at the same rate as during last year.

RAILWAY FROM OVIEDO TO INFIESTO.—The construction of this narrow gauge railway is so far advanced that the opening of the line for traffic may be expected to take place next May or June. The line has been thoroughly well constructed, and will be provided with rolling stock of the best description. It will nevertheless be one of the cheapest lines of its kind. The cost of the line, which is thirty miles in length, has been kept within the estimates, with the exception of an excess of £4,000 on the purchase of land. The cost per mile is £3,200, and it is probable that a dividend of 12 per cent. will be earned on the capital. There are few examples of such a profitable undertaking in this country.

ROME, 23rd March, 1891.

EXHIBITION AT MILAN.—An Exhibition devoted to the subjects of hygiene and the education of children will be held in Milan during the month of May next.

STEAM BOILERS.—The Ministry of Agriculture, Industry, and Commerce has recently published some statistics relating to the use of steam boilers in Italy. The returns show that a considerable increase in the number of boilers has taken place during the last few years in the various provinces. In 1889 the total number of steam boilers, excluding those used for locomotion, amounted to 9,983, representing 156,680 h.p., whilst according to the previous returns made in 1876 there were only 4,459 boilers, representing 55,632 h.p. It is thus seen that in the space of twenty-three years the number of boilers has been doubled, and the total amount of horse-power has been nearly trebled. The average power of each boiler in 1876 was 12·48 h.p., whilst in 1889 it was 15·75 h.p. On examining the figures for each separate province, it is seen that Lombardy takes the first place with 2,540 boilers, developing 42,489 h.p.; the province of Venice comes next with 1,571 boilers, developing 20,644 h.p. The province of Emilia has 1,114 boilers, with 13,319 h.p.; Piedmont, 841 boilers, and 17,033 h.p.; Tuscany, 847 boilers, and 10,717 h.p.; Ligury, 601 boilers, and 16,290 h.p.; Sicily, 545 boilers, and 7,130 h.p.; Campania, 349 boilers, and 9,196 h.p.; the Puglie, 364 boilers, and 5,506 h.p.; the province of Lazio (Rome), 337 boilers, and 2,948 h.p. The other provinces have all less than 300 boilers, and the aggregate power of all of them scarcely amounts to 9,406 h.p. On comparing the figures for 1889 with those for 1876, the greatest increase is found in the province of Milan (Lombardy), where the number of boilers has been increased by 992, and the power by 23,075 h.p. Then the province of Genoa (Ligury) shows an increase of 448 boilers, and 13,630 h.p. With the exception of Cagliari, Cuneo, Pavia, and Potenza, where there has been a decrease amounting to a total of 3,800 h.p., all the other provinces have had a larger or smaller part in the total increase.

NEW YORK, 14th March, 1891.

THE UNITED STATES PATENT OFFICE IN 1890.—The number of patents issued and reissued in 1890, as shown by the Commissioner's annual report to Congress, was 26,292, and the number of applications was 41,048. This shows an increase of business over any previous year, amounting in the respective items to 2,059 and 473. The total receipts of the office were $1,340,373·66 and the total expenditures $1,099,297·74, leaving a surplus of $241,074·92. The Patent Office now has to its credit in the United States Treasury $3,872,745·24.

LIGHTING A RAILWAY TUNNEL.—A good deal of satisfaction is expressed at the announcement that the Delaware, Lackawanna, and Western Railroad has decided that the Bergen tunnel shall be lighted by electricity. The work will be carried out by Mr. Paul H. Brangs, the electrician of the railway company

EARNINGS OF RAILWAYS IN THE YEAR 1890.—The gross and net earnings of railways in the United States for the calendar year of 1890, as compared with those of the previous year, are as follows, according to statistics collected by the *Financial Chronicle*:—

Jan. 1 to Dec. 31.	Gross Earnings.		Net Earnings.		
	1890.	1889.	1890.	1889.	Inc.
	$	$	$	$	P.c.
Trunk ...	272,591,793	256,549,164	84,652,117	82,641,038	2·43
Mid. W'n.	49,776,826	46,138,203	17,827,477	17,095,789	4·28
Nth.-Wn.	126,338,046	118,300,471	43,435,274	42,575,280	2·02
Sth.-Wn.	68,767,372	60,814,175	21,595,233	19,840,694	8·84
Pacific ...	135,126,611	125,473,922	48,493,722	47,563,634	1·96
Southern	83,867,232	74,840,343	27,237,402	24,912,480	9·33
Coal cos..	109,674,874	103,417,221	33,367,765	30,983,568	7·70
E'n&Mid.	111,818,255	102,861,537	37,591,198	33,821,959	11·15
Mexican	3,754,966	3,660,124	827,006	666,694	24·05
Total, 187 r'ways	961,715,975	892,055,160	315,027,194	300,101,136	4·97
11 m'nths, 19 r'ways	45,824,793	43,344,078	12,982,264	13,679,433	5·10
Gr. total, 206 r'w'ys	1,007,540,768	935,399,238	328,009,458	313,780,569	4·53

PHILADELPHIA, 13th March, 1891.

AMALGAMATION OF IRON AND STEEL COMPANIES.—The Lackawanna Coal and Iron Company and the Scranton Steel Company have combined under the title of the Lackawanna Steel and Iron Company. The new company will issue stock to the amount of $3,000,000 to the stockholders of the Lackawanna Company and $750,000 to those of the Scranton Company.—A steel rail combination has been formed, and includes the following companies:—Bethlehem Iron Company, Illinois Steel Company, Penna Steel Company, Edgar Thompson Steel Company, Cambrian Iron Company, and the Lackawanna Steel and Iron Company.

RAILWAY RETURNS.—The annual report of the Pennsylvania Railroad Company for the year ending December 31st, 1890, shows that the gross earnings were $133,521,622; working expenses, $92,003,364; and net earnings, $41,518,257. The net earnings of the main line and branches between Philadelphia and Pittsburgh were $11,030,401, and the dividends paid during the year, at the rate of 5½ per cent., amounted to $6,241,873. The amount transferred to profit and loss account for 1890 was $3,014,441. After deducting extraordinary expenses incurred through the Johnstown floods, there was a balance of $1,949,739. The total amount placed to the credit of profit and loss account on December 31st, 1890, was $22,017,793.—It is now practically settled that the Ohio Valley Railroad will pass into the control of the Chesapeake, Ohio, and South-Western Railroad. This acquisition virtually gives through connections and entrance into Chicago to the latter company.—A company to provide Kansas City, Mo., with a belt line and terminal facilities has been organised under the title of the Kansas City Circular Railway Company, with a capital of $1,500,000.

INTERCONTINENTAL RAILWAY.—The Intercontinental Railway Commission has arranged the preliminaries for making a survey of the proposed railroad. Mr. William F. Shunk, of Pittsburgh, was selected as organising engineer, and will have general charge of the work, for which his services in carrying out the line of the Pennsylvania Railroad over the Alleghany mountain particularly fit him. There will be three surveying parties, including the military party already assigned to the Central American States, and they will work north and south from a centre point in Colombia. It is expected that it will take eighteen months to complete the surveys with the present staff, which is limited, owing to the comparatively small amount of funds at the disposal of the Commission.

THE EDGAR THOMPSON STEEL COMPANY.—The shutting down of the Edgar Thompson Steel Company for repairs several weeks ago has thrown 2,000 men out of employment. The works will not resume operations for several weeks.

THE STRIKE AT MONONGAHELA VALLEY.—The strike of the Monongahela Valley coal miners has ended in a victory for the men. The demand for an increase of ½c. per bushel was acceded to. The strike, which continued since January 1st, has affected 25,000 people. The number of miners idle since January 1st was 10,000.

FLOODS IN ARIZONA.—The damage done by the floods near Clifton, Azizona, will amount to $100,000. The San Francisco River has shifted its channel, leaving several bridges over dry land.

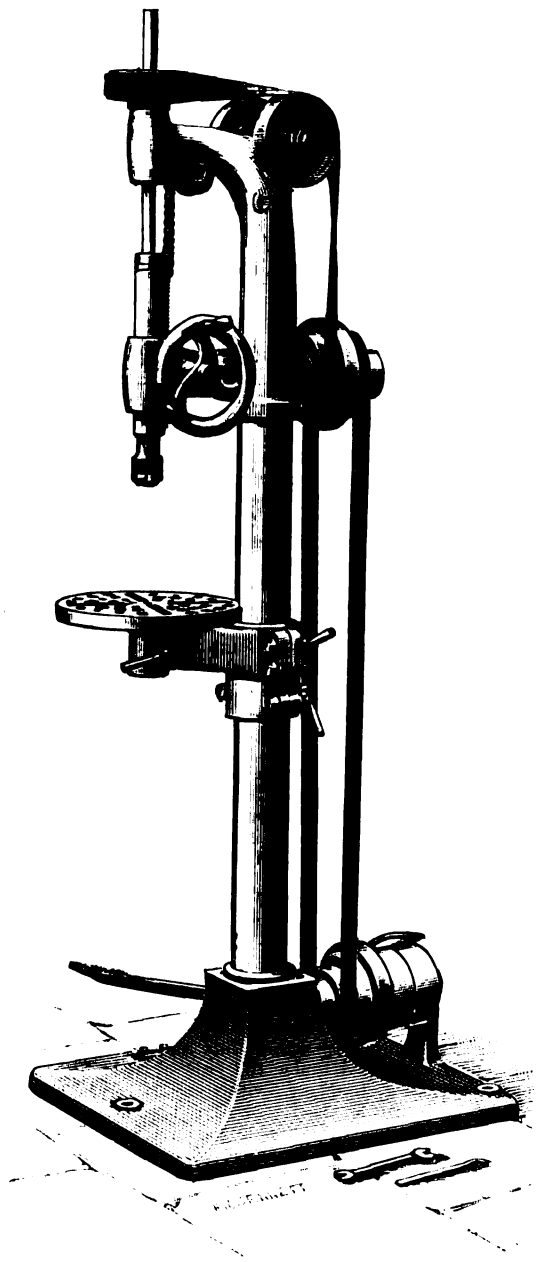
NAVAL.—The cruisers "Philadelphia" and "San Francisco" have been formally accepted by the Secretary of the Navy. The former was built by Messrs. Cramp, and the latter in San Francisco.

PROPOSED DRY DOCK.—The committee appointed to select a site for a dry dock on the Gulf of Mexico recommends the South Pass of the Mississippi, as affording the only entrance 26ft. deep to a harbour far enough from the sea to be safe from gun fire. The property selected belongs partly to the Government the remainder being available at about $150,000.

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QUICK-RUNNING DRILLING MACHINE.

The accompanying illustration represents a quick-running drilling machine, which is specially designed for light work, such as that likely to be met with in electrical engineers' shops, where small holes are required to be drilled in large numbers with accuracy and despatch. The machine, which is made by the Britannia Company, of Colchester, has a counterbalanced steel spindle working through the driving pulley and sleeve,



and is adjustable by a hand feed through a distance of 6in. It will drill a hole ⅝in., and has its spindle nose fitted with a convenient scroll chuck. No toothed gearing is used, the revolving parts being driven by flat belts, while the starting appliance consists of a treadle lever, by means of which the driving belt may be transferred from the fast to the loose pulley, or *vice versâ*. The machine stands 6ft. 6in. in height, and weighs about 5¼ cwt. It is excellently finished, and of the best material.

SOME DETAILS IN MARINE ENGINEERING.*

In laying a description of the following details before so important an Institution as that of the Naval Architects, the writer feels that some apology is needed, as he has no new theory to evolve, no new discovery to lay bare, and little or nothing to describe that is new in any way. In the conviction, however, that the difference between economical and uneconomical engines, between long-lived and short-lived boilers, between satisfactory and unsatisfactory engineering, lies very commonly in small differences of detail rather than in any grand difference of principle, he has thought that the discussion of a short paper regarding a few details to which he attaches importance might be of general interest.

* Paper read by Mr. Thomas Mudd before the Institution of Naval Architects on the 20th inst.

Boilers.—The ordinary method of building marine boilers is to flange the end plates and fit these into plain cylindrical shells. The end plates in boilers of ordinary size cannot be made in one piece, and hence the flange is not a plain continuous flange, but is broken up where it passes the cross joints of the plates, the plates being thinned at the joint so as to imitate as far as possible a plain, continuous flange. The flange, however, meets with another difficulty where it passes the inside butt strap of the longitudinal shell-joint, and here it is common to thin down the inside strap plate to a wedge shape, and cut out from the flange of the end plate a similar wedge piece, so as to minimise that obstruction. It should be noted in passing that it is practically impossible in boiler work to make the wedge-shaped gutter in the flange of the end plate a steam-tight fit on the wedge of the strap plate, and leakage at the ends of these butt straps is of the commonest occurrence, even where great care has been bestowed to avoid it. Another source of leakage at the ends of the butt joints is due to there being always presented to the atmosphere an open joint where the butt occurs, equal to the thickness of the plate, the tightness of which depends upon the tightness of the inside strap and on external caulking. The writer believes that both boiler builders and boiler users will sympathise with his remark when he states that nothing is more difficult or more tedious in boiler building than to get the ends of these butt-strap joints quite satisfactory.

Another difficulty incident to this ordinary method of making boiler ends is that the rivets securing the end of the boiler shell are placed radially to the boiler, and round the bottom they are practically beneath the boiler, where they are very liable to severe corrosion. It is obvious that when these lower rivets in the front end seam become corroded, renewal is very difficult, and sometimes quite impossible, owing to the proximity of the furnace tubes. In putting the boiler together, also, it is obvious that the shell ring and the end plate flange should be so exactly of one size as would be represented by a turned and bored driving fit; for where the end plate flange is a shade too small for the shell ring when the shell-plate joints are hard butted together, there is obliged to be a pucker somewhere when riveted up. Such an end joint is certain to leak, and it has the aggravating characteristic that, when the leak is caulked, it simply shifts along ahead of the caulker, leading him on farther and farther, like a "Will o' the Wisp." If, on the other hand, the end plate is rather too large, the shell butt joint remains sufficiently open to make it almost impossible to prevent leakage through it. In endeavouring to sail between these two rocks, it is common practice to leave one cross joint of the end plate loose until the flange joint is riveted to the shell. And whilst this is, doubtless, the best way to proceed, it is clear that, with the end plate keyed on the inside butt strap, as above described, it is not easy to arrive at perfection even by that expedient.

To speak generally, therefore, this common method of building marine boilers by flanging the boiler end plate involves difficulties by its very principle, incurs great and tedious labour to secure anything approaching good work, and when all has been done that the highest boiler-making skill can do, the result is not entirely satisfactory. When boilers were built of iron, one or two prominent makers, who recognised the above facts and difficulties, set about overcoming them by the simple expedient of putting the flange on the shell plate instead of on the end plate. At first sight this might not appear to be any gain, but it is quite otherwise when the possibilities which this change brought with it are fully thought out. It has been suggested that, instead of flanging the shell, the ends of the seams of the end plates might be welded, and the end plate flanged in the usual way, so as to make one continuous flange all round. This is certainly one step in advance, and it is a method that is carried out by some of the best makers. Whilst, however, this method obviates all the trouble at the ends of the cross seams of the end plate, it does not affect in the least the perhaps greater troubles at the ends of the longitudinal butt joints, and it prevents any advantage being taken of the slight adjustment that can be got by leaving a cross seam of the end plate loose, as above described. The difficulty, therefore, of making the shell ring precisely fit the flanged end plate still remains, and the danger of the shell being a shade too large, causing pucker and local stress in the plate, or of its being a shade too small, causing leakage troubles at the butt joints, are not by this method likely to be removed. When, however, the shell ring itself is to be flanged, there is nothing whatever to prevent its first being welded at the butt joints for a short distance, say 18in., so that the flange subsequently made is one continuous ring flange, without break or change at any part. The end plate then becomes a mere flat disc, without any flange whatever, and, as the ends of its cross seams can also be welded into one thickness, it becomes at once apparent that every difficulty to which we have referred vanishes completely. For since the shell ring is welded at the flange, the difficulty with butt straps interfering with the flanged part ceases, because both the inside and outside butt straps can be stopped short just at the place where the turn of the flange begins, having then well covered the commencement of the weld.

In the next place, the trouble from thinned corners on the end plate ceases, because the end plate is welded up at the ends of its seams into one complete flat disc. Further, there is no such thing to do as fitting one part into another, there is no such thing to fear as pucker or local stressing of the shell, for the end plate plies up naturally to its flange in the simplest possible way, without any fitting whatever. Besides all this, from the constructive point of view there remains the fact that the rivets in this end seam are by this method placed longitudinally in the boiler, and whilst the seam near the bottom of the front is not so liable to corrosion as by the more common method of building, there is this great advantage, that when the rivets do corrode they can be quite easily renewed, because the furnace tubes do not interfere with getting them in.

When mild steel was introduced in boiler building the question arose as to whether the material would bear this treatment as satisfactorily as the iron had previously done. The writer was of opinion that if the steel were of such a character as to be fit for boiler building at all, it ought to be able to bear, and would bear, this simple treatment. Indeed it is now matter of the commonest knowledge that good mild steel will bear enormously more punishment than iron would. Feeling confident in this belief, and knowing from previous experience the very great advantages both to the constructor and the user of this method, the writer commenced in 1884 to build steel boilers on this plan, having first provided special plant for satisfactorily dealing with them, and to the present time more than 200 high-pressure boilers have been so constructed without the slightest hitch or difficulty, or failure of any kind arising in any one of them. There are various points in this method upon which difference of opinion might be expected, at all events amongst those who have not seen a boiler so constructed, as for instance the following:—

The Weld.—Can boiler steel be satisfactorily welded? Is any test applied on the individual weld? Has the weld to bear tension when the boiler is at work? In answering these, experience over the many hundreds of shell welds that have been made in 200 steel boilers shows that with ordinary care an ordinarily good workman can make a sound weld by using a best Yorkshire iron glut, and we have never had a single weld show leakage. Perhaps the very best test of all that could be applied under the circumstances is applied to each individual weld—viz., the weld being made before the plate is flanged, has to stand the subsequent flanging in the hydraulic press, and it seems certain that if it were a mere surface weld it would divide when the disturbance caused by the flanger came upon it. With regard to tensional stresses, the writer wishes to be very emphatic in disclaiming any application of the tensional stresses of the boiler shell to the weld. The butt straps extend to the very edge of the curve of the flange, and the flange itself represents an extra amount of shell material given in beyond what is required to sustain the stresses due to the length of the boiler. Even this flange is also in the condition of having a strap passing over the weld, for the end plate forms a good practical strap to the flange. To put the matter another way, the flange of the shell forms a kind of strengthening bead at the edge of the plate, adding considerably to its strength, and greatly reducing liability to rupture from the edge. The weld, therefore, is only exposed from beneath the straps at the curve of the flange, where from the form of the plate it is very strong, and where practically it has nothing to do but secure steam tightness. An eminent engineer, whose views on practical matters are greatly valued by this Institution and by the profession at large, remarked, in his usual original way, on seeing one of these boilers:—"Suppose you saw-cut the weld through at the part where it is exposed, what would happen? The boiler would not burst, for the stresses are securely carried by the straps. All that could happen would be leakage."

The Effect of Flanging.—Will heavy boiler steel satisfactorily stand flanging to a right angle? Does the necessary local heating seriously injure the plate? Are the plates annealed after flanging? The writer is of opinion that if boiler steel cannot be flanged at right angles with a fairly large radius in the corner when red hot without injury, it is not fit to build boilers with at all; and since he has now had flanged about 1,000 large thick shell plates without returning to the makers more than two plates which showed slight surface tearings on being flanged, he has no hesitation in saying that ordinarily good mild boiler steel will stand this flanging in a perfectly satisfactory manner. With regard to local heating, there is probably a great difference in effect on the plate between heating along the edge and heating locally towards the middle of the plate. In any case the writer again appeals to the large experience he has now had of this method as the proof that no damage accrues to the plate. It does, however, seem to be a wise precaution to anneal the plate after the welding and flanging is completed, and before any riveting is done, and therefore these shell rings are lowered flange downwards into an annular furnace, heated to a red heat, and allowed to remain to cool down with the furnace.

The Rivets and the End Seam.—Rivets are generally put in shearing stress. The rivets in this end flange are exposed to tensional stress. Is that detrimental, and does the tendency of the pressure on the ends of the boiler to tear away the end plate from its flange result in springing the joint and causing leakage? The back ends of single-ended boilers are riveted by a large vertical hydraulic riveter, forming a snap head both inside and outside. The front end seam being the closing seam of the boiler, is riveted by hand, the rivets having snap heads inside and deep countersinks almost through the plate on the outside. Both ends have double-riveted joints, the rivets being placed in zig-zag. Mild steel is so excellent a material for carrying tensional stresses that it is difficult to find a reason for preferring rivets acting in shear. Indeed, the question only seems to be suggested by the fact that in ordinary practice rivets are generally in shear. The tension also on these rivets is extremely light, as will be observed by noticing the distance between the centre of the seam and the nearest mainstays and tube stays and furnaces. Referring, again, to that sure guide—experience—the writer has to say that these end seams give practically no trouble whatever, and are infinitely superior in their capability to remain all the year round quite free from leakage to boiler ends made on the older plan. The writer's latest development is in connection with boilers of large diameter where the front end plate consists of three plates—viz., a top plate taking the main stays, a middle or tube plate, and a lower or furnace front plate. In these cases the top plate and the bottom plate are set to their proper distance apart, and permanently connected together at the corners by welding to them a narrow, curved strip of plate of equal thickness, so as to make the edge continuous all round, just as it would be if the end plate were in one piece. Then the gap in the middle is filled up by laying the tube plate over these, upon which it sits quite naturally without any bending, joggling, or thinning whatever. The end seam rivets in this case pass through three thicknesses of plate, where they attach the tube plate to the shell flange. This has proved eminently satisfactory, and leaves a flat surface on which to build the smoke-box.

Summing up this method generally, it may be remarked that there are no thinned corners in any of the plates or straps, there is no joggling of one plate over the edge of another, there is no relying for good work upon exceptional skill and almost impossible care, as one part plies naturally to another, with the result that at the hydraulic test of twice the working pressure it is a rare thing to see the slightest leak from these boilers, and they give practically no trouble whatever in use at sea, to the great comfort of those in charge and the great saving of those who own them.

Boring Stern Frames.—If a line of shafting in a ship is to run well it is necessary that it should lie naturally in its bearings, without binding hard on any special side; or, in other words, that one shaft should lead perfectly fair with another throughout the whole length. As stern tubes require to be water-tight where they pass through the stern frame, it is usual to make at that part no flexible joint, but a rigid one, either by a taper or otherwise. It thus becomes necessary for the bore of

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the stern frame to be accurately done, as that bore determines the direction in which the tube will lie, thus also determining a fixed and rigid lead for the first after-length of shafting. A little relief to inaccuracy there certainly is, inasmuch as the engines themselves in the engine-room may generally be moved from side to side, or up and down, through a small distance to accommodate any slight deviation from absolute accuracy in lead. But when it is remembered that an inch, or even two, at the engine-room represents a very faint amount in the length of the bore of the stern frame, the accuracy that is necessary in placing the boring bar, if there is to be no spring upon the shafting, becomes apparent.

Various methods are adopted for lining off a vessel with a view to determining the position and direction of the axis of the boring bar for boring the frame, some of which are more or less primitive and defective. When getting up new plant for a new marine engine building establishment in 1883–4, it occurred to the writer to have a special boring plant, devised in such a way that the bar should be hollow, having a clear opening from end to end, with a part of the opening at the after end truly bored in line with the axis of the bar, and of such a diameter as to receive a carefully constructed telescope, which could be easily slid into it. This telescope is provided with cross hairs and proper focal adjustments, so that the horizontal and vertical marks indicating the intended position of the centre of the crank shaft marked on a board erected on the engine seating can be easily seen from the distance of the stern frame of the ship. Besides the great degree of accuracy incident to this method, it has the advantage of being simple and direct, for the bar is in position when the sight is taken, and is simply adjusted up and down, or from side to side, until the user of the telescope is satisfied with the sight: it is then only necessary to make all fast and commence work. A hundred steamers have been sighted and bored with the use of this telescope during the past six years with highly satisfactory results. The writer is not aware whether this method is in use at any other establishment. It is certainly not in common use on the North-East Coast, though from its simplicity and accuracy it would seem to be well deserving of adoption.

(To be continued.)

SHIPBUILDING NOTES.

On the 2nd inst. the s.s. "Sophia Couppa," built by Messrs. Craig, Taylor, & Co., of Stockton-on-Tees, to the order of Messrs. Vagliano Bros., of London, was taken out to sea for her trial trip, which proved very satisfactory. The dimensions of the vessel are:—292ft. by 37ft. by 20ft. 3in. She is built on the web-frame principle, and has double bottom for water ballast for about 600 tons. Her engines, on the triple-expansion three-crank system, by Messrs. Blair & Co., Limited, of Stockton, have cylinder diameters of 21in., 35in., 57in., by 39in. stroke, and two large steel boilers give 160lb. pressure. During the trial a speed of over 9¼ knots was obtained against a severe head wind.

On the 7th inst. Messrs. Short Bros. launched a screw steamer, built to the order of Mr. John Sinclair, West Hartlepool. Her principal dimensions are—Length between perpendiculars, 180ft.; breadth, 29ft.; depth, 12ft.; and she has been specially designed to carry a large cargo on a light draught. The engines are by Messrs W. Allen & Co., Scotia Engine Works, of 15½in., 25in., and 41in. cylinders, and 27in. stroke, with steel multitubular boiler of 160lb. working pressure. The vessel is constructed to the highest class in Lloyd's Registry for steel, and has a long raised quarter-deck, bridge amidships over engines and boiler, and top-gallant forecastle. She has three very large hatchways, two steam winches, and donkey boiler, steam steering gear, &c., and is fitted with water ballast in the fore and after holds. Both peaks are fitted as trimming tanks. The engine skylight is fitted with six of Mason's patent skylights, each containing two 9in. lights. The saloon is similarly fitted with Mason's side-lights. The hull, engines, and boilers have been built under the personal supervision of Mr. George N. Arnison, Jun., of Sunderland.

On the 7th inst. the fine steel screw steamer "Buckingham" had her trial trip in the bay off Hartlepool. The vessel has been built by Messrs. Wm. Gray & Co., Limited, to the order of Mr. Christopher Furness, for Messrs. Raeburn & Verel, of Glasgow. Her dimensions are:—Length over all, 324ft.; breadth, 40ft. 6in.; depth, 23ft. 8¼in.; and her deadweight capacity is about 4,350 tons. The engines, which are of the triple-expansion type, have been supplied by the Central Marine Engine Works of William Gray & Co., Limited, and are of the size designated by the makers, 1,300 i.h.p. Steam is supplied by two large steam boilers working at a pressure of 160lb. per square inch. A speed of 12 knots per hour was obtained.

On the 9th inst. the s.s. "Loo Sok," built by the Fairfield Shipbuilding and Engineering Company, Limited, was launched from their yard at Govan. The vessel has been built to the order of the Scottish Oriental Steamship Company. The "Loo Sok" is intended for Chinese coasting service, and has been built to the requirements of the Bureau Veritas and the Board of Trade. The dimensions are:—Tonnage, 1,650; length, 270ft.; breadth, 36ft. 9in.; depth, 22ft. 9in. There is a double cellular bottom, a straight stem and elliptical stern, and a double turtle-back. The engines are of triple-expansion type, with cylinders 22in., 36in., and 57in. diameter respectively.

On the 10th inst. Messrs. Richardson, Duck, & Co. launched from their building yard at South Stockton a steel screw steamer, "Crown of England," of the following dimensions, viz.:—Length over all, 307ft. 4in.; breadth, extreme, 40ft.; depth, moulded, 21ft. 8¼in. This vessel, which has been built for the Crown Steamship Company, Limited, Belfast (Messrs. W. Gibson & Co., managers), is classed 100 A1 at Lloyd's. She has a cellular bottom fore and aft for water ballast, a short poop, long raised quarter-deck, and partial awning deck extending from after end of engine-room to stem. The engines, by Messrs. Blair & Co., Limited, of Stockton, are triple expansion with cylinders 22in., 36in., and 59in., by 39in. stroke.

On the 12th inst. the "Indefatigable," one of the new second-class protected cruisers, was launched by the London and Glasgow Engineering and Iron Shipbuilding Company, Govan. The firm are building three of these cruisers, of which this is the first. The others are to be called the "Iphigenia" and the "Intrepid." The dimensions are:—Length, 300ft.; breadth, 43ft. 8in.; depth, moulded, 22ft. 9in. The displacement is 3,600 tons. The engines are of 9,000 i.h.p., and are triple-expansion surface-condensing. The cylinders are inverted, and have diameters 33½in., 49in., and 74in. The stroke is 39in. The hull is sheathed with teak, and is copper-covered to about 3ft. above the load-line. The stern-post, stem, ram, rudder, propeller, and shaft tube brackets are of phosphor-bronze. It is expected that a speed will be attained of 20 knots per hour. The armament will consist of two 6in. breech-loading central pivot guns, six 4·7in. quick-firing guns, eight 6-pounder Hotchkiss guns, four 45in. five-barrelled Nordenfeldt guns, and four torpedo tubes.

Notices of Meetings.

THIS WEEK.

Manchester Association of Engineers.—Saturday, March 28th, at 7 p.m. Paper to be read: "Steam Engine Governors," by Mr. C. F. Budenberg.

PRICES CURRENT, 24th March, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	39/3	Cash.
Scotch Warrants, m/n	43/7½	„
Hematite Warrants, m/n	47/10½	„
Stocks in Stores. Scotch	534,186	Tons.
Middlesbro'	124,757	„
Hematite	189,951	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	65/-	.....	58/6	f.o.b. Glasgow.
Gartsherrie	60/6	.....	56/6	„ „
Summerlee	61/-	.....	56/6	„ „
Carnbrae	51/-	.....	50/6	„ „
G.M.B. ex store	44/3	.....	44/-	„ „

METALS.

Spelter: Ordinary	£24	15	0	to	25	0	0
Copper: British Cakes and Ingots	56	10	0	„	57	0	0
„ Chili Bars, G.O.B.'s	52	12	6	„	53	0	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	52	12	6	„	53	0	0
„ Manufactured (strong)	65	0	0		.....		
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	90	2	6	„	90	10	0
„ Australian	90	10	0	„	90	15	0
„ English Ingots	94	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: No change of importance has taken place during the past week, and prices are steadily maintained. Stocks are reported to have decreased about 2,400 tons during the first fortnight in March, and Chili bars have advanced in value, being quoted to-day £52 12s. 6d. cash, with three months' prices 5s. higher. Manufactured unchanged at £65, "strong."

Tin: Steady, with prices slightly lower.

Lead: Rather firmer, but with small demand.

Spelter was a shade easier last week, on a rumour gaining currency that the smelters' arrangements for regulating the production had been ended. This rumour had, however, reference only to a minor agreement in Silesia for manufactured zinc. The general spelter arrangement is firmly upheld, and prices will be maintained accordingly.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	65/6	56/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

	£ s. d.		£ s. d.
Acid: Carbolic Crystals ...lb.	0 0 5½	to	0 0 6¼
„ „ Liquid ...gal.	0 1 0	—	.....
„ Citric ...lb.	0 1 8½	—	.....
„ Oxalic ... „	0 0 3½	—	.....
„ Sulphuric ...ton	1 15 0	—	.....
„ Tartaric ...lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.) ...ton	5 12 6	—	.....
Ammonia: Carbonate ...lb.	0 0 3½	—	.....
„ Muriate (Grey) ...ton	25 0 0	—	.....
„ „ (White) ... „	26 10 0	—	.....
„ Sulphate ... „	11 12 6	—	.....
„ Liquor ...lb.	0 0 3	—	.....
Antimony ...ton	75 0 0	—	.....
Bleaching Powder ... „	6 12 6	—	.....
Bisulphide of Carbon ... „	13 0 0	—	.....
Borax ... „	29 0 0	—	.....
Benzole (90 %) ...gal.	0 4 7	—	.....
„ (50/90 %) ... „	0 3 5	—	.....
Copper Sulphate ...ton	16 10 0	—	.....
Copperas ... „	2 0 0	—	.....
Kieserit ... „	.....	—	.....
Lead: Nitrate ... „	21 10 0	—	.....
„ White Sugar ... „	26 0 0	—	.....
„ Brown „ ... „	19 10 0	—	.....
Potash: Bichromate ...lb.	0 0 3¾	—	.....
„ Caustic ...ton	22 0 0	—	.....
„ Carbonate ... „	20 10 0	—	.....
„ Chlorate ...lb.	0 0 5½	—	.....
„ Prussiate (Yellow) ... „	0 0 10	—	.....
„ Sulphate (Basis 90 %) ...ton	4 0 0	—	.....
Precipitate: Red ...lb.	0 3 6	—	.....
„ White ... „	0 3 6	—	.....
Salts: Epsom {Bags ...ton	3 0 0	—	.....
{Casks ... „	3 15 0	—	.....
„ Glauber ... „	1 10 0	—	.....
Sulphur: Sublimed Flowers ... „	10 10 0	—	.....
„ Recovered ... „	7 0 0	—	.....
Soda: Ash ...deg.	0 0 1¾	—	.....
„ Caustic (White 70%) ...ton	11 0 0	—	.....
„ „ „ 60%) ... „	9 15 0	—	.....
„ „ (Cream 60%) ... „	9 7 6	—	.....
„ Crystals ... „	3 10 0	—	.....
„ Bicarbonate ... „	7 0 0	—	.....
„ Hyposulphite ... „	6 10 0	—	.....
Solvent Naphtha ...gal.	0 1 7	—	.....
Tartar, Cream of ...cwt.	5 7 6	—	.....
Zinc Sulphate ...ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Since our last there has been a very strong demand for all qualities of sulphur, and prices have advanced some 20s. to 30s. per ton. Sulphate of ammonia also has attracted many buyers, and a large business has been done at considerably advanced figures. With these exceptions the markets are flat. Sulphate of copper has lost ground, and there is quite a want of confidence in the future. Lime salts are more freely offered at lower prices. Green copperas is more plentiful. Yellow prussiate is steady, though quieter.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	36 0 0
„ Ceylon	„	29 0 0
Cottonseed	„	21 10 0
Cod	„	23 0 0
Lard	„	35 10 0
Linseed	„	22 12 6
Olive, Spanish	„	43 0 0
Palm, Lagos	„	27 0 0
Rapeseed: English	„	29 15 0
Seal: Pale	„	.....
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	21 0 0
Turpentine	per cwt.	1 9 9
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 5¾
Spirit		0 0 7

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HOME INDUSTRIES.

LONDON, 26th March, 1891.

The Money Market.—The key to the condition of the money market was supplied in the allotment of a million and a half of Treasury Bills on the 23rd inst. Discount rates had hardened a trifle towards the end of last week, owing to considerable withdrawals of gold for the River Plate, but when Treasury three months' paper was placed at a price equivalent to a discount rate of 2⅛ per cent., an easier feeling speedily became apparent. Although the Stock Exchange settlement gave employment to a fair amount, call money has been easily obtainable. A week which begins with a settlement and ends with holidays is never productive of much interest on the Stock Exchange, and this has been no exception. The tendency has been fairly firm, but business has been on a small scale. The most noteworthy feature was the improvement in most home railways, owing to the scarcity of stock revealed at the settlement. American railways have been better, notably the favourite investment stocks. Foreign securities have kept steady. Copper shares have advanced, but in mining and miscellaneous shares generally there has been no feature of note.

Royal Meteorological Society.—The usual monthly meeting of this Society was held on the 18th inst., at the Institution of Civil Engineers, 25, Great George Street, Westminster, S.W., Dr. C. T. Williams, Vice-President, in the chair. Mr. G. J. Symons, F.R.S., read a paper on the "History of Rain Gauges." It appears that Sir Christopher Wren, in 1663, designed not only the first rain gauge, but also the first recording gauge, although the instrument was not constructed till 1670. The earliest known records of rainfall were made at the following places:—Paris, 1668; Townley, in Lancashire, 1677; Zurich, 1708; and Londonderry, 1711. Mr. Symons gave a very full account of the various patterns of rain gauges, and in most instances pointed out the merits or defects of each. Mr. A. W. Clayden, M.A., showed on the screen a number of interesting transparencies of photographs of clouds, lighting flashes, and other meteorological phenomena. The meeting was afterwards adjourned in order to allow the Fellows to inspect the exhibition of rain gauges, evaporation gauges, and new instruments, which had been arranged in the rooms of the Institution.

Royal Institution.—The following are the lecture arrangements after Easter:—Mr. J. Scott Keltie, three lectures on the Geography of Africa, with special reference to the Exploration, Commercial Development, and Political Partition of the Continent; Dr. E. E. Klein, three lectures on Bacteria: their Nature and Functions (the Tyndall Lectures); Mr. William Archer, four lectures on Four Stages of Stage History (the Betterton, the Cibber, the Garrick, and the Kemble Periods); Professor Dewar, six lectures on Recent Spectroscopic Investigations; Dr. A. C. Mackenzie, four lectures on the Orchestra considered in connection with the Development of the Overture; Professor Sylvanus P. Thompson, four lectures on the Dynamo; Mr. H. Graham Harris, three lectures on the Artificial Production of Cold; Professor A. H. Church, three lectures on the Scientific Study of Decorative Colour. The Friday evening meetings will be resumed on April 10th, when a discourse will be given by Sir William Thomson, on Electric and Magnetic Screening; succeeding discourses will probably be given by Professor A. W. Rücker, the Rev. Canon Ainger, Mr. J. E. Harting, Professor W. Ramsay, Professor G. D. Liveing, Professor J. A. Ewing, Dr. David Gill, Professor Harold Dixon, and other gentlemen.

Miners' Electric Safety Lamps.—The Council of the Federated Institution of Mining Engineers are desirous of receiving exhibits of miners' electric safety lamps, to be shown at the annual meeting of the Institution, which is to be held in London on May 27th and 28th next. Intending exhibitors are desired to communicate with, or send their exhibits to, the secretary, Mr. M. Walton Brown, Newcastle-on-Tyne.

Appointment.—Mr. W. S. Child, A.M.Inst.C.E., for many years chief assistant to the late firm of Messrs. Kinipple & Morris, of Westminster, has been appointed engineer to the Port Aden Harbour Trust.

St. Pancras Electrical Exhibition.—Owing to the great success of this Exhibition, which is now being held at the St. Pancras Vestry Hall, it has been decided to allow it to remain open until 1st April.

United Asbestos Company, Limited.—At the annual meeting of the shareholders of this company, held recently, a dividend of 10 per cent. was declared and paid upon the preference shares, and the balance of profit for the year, equal to a little over 5 per cent. on the ordinary shares, was carried forward.

MANCHESTER, 26th March, 1891.

The Ship Canal.—A meeting of citizens of Manchester was held on the 23rd inst. to consider the proposals of the Corporation to contribute a loan in aid of the works connected with the above company. There was a large attendance, and a resolution approving of the action of the Council was passed almost unanimously.

The Reduction of Hours Movement.—The Iron Trade Employers' Association, after considering the joint circular issued by the various trade unions affected, asking for a reduction of hours to 53 per week, have replied, stating that under all the circumstances they cannot agree to the request. It now remains to be seen whether any attempt will be made to enforce the adoption of this working week. In some respects the opportunity is a favourable one, as, despite the undoubted slackening of demand, the majority of the engineering concerns are full of work and have enough to employ them throughout the year.

Arts and Crafts Exhibition.—An Exhibition has been opened in the City Art Gallery of various arts and crafts practised in the neighbourhood. Specimens of art work from South Kensington Museum form a great part of the Exhibition, which, although interesting, is in some respects disappointing. One of the rules of the Exhibition provided that although business firms might send exhibits the name of the actual craftsman must be supplied, and this has been done. A first sight of the exhibits enables their scope to be understood, but generally the result is not very satisfactory, only a few of the cases being worthy of separate notice. It is somewhat noticeable that although there are large numbers of designs for printed cotton fabrics those for woven fabrics are much fewer in number. The most promising work is seen in the cases from the weaving department of the Technical School, Sloyd work from the Deaf and Dumb School, in some art metal work of good quality, and in one or two cases of embroidery. The Exhibition is to remain open till June.

The Linen and Jute Trades.—There has been a better feeling during the past week, but the approach of Easter so soon after the depressing effects of recent unfavourable weather had been dispelled rendered it impossible to altogether compensate for the losses incurred. Distribution has undoubtedly proceeded rapidly during the past fortnight, and the demand for stocks in the hands of merchants has been considerable. Scotch agencies here are now engaged in stocktaking, which operation will be completed by the end of March. There is a steady demand for the fine Hessians used for packing by the home trade firms, and this is a sure sign that the general dry goods trade is satisfactory. The demand for the limited number of flax yarns consumed in this district is fair. Quotations for foreign "spins" are very firm, and it is evident that the position on the Continent has been strengthened considerably of late, as there is no disposition on the part of sellers to meet buyers except at full rates. The shipping trade keeps dull, and Chilian prospects become worse, private telegrams from Iquique received recently in Manchester saying that the conflict may eventually be extended to the sea, where the Parliamentary party is at present supreme. For Canadian and Australian account there is not much doing.

English versus Continental Prints.—Inquiries made this week in the print departments of the leading wholesale houses reveal the pleasing fact that the leading Lancashire and Cheshire printers have now attained such excellence in the processes they employ that even in goods of the highest class, which have been usually imported from France, they can beat the best Continental manufacturers and sell much more cheaply. Large merchants find that all their requirements can now be satisfied at home, and that the supremacy of "French prints" is a thing of the past.

GLASGOW, 26th March, 1891.

Railway Operations.—The execution of the contract on the eastern section of the Caledonian Central (Underground) Railway at Bridgeton has been stopped in consequence of an interdict having been granted by the Sheriff Substitute on the application of the Corporation of Glasgow. The ground of the application was that no definite arrangements had been made regarding the diversion of the sewage. The work of piling and underpinning has therefore been entirely suspended.—The Ayrshire and Wigtonshire Railway, which has been worked by the Glasgow and South-Western Railway, and which has been a source of loss both to the original promoters and to the working company, was the subject of a Bill, brought forward in the interests of the shareholders and of the Caledonian Railway, for the purpose of sanctioning a perpetual lease or sale of the line. The Bill was opposed by the Glasgow and South-Western Railway, and, after evidence had been taken, the preamble was found not proved, and the Bill was therefore thrown out.

The North British Railway Company.—The circular issued by the company last week, containing a statement of the concessions the directors are prepared to make, was discussed by the men at their meetings in different parts of the country on the 22nd inst. The general feeling seemed to be one of dissatisfaction with the extent of the changes. The chief question, which is that of excessive overtime, is represented by the men as being practically untouched. This is, no doubt, an exaggerated view; but the continued existence of unallayed discontent is a serious matter for the railway, which has already suffered so severely from a strike. Any trifling with the matter must inevitably result in trouble. The company has been compelled to concede so much that the men feel encouraged to show a bold front and to demand more. If the directors have re-organised the service on a sound basis no one can blame them if they adhere firmly to the terms of their new regulations; but if they have any further modifications to make, it were well that these should be made now, since unquestionably further trouble is brewing. It is not unlikely, however, that the men will be pacified by the prospect of the legislation that is regarded as certain to be the outcome of the Select Committee now inquiring into the hours of railway servants.

(From our own Correspondents.)

LIVERPOOL, 25th March, 1891.

The Mersey Railway.—As a result of the protests made at many of the recent meetings of the shareholders of this company against the meeting being held in London, the last half-yearly meeting was held in Liverpool. In the absence of the chairman—Mr. Francis Fox—through illness, the chair was taken by Mr. J. T. Balfour, M.P. The report states that the receipts have increased from £28,175 in 1889 to £29,974 last half year; there had, however, been a slight increase in the working expenses, owing to the increased price of coal. The cost of pumping, ventilating, and working the lifts was 22·82 per cent. of the expenditure, the working expenses, exclusive of the exceptional charges, being 58·04 per cent. The extension to Rock Ferry is nearly completed, and will form the connection with the Great Western and the London and North-Western Railways. The extension to Bold Street, Liverpool, will be opened during the summer. As regards the financial condition of the company, the receivers and managers are now in a position to apply to the Court to make a payment on account to the debenture holders.

The Cunard Company.—The annual report of this company states that the profits for the year, including £4,988 brought forward from 1889, amount to £246,600, and, after deducting income-tax and providing £125,840 for depreciation of ships and property and £43,143 for insurance, there is left £72,838. Out of this the directors propose to pay £64,000 as dividend, equal to 4 per cent. per annum, and to carry forward £8,838 to the credit of profit and loss in 1891. The price of coal, increased wages, and strikes have involved the company in considerable additional expenditure.

LEEDS, 25th March, 1891.

The Iron and Steel Trades.—The amount of business in the iron and steel industries of this district towards the end of the first quarter is less than was expected at the opening of the year. There is quietness all round, with unremunerative prices, particularly in the finished iron trade, and the holding of the quarterly meetings is awaited with much interest. In the engineering branch there is less activity than was the case a few weeks since, and some of the largest establishments have felt the effects of a quiet market and the disinclination of people to place orders. There has during the year been a falling off in the orders from shipbuilders. A large amount of work for railways, however, is in hand, both in engineering shops and at rolling mills.

The Coal Trade.—Cold weather has in the last fortnight rather stimulated the demand for house coal. There is a fair trade in steam and other classes of coal. Prices remain unchanged.

The Late Mr. David Greig.—Mr. David Greig, of the firm of Messrs. John Fowler & Co., steam plough and locomotive works, Leeds, died on the 20th inst. Mr. Greig had, either as manager or partner, been identified with the firm of Messrs. Fowler & Co. for many years.

SHEFFIELD, 25th March, 1891.

The Iron and Steel Trades.—The iron and steel trades continue active in all their branches. The demand for railway material shows no signs of falling off, and the orders recently given out by the home railways will keep works well employed. Prices continue steady at the following rates:—Tyres, £10 to £11; axles, £10 to £12; springs, according to the amount of skilled labour required, from £11 to £15. The Admiralty have issued tender forms for 12,500 tons of ship plates, mild steel, and about 4,000 tons of angles and other sections used in shipbuilding and general engineering work, and a part of the order will no doubt be placed in this district. The English colonies are just now our best customers, as they are buying rolling stock and bridge material in large quantities. The Leeds engineering firms are also good customers for steel castings and forgings of all kinds.

Coal and Coke.—The demand for coal and coke continues very firm, and prices are unchanged. Prices at the pit bank do not vary much, as the yearly railway and gas contracts keep the collieries fully employed.

Local Trades.—In the specially local trades there is a fair amount of business. File manufacturers suffer from the competition of Continental firms, particularly in the light descriptions. This might have been expected, as the French and German firms have bought largely of the best file-cutting machines made in this district. Edge tool makers are well employed, especially on the best class of work. Makers of sheep-shearing appliances are very busy both on the home and export account. Silversmiths and electro-plate workers are working full time, and a large portion of their products is for the export trade. Messrs. Mappin & Webb have recently erected a powerful engine to drive the numerous machines employed on this class of work.

NORTH STAFFORDSHIRE, 25th March, 1891.

The Iron Trade.—The downward tendency in prices is very marked, and causes much anxiety amongst makers. Owing to the want of orders the forges and mills in this district are working on short time, and there appears little

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likelihood of any immediate revival of demand. Bar iron is quoted about £6 to £6 5s. delivered in Liverpool, and forge pig iron from 42s. to 45s. at local works, according to quality.

GENERAL.—The first ordinary general meeting of the Shelton Iron, Steel, and Coal Company, Limited, was held in London on the 20th inst., when, in the absence of the Chairman, Earl Granville, through illness, Mr. Stuart Rendal, M.P., presided. The statement of accounts for 1890 showed a net profit of £33,920. A dividend at the rate of 7 per cent. on the preference shares was declared, and a balance of £12,539 was carried forward.

ALUMINIUM-BRONZE. — Cowles' aluminium-bronze continues to make headway, and as the price is now slightly below manganese-bronze it will probably supplant that material for screw propellers in high speed vessels. It is also being largely adopted for hydraulic and other engineering purposes, and for firing tubes for gas engines.

BIRMINGHAM, 25th March, 1891.

GENERAL TRADE.—The approach of the Easter holidays just at the close of the quarter seems to give an impetus to business generally. The makers of stamped forgings are particularly busy, as also are their good customers, the cycle makers. The perambulator builders, too, are busy. Makers of shovels, spades, axes, hoes, billhooks, and general garden tools are full of pressing orders, and the light ironfounding and brassfounding concerns are well employed. There is a great demand in the bedstead trade, and the manufacture of fireproof safes, which many of the bedstead makers combine with their business, is brisk. Rivet makers are unusually busy, especially those making boiler rivets and the larger sizes generally. Chain makers in the Old Hill district are well employed, but there is not much prospect of a continued demand. The New British Iron Company, who have large contracts with the Admiralty for cables, are well advanced with the work, and have built extensive testing machinery for proving these cables. The nail manufacturers employing hand labour view with alarm the proposals made by Lord Dunraven to limit to ¼in. the size of iron which women shall work, and to make it unlawful for women to work at chain or nail-making until they are sixteen years of age. They say that if male has to be substituted for female labour they will not be able to compete with German makers. The workmen are opposed to the views of the masters in the matter.

LEICESTER, 25th March, 1891.

WOOL SPINNING AND YARN TRADES.—Business in the local wool market is quiet, but quotations are very firm. Deep stapled fleeces of good average quality realise 22s. 6d. to 23s. 6d. per tod; superior lots, 24s. to 25s. per tod; choice lots, including large proportion of Shropshire, 25s. 6d. to 27s. per tod. Users buy very cautiously, and for present wants only. Spinners are not very well employed generally. It is very difficult to obtain prices which give a fair margin of profit, and hence the acceptance of new business is not large.

HOSIERY TRADE.—In the fancy department there is an excess of activity, and some good orders are already placed; the prospects of this branch are cheerful. The Cashmere hose department is very quiet just now, and so also is the heavy woollen branch of the trade. There is a very fair demand for fine natural wool underwear, which has become an important factor in the trade here now.

BOOT AND SHOE TRADE.—The output is more satisfactory, but the trade of the year so far is much below last year, and, in fact, it has scarcely reached the average. Leather merchants are doing a larger business, but users operate very carefully. The market is firm, and shows no tendency to a reduction of prices.

SWANSEA, 25th March, 1891.

THE RHONDDA AND SWANSEA BAY RAILWAY.—Great disappointment is felt locally at the decision of the Lords' Committee that the preamble of the Bill before Parliament for powers to make a line from Port Talbot to Swansea has only been proved as regards the portions of the line between Carnarvon and Briton Ferry. The Great Western Railway Company are, of course, the great opponents of the scheme, and are said to contemplate the absorption of the new undertaking. Sir J. J. Jenkins is, however, of opinion that the powers actually obtained place his company in a formidable position in respect to the Great Western Railway.

NEW TINPLATE WORKS.—The expected development of the manufacture of tinplates in the United States does not seem to have the effect of diverting capital from new undertakings at home. It has been decided to erect another works, with three mills, in connection with the Briton Ferry Steel Company, near to the Villiers Tinplate Works at that place.—Bessemer steel coke tinplates per box I.C. are quoted at 18s. to 18s. 3d., 6d. more being asked for Siemens quality. Plates are accumulating at the Swansea Docks, all of which are sold, and are only waiting for shipment.

CARDIFF, 25th March, 1891.

IRON AND STEEL.—The hematite iron trade is still unsatisfactory. A reduction in the price of fuel and iron ore has been again discounted by another fall in the price of iron. In the Bessemer departments there is no better prospect, and tinplate makers refuse to purchase beyond June next, pending the result of the McKinley tariff. In the iron ore trade business is dull. The mine owners in Spain maintain their price very well, and good ore is in very fair demand. Rubio ore is quoted at 13s. 3d. to 13s. 6d. c.i.f. Cardiff or Newport, 14s. 3d. to 14s. 6d. c.i.f. Tees, 14s. 6d. Glasgow, for 50 per cent. iron.

COAL AND COKE.—There is a slightly better tone in the steam coal market, and one or two large contracts have been received. The prospect for the next few weeks is by no means discouraging. Prices for steam coal are as follow:—No. 1 quality, 14s. 9d. to 15s. 3d.; No. 2, 13s. 9d. to 14s. 3d.; No. 3, 13s. to 13s. 6d.; No. 4, 12s. 6d. to 12s. 9d. Small steam coal, 5s. 6d. to 5s. 9d. In the house coal trade there is a steady business, and prices are quoted at 15s. to 15s. 6d. for best No. 3 Rhondda; No. 2, 12s. to 12s. 6d. Patent fuel is active at 13s. to 13s. 6d. per ton. For coke there is only a small demand, the depressed state of the iron trade having affected this department. Furnace coke realises 19s. to 19s. 6d. per ton; foundry, 22s. 6d. to 23s.; best foundry, 24s. 6d. to 27s.

BARROW-IN-FURNESS, 25th March, 1891.

HEMATITE.—There are further signs of depression in the hematite pig iron trade. Few orders for forward delivery are taken, and the business for prompt delivery is very quiet. Hematite warrants have gone down in price to 48s. per ton, and makers find it impossible to sell Bessemer mixed numbers at less than 50s. to 52s. per ton. They are engaged on old contracts, and when these are done, if prices are still unremunerative, it is evident that more furnaces will have to be shut down. There is in the meantime a gratifying reduction in stocks, the decrease this week being over 4,000 tons, but the aggregate of stocks still stands at over 190,000 tons, or about eight weeks' make at the present rate of output.—The Solway Hematite Iron and Steel Company, Maryport, have posted notices that on and after April 3rd the services of all workmen and contractors employed by them will no longer be required. Upon inquiry the manager stated that the company had not considered the question of reduction in wages, but that, finding it was out of the question to make hematite pig iron at a profit owing to the abnormal prices of fuel, they had determined to temporarily close the works.

STEEL.—A very quiet tone continues to characterise the steel trade. Orders for rails are only few, although it is known that some large foreign contracts are in the market, which it is evident will be taken at lower prices. Heavy rails are at £4 12s. 6d., light rails at £6, and colliery sections at £7. In steel shipbuilding material there is only a small trade. The general steel trade in the Siemens-Martin department is quiet, and very little is being done in tinplate bars.

SHIPBUILDING.—The "Empress of Japan," the second of the Canadian Pacific steamers built at Barrow, has left the port for her trial trip, and the third of the fleet, the "Empress of China," was launched on the 18th inst. Some new orders of importance are expected, and a continuance of activity in the shipbuilding and engineering departments may be looked for.

A NEW INDUSTRY.—At length the arrangements for the transfer of the Vulcan Steel and Forge Works at Barrow to the Tubular Frame Waggon Company, Limited, have been completed, and the new owners took possession this week. They have orders in hand for the construction of bogie waggons about 32ft. in length for foreign railways which will keep them fully employed for fully two years to come.

MIDDLESBROUGH, 25th March, 1891.

THE IRON MARKET.—The iron market has been very dull during the past week, and business is almost at a standstill. Messrs. Walker, Maynard, & Co. are blowing out one of their four furnaces at the Redcar Iron Works, and Messrs. Bell Brothers have decided to blow out two of their Walker furnaces. The furnace at Redcar has been producing Cleveland iron, and the Walker furnaces hematite. With this decrease in the production of iron, and therefore also in the consumption of materials, the price of the latter must be lowered. Merchants are quoting 40s. per ton for f.o.b. deliveries of No. 3 G.M.B., but this is only nominal, and no business is done, seeing that Middlesbrough warrants have dropped down to 38s. 8d. buyers, and sellers a penny more. No quotations for forward delivery can be obtained under the present depressing circumstances.

SHIPMENTS OF PIG IRON.—Shipments do not improve, for the quantity of pig iron sent from Middlesbrough up to the 21st inst. was 45,698 tons, as against 56,014 tons during the same period of February. Of the 45,698 tons, Scotland took 24,380 tons, England and Wales 5,671 tons, and foreign countries 15,557 tons. There is a marked decrease in foreign shipments, which are 12,000 tons less than during the same period of March last year. Connal's stock is 123,983 tons, a decrease since the beginning of the month of 195 tons. East Coast hematite pig is quoted at 54s. per ton for mixed numbers f.o.b.

MANUFACTURED IRON AND STEEL.—There has been no change in the prices of manufactured iron and steel, but the demand is very poor. Steel ship plates are £6 2s. 6d., iron ship plates £5 12s. 6d., and heavy steel rails £4 12s. 6d.

COKE.—Coke is being reduced in price quickly, and several sales of fairly good sorts have been made here at 14s. per ton, though 14s. 6d. is still asked for the best kinds.

PROPOSED REDUCTION OF WAGES.—The masters and the men had a meeting yesterday to confer on the reduction of wages demanded by the masters. The men's delegates offered to take 5 per cent. reduction, but the masters demanded 12½ per cent. The meeting was then adjourned till April 7th for the delegates to consult their constituents.

NEWCASTLE, 25th March, 1891

THE IRON TRADE.—The statistics of production and selling prices, which are obtained periodically by direction of the Board of Conciliation and Arbitration, for the North of England manufactured iron trade, have just been published. The production in the two months, ending on the 28th ult., fell considerably short of the production in the preceding two months, the figures for each period being 48,961 tons and 38,928 tons respectively. As compared with the corresponding periods in 1889 and 1890, the output for the last two months shows a still greater falling off, and the figures exhibit a marked slackness in the trade. Fortunately prices have not declined in proportion to the output, the average selling price for the two months being £5 17s. 11d., or 1s. 10d. per ton less than the average price for the previous two months. According to the sliding scale arrangement, this small reduction of price will not affect the rate of wages, which, though estimated to be 17½ per cent. above the minimum of three years ago, will remain the same up to the end of May as they have been in the past six months. In galvanising works there is rather less activity, and in both forges and foundries there is a lessened pressure of work. Rivet works are also short of orders, and one establishment which has been closed for some time is, with its plant and machinery, advertised for sale.

THE COAL TRADE.—The state of the local coal trade continues satisfactory, the demand for household and manufacturing qualities being specially brisk. There is also a fairly good business in other descriptions, and the whole of the pits in the county are now working. The construction of the new coal shipping staiths at Tyne Dock is being pushed forward, and it is thought they will be ready for use at an earlier date than was at first anticipated.

ASSOCIATION OF STUDENTS INST.C.E.—The first ordinary meeting of the Newcastle-upon-Tyne Association of Students of the Institution of Civil Engineers was held in the Durham College of Science, Newcastle, on the 18th inst., Mr. Charles A. Harrison, M.Inst.C.E., presiding. The secretary reported that an excursion had been made on the 14th inst. to Wylam Railway Bridge. Mr. Hubert Laws, M.Inst.C.E., had conducted the party, and at the point where the railway crosses the Newcastle and Gateshead Water Company's 30in. main pipe, read a paper, in which he described how, during the construction of the railway, when it was found necessary to lower this pipe, the work was successfully accomplished without interrupting the supply. The bridge itself and the method of its erection were also clearly described. The hon. secretary read Mr. W. G. Laws' paper on "The Railway Bridge over the Tyne at Wylam" (*Min. Proc. Inst.C.E.*, Vol. LVI.). Mr. Laws then gave an instructive discourse on the various forms of iron bridges, and replied to a number of questions raised regarding the paper. The original drawings of Wylam Bridge were placed at the disposal of the Association for the evening by Mr. C. A. Harrison. Mr. Laws also showed photographs of the bridge in various stages of construction.

GLASS WORKS.—Flint glass works are still very slack, and manufacturers of lamp chimneys and similar specialties have few orders. The Tyne Plate Glass Works, South Shields, are still only in partial operation. In the glass bottle trade business is good, and the works at Blaydon are briskly employed.

DUNDEE, 25th March, 1891.

JUTE AND FLAX TRADES.—Business in both branches of the Dundee trade is quiet. Raw jute is, according to cablegram from Calcutta, lower in price. There is a fair business here at recent prices. Some speculative sales of the 1891 crop are already reported—an unusually early date at which to commence the new season's business. The price of the August-September shipment is £12 10s. for first marks. Jute spinners and manufacturers maintain their position, and prices are steady. There has been a rather better inquiry for flax and tows at firm rates. Yarns are quoted at better prices, and the tendency of the market is stiff. Foreign orders for linens are coming in pretty well, and there is a fair average business passing on home account.

TRAMWAYS.—The Dundee tramways, which were laid by the Corporation thirteen years ago, have been worked by a company from the first, but scarcely a year has passed which has not brought loss to the lessees. By their contract the company pays 5½ per cent. on the cost of one of the lines, and 6½ on the cost of another. It is also held bound to maintain the line—an arduous undertaking considering the heavy nature of the general traffic. The company has submitted a proposal for the revision of the contract, so that the rent may be made 7 per cent. on the cost, on condition that the Police Commission maintains the line.

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THE NICARAGUA CANAL.

(For description see page 289.)

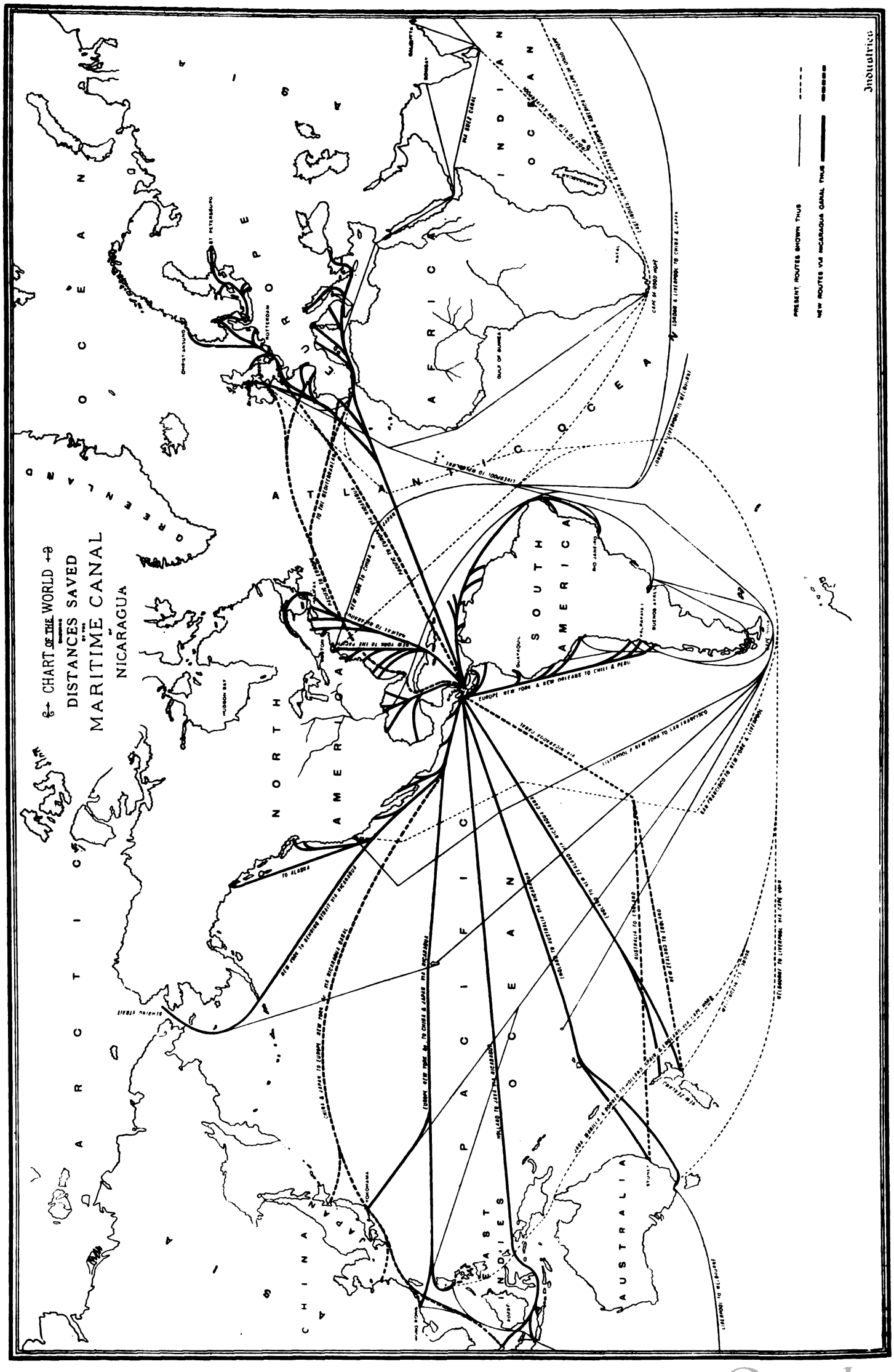


FIG. 2.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 27TH MARCH, 1891.

THE SHIPS OF THE FUTURE.

THERE are many and multiplying evidences that the arts of the marine engineer and of the naval architect are neither lost nor inactive. There has probably never been a period when so much enterprise, such bold and original conceptions, and such far-reaching designs were being put forward as there are at the present day. It might have been supposed that, after the enormous development that has taken place in the shipbuilder's art during the last twenty years, there was little more to be said or done, and that both shipbuilders and shipowners had only to rest and be thankful. Instead of this, however, we find that the heights already "reached and kept" by the marine engineer are only regarded as gentle eminences from which to view the promised land that lies far away, and that there is no idea of finality in the possibilities of the future. Only a few months ago Sir Nathaniel Barnaby expressed his opinion that "we shall get the mastery over the seas, and shall live more happily in a marine residence capable of steaming 15 knots an hour than we can ever live in seaside towns." As a contribution towards this end, he proposed to construct a vessel 1,000ft. long and 300ft. broad, with engines of 60,000 horse-power, and capable of steaming at 15 knots. Such a ship would be, in point of fact, a steel island, incapable of entering any dock, and having still-water harbours or docks within the vessel herself, entered by gates in the sides, where she would carry loaded barges and tugs. Sir Nathaniel has satisfied himself that such a ship could be made absolutely secure against fatal injury arising from perforation, but she would require to be fortified and garrisoned like a town. This is undoubtedly a bold idea, and one that opens up a wide vista of possibilities in the future. Lord Brassey, in his admirable paper read last week at the meeting of the Institution of Naval Architects, defined the requisites that were, in his opinion, called for in different types of warships, and indicated the desirability of keeping the dimensions of warships within 10,500 tons, rather than increasing them to 14,000 tons, which has been considered in some quarters a practicable limit. One advantage of such an arrangement would be that the same tonnage would, by a reduction of the maximum, give eight ships instead of six. This view of the future policy of warship construction has been approved by Sir N. Barnaby, who says that "a large naval Power, having very widely spread interests, and subject to modern modes of attack, would suffer more in a war from fewness of ships than from comparative smallness of size of ships and of crews." In the next sentence the same authority appears to draw a sharp distinction between warships and merchant vessels, in reference to the question of dimensions, for he adds that "the advantages arising from size in a passenger ship seem to me to be so great that I do not see where we shall stop."

It appears, therefore, as if the shipbuilding programme of the future were to be directed to increasing still further the size of passenger or merchant ships, and decreasing the size of war vessels. This policy has, indeed, received the sanction of the most eminent naval authorities of the day, and it is sanctioned by the accumulated experience of the greatest naval Power in Europe. The main object of a navy like ours is that of protecting our commerce, which, as Lord Brassey told his audience last week, is always afloat to the value of over 150 millions sterling. That commerce is likely to be much more effectually protected if the merchantmen which compose the mainstay of British commerce are to be increased in size, so as to limit their number relatively to the work to be done, and if the warships which are to protect them are so far increased in number as to be more widely scattered over the wide dominions belonging to the English Crown. According to a table submitted by Lord Brassey, the total strength of the British navy at the present time is 170 vessels of all kinds—of which 32 are first-class and 13 are second-class battle-ships—having a total tonnage of 921,000. The average tonnage of the first-class battle-ships is rather over 11,000, so that it exceeds the limit fixed by Lord Brassey as most convenient and desirable. It is probable that this limit will be steadily reduced in the Admiralty programme of the future, and that our naval administrators will aim rather at a handy, easily manageable size of vessel, possessed of adequate speed and sufficient coal endurance, rather than a naval colossus, with armaments that may, indeed, be powerful on paper, but which experience has proved to be wanting in power in cases of emergency. The future marine architect must study compressibility, and must secure the maximum of speed and of fighting power with the minimum of size.

But the remarkable scheme for a new type of merchantman propounded by Sir Nathaniel Barnaby appears to point to the possibility of a ship that will be competent to undertake either aggressive or defensive warfare. He speaks of a vessel "fortified and garrisoned like a town." Such a ship would probably be able to undertake its own defence, and to give a good account of itself in any emergency that it might be called upon to face. In such an event, how far would our naval strength be required for defensive purposes? There would seem to be a possibility of having each individual merchantman constructed like and as a fortress, with both carrying and defensive capacities far in excess of anything hitherto dreamt of, but limited in speed by reason of its unwieldy proportions. In merchant ships, as in factories and workshops, economy of working is a concomitant of size, and it is hardly to be doubted that a "floating island," like the vessel contemplated by Sir N. Barnaby, if practicable at all, would be more economically worked than a number of smaller vessels of nominally the same carrying power. There is only one serious drawback to this magnificent scheme. It is doubtful whether the "floating island" could even approach some of the principal docks and harbours, although Sir N. Barnaby appears to think that a draught of 26ft. of water would be sufficient; but even if this were so, there are not many ports that could furnish the cargoes necessary to fill up such a structure, and hence it could only be used, if used at all, between the largest ports, such, for example, as those of Liverpool and New York. The idea of a vessel of 1,000ft. in length engaging in the business of an "ocean tramp" is hardly to be seriously entertained. If it should be found that a structure like that described should be the ship of the future, and if it should

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appear that by some such vast leviathan the mastery over the seas is to be obtained, the future would be likely to witness developments of shipbuilding and marine engineering far more notable than anything hitherto attempted or achieved.

THE INSULATION OF OVERHEAD WIRES.

The London Chamber of Commerce has circulated a *résumé* of the Overhead Wires Correspondence. The difficulty is this: The Board of Trade has issued rules, according to which a 2,000 volt circuit, however small the wire, must have an insulation of at least a tenth of an inch, and the wires must be suspended from supporting wires by means of non-metallic ligaments. Electrical engineers object to these regulations when applied to very small wires, such, for instance, as $\frac{7}{16}$in. cable.

As the questions of insulation and suspension are independent, they may be discussed separately. Electrical engineers argue that much less than one-tenth of an inch is enough for a small cable, and that using a thicker coating does not materially improve the insulation, while it makes the wire more liable to injury due to kinks, and makes it also dangerous in gales or snowstorms. Major Cardew, on behalf of the Board of Trade, replies that gales and snowstorms will do no harm if the cables are properly suspended according to the regulations, and that thickening the coating of dielectric must improve the insulation, other things being equal. But in such a case a great deal depends on what is meant by insulation. The question is, What is the duty of the insulation in an overhead wire? If it is covered by a metallic sheath the need for insulation is obvious; but if merely suspended in the air the insulation is a protection needed only in the case of accidental contacts. Though the chance of accidental contact in the case of any one wire is small, if many overhead wires are used the probability of somebody touching one is much greater, and the consequences would be so serious that bare wires are out of the question. Measurements of the insulation in megohm miles give little useful information, as there is no reason to suppose that a cable which gives good results in this way is good for overhead work. With a given quality of dielectric the insulation resistance in megohm miles depends only on the ratio of the diameters of the bare and covered wires. If a 2in. cable gave a high enough insulation test with a tenth of an inch of rubber on it, a No. 25, which is one-fifth of an inch in diameter, would give the same insulation in megohm miles with a covering only one mil in thickness. It would then be quite useless for high pressures, as it would break down at once, whereas the 2in. cable might stand perfectly. In an article which we published recently, it was pointed out that what is probably needed is capability to withstand disruptive breaking down of the dielectric, and not necessarily high insulation, and that this capability most likely depends, not only on the nature of the dielectric, but on the electric stress to which each layer of it is subjected. Let us take the case of the 2in. and No. 25 leads again. If the resistance in megohm miles is kept the same, the insulation of the small wire has just 100 times as many volts per mil on the insulation, and would, of course, break down much more easily. Suppose the insulation test of the 2in. cable to be 1,000 megohm miles, and suppose it is subjected to 1,000 volts. As the thickness of the insulation is small in comparison with the radius of the cable, we may take it that there is a fall of potential of 10 volts per mil in the dielectric. In the small wire, with the mil insulation, there is, of course, 1,000 volts per mil. Suppose the small wire is now insulated with one-tenth of an inch dielectric. The insulation resistance in megohm miles varies as the logarithm of the ratio of the bare and covered diameters. It is thus 25,000 megohm miles—that is to say, not 100, but only 25 times as much. Though the insulation resistance is enormously increased, the stress on the inner layer of dielectric is 42 volts per mil, or more than four times as much as in the case of the 2in. cable. This stress cannot be much reduced without increasing the covering of insulation to an absurd extent. We thus find that for a given electromotive force there is a size of wire below which the stress on the dielectric is too great, with any insulation within reason. If a needle point is inserted in a piece of rubber and put under electric pressure, probably the dielectric breaks down round the point, and becomes virtually part of the conductor, which increases till there is practically a round knob, so that there is no longer excessive stress on the inner layers.

However this may be, it is most probable that it is much more difficult to insulate against disruption in the small wires than in the large, though it is much easier to get megohm mile insulation. In the case that actually came up, of $\frac{7}{16}$in. cable, one-tenth of an inch insulation means a fall of 29 volts per mil at the surface of the copper under 2,000 volts; if the coating is only one-twentieth of an inch there are 50 volts per mil. The insulation in megohm miles, however, in the latter case would be equal to that of a 2in. cable covered with five-eighths of an inch of rubber.

The question of cracks and minute leaks is, of course, of the greatest importance. It is quite out of the question to attempt to make the insulation so thick that a crack in it will not matter. The striking distance of 2,000 volts may be under a tenth of an inch, the creeping distance is quite another thing. In clean places an inch or so is little enough to allow. The way 2,000 volts will creep over apparently clean surfaces is astonishing. As thickness of insulation will not avoid faults from cracks once the cracks are formed, it is important to know whether a thin or thick covering is least likely to crack. We should think the cable makers would be able to answer this question. The Board of Trade seems to prefer to consult the Council of the Institution of Electrical Engineers. But this is like leaning upon a broken reed, and it would be much more to the purpose to take the opinions of cable makers and contractors who have had to do with high-pressure distribution.

As to suspending the wires, the first thing that strikes one is that if the overhead wires are sheathed with a metal covering, which is itself earthed, there is no object in insulating it by means of non-metallic suspenders. In any case, non-metallic suspenders are unnecessary. The engineer who puts his trust in several imperfect insulators in series always finds himself in trouble. If the covering of the cable is good, the whole duty of insulation should be entrusted to it. Leather or similar ligaments are useless. They get dirty and wet, and 2,000 volts can creep easily along them. The only safe rule in high pressure work is to consider all such substances as leather, wood, fibre, paper, and all exposed surfaces that may get dirty, as perfect conductors, and not to depend on them for insulation in the least. Then, if a cable with an earthed sheathing is safe, why not earth the suspending wire and use mechanically good suspenders. The suspending is in contact with the insulation at points only, while the sheath is in contact all along, and is therefore much more likely to come in contact with the cable. Why contractors should argue that suspending is less needed in small than in large cables we cannot understand. Of course the cost per ampere is greater in the case of the small cables; but the factor of safety is much greater with the large ones, as the cross section of copper is much greater in proportion to that of the whole cable.

However these matters may really be, it is most important that in any points on which the adviser of the Board of Trade wants additional information he should refer to people conversant with the subject. The Board of Trade are in a position which, without the greatest care, may lead to great difficulties in electric lighting. If a rule is made lax, and an accident happens, it can be brought home to the Board of Trade at once. If the rule is made too stringent, and industry is hampered, nothing can be directly brought against the Board of Trade. It is therefore strongly to its interest to make the rules as stringent as possible, and not to consider the difficulties thereby thrown in the way of industry, but it is earnestly to be hoped the Board of Trade will take a broad view of such questions, and not sacrifice the progress of electric lighting simply in the interests of its own reputation.

ENGINES IN THE NAVY.

The Parliamentary Return which was recently issued, showing, in regard to ships launched since January, 1883, the estimated and actual speed, and the estimated and actual horse-power, is a very complete and instructive paper, and will be studied by engineers with great care. In each case it gives the class of the ship, its name, the date of its launch, and when it was completed, the periods during which it was in commission, and by whom the engines and boilers were designed and constructed. It then gives details of the official steam trials, and why they were repeated when that occurred, and the nature of the casualty or the reasons why the contract was not strictly fulfilled. Returns are then given regarding the speed as estimated in the design of the ship, as reported on the measured mile, and as at present estimated under continuous steaming, and each of these in many cases both with forced and natural draught, and similar figures are given for the indicated horse-power under the same conditions. A column is set aside for the duration of steaming at contract horse-power before receipt, and in cases where subsequent defects of importance have been discovered in the machinery and boilers, these have been reported up to 1st of January, 1890, and the cost of making them good duly noted. Special returns are given of the renewals of tubes both in the boilers and condensers, when these have been due to defective material. The last column notes the occasions on which the measured mile speed and horse-power have since been developed. The return was ordered at the instance of Lord Randolph Churchill, but it is quite evident that his lordship has had the benefit of the advice of an engineer who knew the points on which it was desirable to obtain accurate information.

We will not attempt to reproduce all the returns, but would advise our readers to obtain them and study them for themselves. There are, however, a few points to which we wish to direct attention. And first, with regard to speed, we are struck with the comparatively small number of ships which have not been tried on the measured mile, or under measured mile conditions. We think that Members of Parliament, for whose special benefit this return was made, should inquire why this is so, and indeed why any ship should be taken over without having been tested in the manner stated in the contract. When we compare the speed estimated in designing the ship, and that at present estimated under continuous steaming for ninety-six hours with smooth water and clean bottom, we observe a very great deficiency, in some cases amounting to almost four knots. In the same way the indicated horse-power under the last conditions is very much under the estimated power when designing the ship, and also very much under what was reported on the measured mile. It seems very odd that observations on the indicated horse-power have been made when the ship was running the measured mile, and none on the speed, which is supposed to be the main object of the trial. This is another point which requires explanation. It is satisfactory to find that when the official trials required to be repeated the defects in the machinery appear to have been of a comparatively slight nature, and such as could easily be put right, if we except a few cases in which bad condenser tubes had been used, and of which we think we have heard before, and the cost of making good comparatively small. Such returns are of the greatest use not only to engineers, but also to the general public, and we hope we shall have more of them in the future than we have had in the past.

IRON AND STEEL WIRE ROPES.

Mr. A. H. Stokes, Her Majesty's Inspector of Mines, read last Friday before the Derby Society of Engineers an interesting paper on "Iron and Steel Wire Ropes, Chemically, Microscopically, and Mechanically Considered." The importance of the subject was shown by pointing out that in the United Kingdom alone upwards of 500,000 lives were daily trusted to the efficiency of these appliances. Wire ropes, the author explained, are divided into three great classes, according to the material from which they are made—viz., iron, steel, and plough steel. The average breaking load of iron wire ropes is 20 tons; of steel, 35 tons; and of plough steel, 50 tons per square inch of sectional area. The safe working load for iron wire ropes is 2 tons; for steel, $3\frac{1}{2}$ tons; and for wire ropes of plough steel, 5 tons per square inch. It will thus be seen that a limit may soon be reached—but soonest in the case of iron—when the weight of the rope alone is all the load that the wires of which it is made up can safely carry. The increasing depths of our coal mines compelled the introduction of materials of greater strength, although Mr. Stokes is of opinion that for reliability the old charcoal iron has not yet been excelled by its modern competitors in the various qualities of steel. An iron wire rope reaches its limit of safety at 3,000ft., one made of steel wire at 4,790ft., and one of plough steel at 7,185ft. The difficulty of raising minerals from increasing depths has been overcome by making the ropes of a taper form, so that as the rope is paid out and the suspended weight increases, so also does the sectional area of that part of the rope supporting the weight go on increasing. As, owing to inertia, the working load increases considerably with augmenting speed—so that a velocity of 30ft. per second actually doubles the load—it is easy to understand that ropes are severely tried just where they show over the drum from which they are suspended when the cage is at the bottom of the pit. To avoid the danger arising from this source 6ft. or 7ft. of the wire rope are cut off from the cage end every two or three months and newly fastened, so that the severe straining mentioned comes on different parts of the rope. By this means the life of a wire rope, with proper care in other respects, may be safely taken at two and a half years. Owing to internal corrosion, which it seems impossible to arrest by any known means, it is quite unsafe to work them longer for raising purposes, whatever their appearance may be after this period of use, or even of rest, if they have been exposed.

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Mr. Stokes went fully into the question of testing wire ropes, and, putting aside as impracticable chemical and microscopical tests, however interesting from a scientific standpoint, he showed how by very simple mechanical methods the colliery manager may assure himself of the fitness of a rope for its intended work. The tensile resistance of the wires is readily ascertained by taking out a few feet of wire from one end of the rope. Suspending the wire from some convenient attachment it is made to hold up an empty tub at the lower end. Water is then carefully poured into the tub until when the tensile limit of the wire is reached it breaks. Afterwards the water in the tub can be measured and the breaking strain calculated. The resistance to torsion is, however, of no less importance, and a method that could be readily applied where testing machines were not at hand was described. For this purpose a piece of the wire to be tested, 8in. long, is screwed up tight at one end in an ordinary smith's vice, and the other is held fast between the plain faces of a pair of dies in stocks, which have only to be rotated, and the number of whole turns before the wire breaks carefully counted, to ascertain the torsional limit. Steel wire should stand twenty-eight twists. Great care has to be taken that the wire is properly fastened at each end in this test, and hence it is well to have the wire marked and watched whilst the test is proceeding.

During the discussion Mr. Fletcher remarked that he had found it of service to draw a line along the wire before subjecting it to the torsion test. As the wire is twisted this line forms a screw, the number of turns actually performed by the wire before it breaks being readily counted. Mr. Carulla observed that much excellent steel was manufactured in Sheffield for wire-rope purposes from Bessemer scrap. The scrap was re-melted in crucibles by the old cast steel process, and there could be no question that a more reliable material was thus obtained for wire-rope purposes than was the case if got direct from the Bessemer converter, or even the Siemens furnace. The scrap being cut up small, and care generally taken to have it as nearly alike as possible in temper, a very uniform product is the result.

Replying to a question, Mr. Stokes explained the method adopted to ascertain the presence of broken wires in any rope. For this purpose a piece of spun yarn is just looped around the rope, the spun yarn being held by two men, one at each end, as the wire rope is slowly lowered through the loop, which is in close contact with the rope. The projecting ends of any broken wires catch on the spun yarn, and in that way reveal the defect.

MANCHESTER JOINT BOARD OF CONCILIATION.

We are much pleased to note the growth of the application of a method of settling trade disputes which we have often advocated—namely, by means of Boards of Conciliation. The past year has been one of great unrest in the labour world, but it has not been without some symptoms of the advent of a better state of affairs, for thinking men of all classes see that the present state of unstable equilibrium is most hurtful to the best interests of the country. For some months past negotiations have been carried on between the Manchester Chamber of Commerce and the Manchester and Salford Trades Council for the establishment of a Board of Conciliation, which is intended to bring about a speedy settlement of trade disputes between employers and employed, and regulations have been adopted which have received the approval of the Chamber of Commerce and of the Trades Council, of which the following are the most important:—The extent of jurisdiction is unlimited as regards the nature of the trade or industry, as any trade may make application for the services of the Board in any existing or anticipated dispute. As soon as it comes to the knowledge of the secretary that any serious labour difficulty has arisen, it shall be his duty to summon a meeting of the Board to consider the propriety of offering its services with a view to a peaceful settlement of the difficulty, and, if so decided, shall arrange for a conference between the disputants. In the event of the disputants not being able themselves to arrive at a settlement, they shall be invited to lay their respective causes before the Board with the view of receiving its advice or mediation. The utmost efforts of the Board shall in the meantime be exerted to prevent, if possible, the occurrence or continuance of a strike or lock-out. The decision of the Board shall not be necessarily binding upon either of the parties to the dispute, except when a joint application has been made and an agreement come to on the part of both disputants that they will respectively abide by the decision of the Board. In other cases, when an award is agreed upon, the decision shall be made public on the authority of the chairman, with such comments as shall be approved by the Board, but in the event of the decision not being unanimous, the report of the minority, if they desire it, shall also be published. Upon the occasion of an equality of votes, so that no definite award can be given, then the chairman shall make an announcement to that effect, and at the request of either of the parties to the dispute shall publish such separate report or reports as they may wish to have made public. Arrangements are made for calling in the assistance of expert members, two for each party, who may express opinions, but who shall not be allowed to vote.

The Board is to be affiliated to the Manchester Chamber of Commerce, and it is to be composed of six members representing employers, to be elected by the directors of the Chamber, and of six members representing employés, to be elected by the Manchester and Salford Trades Council. Regulations are laid down for the management of business and the duration of service and retirement, which seem well designed to meet the requirements of the case. We wish the Board all success, and look forward to its operations with much interest.

THE CENTENARY OF THE AMERICAN PATENT SYSTEM.

The celebration of the beginning of the second century of the American patent system, by inventors and manufacturers of patented inventions is about to be held at Washington from the 8th to the 10th prox. A very influential and numerous executive has been formed, with Mr. J. E. Williams, of the United States National Museum, Washington, as secretary. In a circular issued to inventors and manufacturers of inventions in America the secretary states:—"The completion of the first century of the American patent system marks so important an epoch in the history of the nation that it is eminently proper that the beginning of the second shall not pass unnoticed. The centennial anniversaries of other important national events have been celebrated in a manner worthy of a people proud of their country and its growth. Surely the system that has aided the agriculturist in the field, the mechanic in the shop, and the toiler in the mine, and has stimulated invention and helped every branch of modern industry, has played no small part in a history so full of the triumphs of human achievement. Believing that the American inventor and manufacturer of inventions will regard it a privilege as well as a duty to co-operate in making due recognition of these facts, it is proposed to hold a celebration at the National Capital in April, 1891, which shall, in a fitting manner, commemorate the important event, and place on record the nation's appreciation of the labours of those whose ingenuity, patience, and tireless effort have exercised such a potent influence in accelerating the prosperous growth of the nation, and in aiding the progress of our civilisation."

It is also proposed to form a "National Association of Inventors." The first public meeting, which will be presided over by the President of the United States, will be held on April 8th. Another meeting of a similar character will also take place on that date, which will be presided over by the Hon. John W. Noble, Secretary of the Interior. A special reception of inventors and manufacturers will be held at the Patent Office on the morning of the 8th, by the Secretary of the Interior and the Hon. Charles Eliot Mitchell, Commissioner of Patents. Two meetings will also be held on April 9th, and will be presided over by the Hon. Frederick Fraley, LL.D., and Professor S. P. Langley, LL.D. On the 10th, being the anniversary day of the signature of the first American patent law by George Washington, there will be an excursion to Mount Vernon, where an address will be delivered by J. M. Toner, M.D., upon "Washington as an Inventor and Promoter of Improvements." A long list of addresses on suitable subjects has been arranged for these meetings.

Letters to the Editor.

THE INSTITUTE OF CHEMISTRY.

To the Editor of "Industries."

Sir,—I have read with much interest your two articles on the Institute of Chemistry, and also the letters from your correspondents on the same subject. I note that a contemporary, on the publication of your articles, took exception to the ventilation of the subject in your columns, on the ground that there were special chemical journals which were available for the subject, but it is obvious from the interest displayed in the subject that it was waiting to be discussed, and I for one am glad that you have been able to devote so much space to the question under discussion. Although I agree with the writer of the articles in his wish for reform in the management of the Institute, I think that many of the Fellows will be of opinion that the general tone of his remarks might have been couched in a somewhat less radical form. It is always difficult to bring about changes, but the difficulty is often enhanced when drastic measures are resorted to, and the reformation and development of the Institute of Chemistry which the main body of the Fellows desire is, I believe, making progress, although perhaps not so rapidly as the writer of the articles wishes. Your correspondent, "A Technological Associate," points out that the Institute of Chemistry does not exist for one special class of chemists, and it must be the general opinion that it would be a great mistake to narrow its functions in any way. What we want is undoubtedly an institution which will confer upon its members a distinct qualification which will be publicly recognised as a stamp of a man's chemical knowledge being of a standard sufficient for his advice to the public to be of value. The great obstacle in the way is the magical influence of the letters "F.C.S." upon the general public, and the Institute will only succeed in raising itself to its proper level by demonstrating to the public that the Chemical Society has ceased to be, if it ever was, a diploma-giving body, and that when it obtained its present charter the Chemical Society then relinquished its position as a body of professional men for that of a scientific club.

Yours, &c.,

London, 21st March, 1891. Alchemist.

To the Editor of "Industries."

Sir,—Permit me to offer a few remarks on the articles on the Institute of Chemistry which have recently appeared in your valuable journal. The cosmopolitan nature of your readers assures me of a more generous and impartial hearing than I should receive in a paper devoted solely to the interests of chemists.

To credit the general public with a mere pittance of common sense is impolitic on the part of your contributor, who might also have omitted the overt sneer at the biographer, and have shown some appreciation of the work the professor and his kin have done for the advance of analytical chemistry. A modicum of good taste would have kept hidden such narrow-mindedness. Your contributor wishes to "convert the practice of chemistry into a close profession," or, failing such happy consummation, to sail as near the wind as possible in that direction. But the engineer and industrial man, if not the maligned general public, will protest against the establishment of such a monopoly. The monopolists, indeed, would prosper, and by lauding the merits of their Institute to the skies, would perhaps—nay, assuredly, if the writer of the articles judges its discrimination aright—deceive the community at large. But a system of high fees, engendered and maintained artificially, will perforce compel the public to appeal as seldom as need be to the analytical and consulting chemist, and the profession thus handed over for nurture to a self-seeking oligarchy will in the end suffer. The simile drawn from the legal profession is infelicitous, and those of your readers who have made acquaintance with lawyers' bills will doubt the expediency of permitting analysts to become a similarly protected class.

Such protection will be attained by increasing the difficulties of qualification, and the essential weapon wherewith to cope with these difficulties will be sufficient means for a protracted course of study. Thus the way will be barred to many a man who would otherwise become an ornament to the profession, but who cannot face such prolonged and expensive apprenticeship. This is surely contrary to the spirit of the age.

The predominating influence on the Council of the scholastic and collegiate branch of the profession is deprecated, but with what reason? The practising analyst and consulting chemist is generally a man of less marked ability than his compeer on the professorial branch, and he displays good sense in transferring the burden of government to the shoulders of the latter. In the welfare of the Institute of Chemistry the self-interest of the teacher is at stake, since unless the profession of analytical and consulting chemists flourish, his *raison d'être* diminishes, and he seeks a livelihood in vain, for the training of the rising members of that profession is his main support.

Yours, &c.,

Oxford, 19th March, 1891. Curculiunculus.

To the Editor of "Industries."

Sir,—To those who can read between the lines of your recent articles on "The Institute of Chemistry," the *raison d'être* is not difficult to discover, and they will summarise it as an attempt to convert the Institute into a trades union for the purpose of raising the standard of fees, or, at all events, of preventing the present standard from being lowered by unlimited competition.

The more thoughtful among the members of the Institute cannot but regret that such widespread publicity has been given to this article by its appearance in the columns of your paper; its circulation among the members was all that was necessary, for it is with them, and them only, that it is concerned.

In referring to the charter, of which "a careful perusal may be recommended," the writer has curiously omitted all mention of the clause on page 7, which reads as follows:—"That the said Institute was not established for the purposes of gain, nor do the members thereof desire to seek any pecuniary profits from their membership, but the society aims at the elevation of the profession of consulting and analytical chemistry, and the promotion of the efficiency and usefulness of persons practising the same. . . ." &c.

From this it is apparent to the meanest intellect that the Institute exists for the benefit of the public, and *not* for the benefit of the profession. That the Institute *will* ultimately benefit the profession is, of course, admitted, but to widely publish that such benefit is the object of its existence is a line of action which carries its folly in its face.

The one aim which all members of the Institute have in common is the attainment of Parliamentary powers for the purpose of preventing the practice of analytical and consulting chemistry by those who are not members of the Institute. It cannot be too strongly insisted upon that no Parliament will grant such powers, and that it is undesirable that any Parliament should grant such powers, to any corporation which has for its object the benefit of the profession rather than the benefit of the public.

Yours, &c.,

London, 20th March, 1891. Microscopist.

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Legal Proceedings.

TUCKER *v.* KAYE.

This action, which is of interest to patentees, was tried by Mr. Justice Romer. It was brought by Mr. A. P. Tucker, the patentee under a grant, No. 5080 of 1886, in respect of an improved spring lock, against Mr. Kaye, a well-known lock manufacturer, to restrain an alleged infringement of the plaintiff's patent rights, and to recover damages in respect thereof.

The plaintiff's lock, as described in his specification, was designed with a view to avoid the use of bolts which project, when the door is open, from the surface of the lock plate. The ordinary spring lock has such a projecting bolt provided with a sloping surface, which comes into contact, when the door is in the act of closing, with the surface of the striking plate, and is so driven back against the spring, which, by its reaction, thrusts the bolt forward and into engagement with its catch as soon as the acting surface of the striking plate has been passed. The particular disadvantage of such locks, which the inventor had in view and avoided in his patented lock, is that the projecting bolt is apt when the door is swinging to catch in the clothes of persons passing or standing by and to tear or do them other injury. He therefore arranged his bolt so as to lie entirely within the lock except when actually in use for the purpose of fastening the door, and caused it to be held back against the pressure of its spring by a detent, which detent is automatically released when the door is closed by the action of a secondary bolt. The releasing bolt, if it projected from the face of the lock, would be just as dangerous as a projecting main bolt, and accordingly the inventor places it in a recess cut in the face of the lock, so that it does not project beyond the general surface, and on his striking plate he arranges a projection which, entering this recess when the door closes, acts then upon the releasing bolt and operates it to disengage the detent which holds back the main bolt. Such is in outline his description of his lock, which is claimed in the following terms:—"In combination with a main bolt urged forward by a spring a detent holding the bolt back when the door is open, but released by a projection on the striking plate in the act of closing the door substantially as and for the purpose herein set forth."

The defendant's lock which was complained of resembled the plaintiff's as above described in all material respects save one, namely, that the releasing bolt does project from the face of the lock. For the plaintiff it was contended that this was a merely colourable difference. For the defendant, on the other hand, it was contended that the difference was of vital importance, and that the plaintiff could not set up a claim to locks in which there were projecting bolts. Other objections urged against the patent were, that the lock described was not new in principle at the date of the grant, having been anticipated by earlier locks which had been used and described in printed books. For the printed anticipations the defendants relied upon Lord Grimthorpe's work upon Locks and the Eighth Edition of the *Encyclopædia Britannica*. In both these works spring locks are described, of which the bolts are held by detents when out of action and released by the automatic withdrawal of the detents effected in the act of closing the door. Various locks of such a type were produced and proved in Court. For the purpose of evading these anticipations, it was contended by the plaintiff that an important difference between the lock described by the plaintiff and those put forward by way of anticipation was that the anticipating locks had, all of them, projections standing out upon the side instead of the face of the lock, and actuated by being pressed against a flange upon the striking plate, or, as the case might be, the rebate of the door post. It was pointed out that a lock constructed in this way could not be used in all the situations for which a lock having facial action would be suitable. Thus, a right-handed lock of the earlier construction could not be used in place of a left-handed, nor could such a lock be applied at all to swing or sliding doors. To all these situations the plaintiff's lock was adapted quite indifferently.

In the result the judge found for the defendant on all the issues named. He held that there had been no such invention as to entitle the plaintiff to the grant of any patent at all, inasmuch as the principle of employing a secondary bolt to release the main bolt had been previously known, and no invention was required to remove the acting parts from the side to the face of the lock. The prior user of locks, having all the essentials of the plaintiff's lock, with the difference, which he had thus decided to be unimportant, of releasing mechanism projecting on the side instead of the face of the lock, had been sufficiently proved in evidence. There was, consequently, no novelty in the plaintiff's lock at the date of his patent. He held also that, as to the issue of infringement, the plaintiff had not succeeded in making out his case, for the use by the defendant of a bolt projecting from the face of the lock was sufficient to take his lock out of the plaintiff's claim when properly construed.

This case is interesting under two points of view—that is to say, for the light which it throws on the attitude which the new judge may be expected to take up with reference to patents, and also for its effect upon a commercially important patent. First, as to the disposition of the judge, the present decision appears to indicate that he may be expected to prove a somewhat exacting critic of patents. The tendency of the judges generally, and especially perhaps of late, has been to refrain from pronouncing a patent bad for want of invention, and rather to be ingenious in finding subject matter in very small improvements than severe upon this head. The present decision is, however markedly severe. It is, no doubt, perfectly true that any mechanician could have substituted the facial action for the lateral if he had been told to do so; but it does not by any means follow that any mechanician would necessarily have perceived that there was practical utility in so doing. The property of being universally adaptable without modification to any situation in which a lock can be required is certainly a valuable feature in Tucker's lock, but it is a merit not indicated in his specification, and so far is it from being an obvious advantage, that it is open to serious doubt whether the patentee had himself perceived it when he made his application for a patent. Such an oversight, if oversight it was, would not harm his patent, but it goes far to show that invention was implied in the result which the patentee obtained, and in view of this admitted merit of the lock which he was the first to describe the judgment against him on the ground of no invention is a little surprising. It is even the more surprising because the alternative ground of non-infringement, on which also the judgment against him was based, appears to be unassailably strong, and the question whether there was good subject matter or not did not actually need to be discussed for the mere purpose of deciding the action.

Upon the other point mentioned above, it is not necessary that we should comment, unless to remark that in this instance a valuable patent appears to have been destroyed through the faulty drafting of a claim. If, at the time when the complete specification was drawn, the patentee had apprehended the view of his invention which was put forward with great force at the trial, and had claimed a lock made so as to be universally adapted to any kind of door, he would no doubt have possessed a narrower patent; but, for all that has yet appeared, a good one.

THE PRINTING, STATIONERY, AND KINDRED TRADES EXHIBITION.

The above-named Exhibition was opened on the 16th inst. at the Agricultural Hall, Islington, and will close on the 30th inst. Although not very extensive, it contains many interesting exhibits connected with the engineering and printing trades.

The most imposing exhibit is that of Messrs. Joseph Richmond & Co., Limited, of 30, Kirby Street, Hatton Garden, London, E.C., who show about thirty machines for all purposes connected with the printing and stationery trades. A useful tool shown by them is a planing machine for getting up the surfaces of lithographers' stones, instead of the old method of grinding. We had an opportunity of seeing this machine at work, and of inspecting the very perfect surface of the stone afterwards. The saving in cost of grinding by the use of this machine is, we understand, considerable. A self-clamp guillotine exhibited by this firm is of neat design and finish. It works noiselessly, and gives a clean cut. The novelties in its construction consist in combining the tangent wheel motion with the diagonal slide motion of the crank, and the rigid connection of the knife-holder and the lower beam by means of rods, the whole being guided in slides. All these parts receive a direct pull from the crank in the direction of the cut, thereby ensuring steadiness in motion and freedom from jerking. The same firm also exhibit Pellatt's gumming machine. This machine can automatically fan out, gum, dry, and deliver envelope blanks at the rate of 20,000 per hour at an inclusive cost of less than a farthing per thousand. The power required for driving it is very little. It is exceedingly simple and requires no skilled attendant. Some of the machines made by this firm we hope to illustrate in a later issue. Messrs. James Salmon & Son, of Blackfriars Bridge, Manchester, exhibit a Wharfedale machine with flyers, and cutting and rolling machines. The Watford Engineering Works have a good show of a varied nature, including dynamos, boilers, gas retorts, and pulp strainers. Messrs. Joseph Foster & Sons, of Soho Foundry, and Bow Lane, Preston, show a double royal stop-cylinder printing machine, with flyers. On this machine is fitted Oldfield's multi-colour printing appliance, by which a number of colours may be printed from one forme at one operation. The Trent Gas Engine Company, New Basford, Nottingham, exhibit three sizes of "Trent" engines—viz., of 12, 6, and 1½ h.p. The Winder Type Composing Machine Company, Limited, of Bowker's Row, Bolton, exhibit their system of composing, which is well worth attention. It is extremely simple, and consists merely of eighteen castings from one pattern, bound together, into which are inserted tin tubes full of type as they come from the distributor. The "stick" is held in the machine, thus leaving the compositor two hands instead of one to pick up the type, which has to be conveyed only a few inches to the stick. The same firm also exhibit a new form of distributing machine. Messrs. H. Wallwork & Co., of Union Bridge Iron Works, Manchester, have on view Cartwright & Wallwork's litho roller covering machine, for putting on, taking off, and tightening skins.

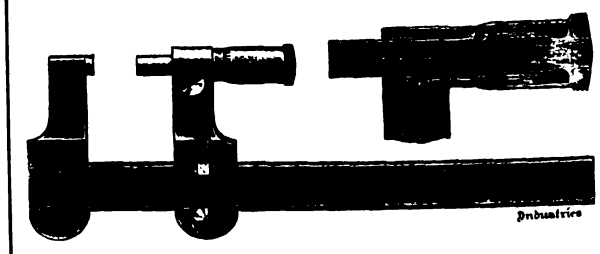
Messrs. Weyman & Co., Limited, of Church Acre Iron Works, Guildford, show a 2 h.p. "Trusty" gas engine, on the four-cycle principle and with tube ignition; also a 2 h.p. petroleum engine, which consumes about ¾ pint of oil per h.p. per hour. Messrs. Furnival & Co., of 32, St. Bride Street, London, E.C., have an attractive stand of printers' machinery; they also exhibit a 7 h.p. "Express" gas engine at work. This engine is of neat design and is economical in working. Messrs. Dick, Kerr, & Co., Limited, of London, Bristol, and Glasgow, exhibit various sizes of "Griffin" gas engines, double and single acting, and electric lighting plant.

(*To be continued.*)

A BEAM MICROMETER CALLIPER.

The accompanying illustration, for which we are indebted to our esteemed contemporary, the *American Machinist*, shows a micrometer calliper, which is manufactured by the Standard Tool Company, Athol, Mass., U.S.A.

As will be seen, the instrument consists of a beam, upon which there are two heads or jaws, one of which is fixed, while the other is movable, and can be clamped at any point, according to the size of the work to be gauged. The edges of the beam are bevelled, and the sliding head is fitted to it closely without a gib, and is open on the front side, as shown, being tightened in position by the screw seen at the bottom, one side of the head of this screw being flattened at an angle to fit the bevelled edge of the beam, so that it acts as a gib. At intervals of ½in. along the beam are placed small pins. In the side of the moving head is a small key, which is let into a slot somewhat longer than the key, so that when the latter is pushed up to the top of the slot it will clear the pins in the beam, but when pushed down it comes into contact with them, and the two together then serve as a stop to fix the head on the beam. The key can be drawn



down to its place in the slot by a screw on the other side This key does not touch the beam, but just clears it, so that, after the key is drawn down to its place by the screw, the head can be moved up against one of the pins, and clamped by the screw at the bottom. The micrometer screw is ½in. long, corresponding to the distance between the pins, and, as shown by the sectional view of this head, is entirely covered. It is fitted to the nut A, and is provided with an adjustment for wear.

A new method of adjusting the screw, so that it will read zero when the contact points are brought together, is used, by which the screw in the fixed head is replaced by a pin, which is driven into place, and need not be moved afterwards. The adjustment is made by means of the screw C, which is tapped into the end of the micrometer screw as shown, and the end of the micrometer screw is bored out tapering, and split, so that when the screw C is tightened it expands the end of the micrometer screw and tightens it in the shell. Thus, when the micrometer is to be adjusted, the points are brought together, and the shell is then turned on the screw until it reads correctly when the screw C is tightened up. These callipers are made in two sizes for measuring up to 4in. and 6in.

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A NEW TWIST DRILL.

The accompanying illustrations, for which we are indebted to the *American Machinist*, represent a twist drill and drill chuck of novel construction. The body of the drill is of the ordinary pattern, and is made to a standard size, the novelty in construction being in the shank of the drill and in the chuck. The groove, instead of terminating at the beginning of the shank of the drill, as is usual, is continued through it in the form shown in Fig. 1, and it is then held in a chuck, such as is shown by the engraving, which has two jaws adapted to fit the grooves in the shank of the drill, and to be clamped tightly in them by the threaded and milled sleeve shown. The jaws are not loose, and their distance from each other does not vary with the different sized drills placed in the chuck, since the shanks of the drills for a given series are of the same thickness through the centre, and are held in the chuck in the manner indicated by Fig. 2, which represents an end view of the chuck, showing the jaws with circles of different sizes, representing the different sized drills in place, the smaller drill being of the same thickness through the centre of the shank, and having correspondingly shallow grooves. It will be seen that the drill is thus driven positively, and does not depend at all upon the tightness of the grip secured by the jaws, but the largest drills are secured in the chuck, and removed from it after doing the heaviest work, simply by applying the hand to the milled shell of the chuck (Fig. 3), without the use of a wrench. A plate at the bottom of the jaws serves to ensure that the drills shall be inserted to the right depth, and as it is loosely held in position, gives opportunity for the slight springing of the jaws above the end of drill necessary to secure it. The grooves on the drill are milled on both sides simultaneously by special machinery, and are afterwards ground to size while held in a chuck, which grips them by these grooves, so that true drilling is ensured. Only two sizes of chucks are used for the full range of sizes of drills, the smaller chuck taking drills from $\frac{1}{4}$in. to $\frac{3}{4}$in., and the larger size all drills above $\frac{3}{4}$in. The chuck shown is of the smaller size, and its shank is grooved to be driven by the larger chuck, though the shanks of either sized chuck may, of course, be of any desired form to suit the machine in which they are to be used. The makers of these drills and chucks are the Graham Twist Drill Company, of Detroit, Michigan, U.S.A.

THE INSTITUTION OF MECHANICAL ENGINEERS.

An ordinary general meeting of this Institution was held on the 19th inst., at 25, Great George Street, Westminster. The chair was taken by the President, Mr. Joseph Tomlinson. After the usual business connected with the previous meeting, the Secretary read the

Fourth Report of the Research Committee on Friction: Experiments on the Friction of a Pivot Bearing.

These experiments were carried out in the works of Messrs. Simpson & Co., at Pimlico, in July, 1890, under the superintendence of Mr. B. Tower. The bearing employed was 3in. diameter, and flat ended. To obtain the equivalent of any desired load on the bearing the latter was pressed upwards against the footstep by means of an oil press having a plunger 6in. diameter, the pressure being applied through a hard steel conical centre formed on the bottom of a plate carrying the bearing and resting against a piece of hard steel let into the top of the plunger. The oil pressure on the plunger was balanced by means of a piston of the same diameter as the plunger, attached to the upper end of the vertical shaft carrying the footstep and revolving with it. This piston worked in an upper cylinder connected by a pipe with the lower cylinder of the oil press. A small hand pump in connection with an air vessel was used for applying pressure. The circular plate supporting the bearing was formed with a groove in its periphery, in which lay a small chain fastened to the plate and embracing a portion of the circumference, from which it led off to a spring balance indicating the force tending to turn the plate. Lubrication was effected by introducing oil through a hole in the centre of the bearing, and distributing it through two radial grooves extending to within $\frac{1}{16}$in. of the periphery of the bearing surface. It was found in working that the oil was delivered out at the top of the bearing, and an arrangement was made by which it was collected and used over and over again, the apparatus thus acting as a sort of oil pump. Subsequently experiments were made with three and four radial oil grooves, but the friction was in this case found to be from one and a half to twice as great as with only two grooves. The trials were carried out at 50, 128, 194,

A NEW TWIST DRILL.

Constructed by the Graham Twist Drill Company, Detroit, U.S.A.

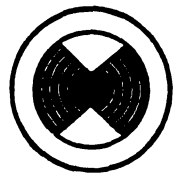


FIG. 2.



FIG. 1.

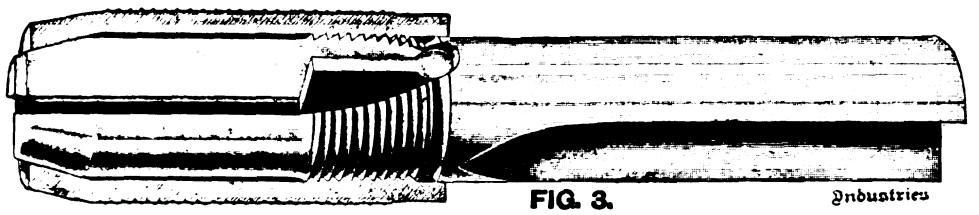


FIG. 3.

290, and 353 revolutions per minute, with various loads on the bearing. The footstep was of steel, and for the majority of experiments the bearing was of manganese bronze, but at one speed a bearing of white metal was also tried. As we shall subsequently publish the report in full, it is unnecessary to refer in detail to the results of the trials; it may, however, be mentioned that at the higher speeds the coefficient of friction is less, and that this is ascribed in the report to the lubrication being more perfect at high than at low speeds, owing to the more rapid circulation of the lubricant. The loads with which the bearings heated and "seized" were also ascertained, and these were found to be from 260lb. to 300lb. per square inch with manganese bronze, and 240lb. per square inch with white metal. The paper was illustrated by diagrams.

Mr. Wicksteed, who opened the discussion, referred in complimentary terms to the design of the machine used in making the experiments, and expressed a hope that such experiments would be proceeded with in the future. A very interesting feature of the apparatus, he considered, was the ram with circular grooves working without packing. The pressure in the ram cylinder was of course not great; the load on the bearing had generally been carried up to about 160lb. per square inch, and this was equivalent to about 40lb. per square inch on the ram; in some cases as much as 240lb. had been applied, equal to 60lb. on the ram. He should be glad to know whether the flow of oil for lubrication increased noticeably at higher pressures; it might be expected that when a certain point was reached the flow would be very copious. He regretted the absence of Mr. Ford Smith, who had carried out trials with a pivot bearing very similar to that shown in the diagrams, but furnished with several discs, with oil circulation round the pivot. Mr. Ford Smith, however, gave the pressure due to the weight of the shaft used by him at 450lb. per square inch, whereas in the report it was stated that the bearings seized at 240lb. It would be interesting to learn what happened at the intermediate pressures between the highest at which the lubrication was recorded as still satisfactory and that at which heating and seizing were observed. Were the resources of engineering exhausted at the latter pressure? He believed not, but that, by using a large number of superimposed discs in the manner adopted by Mr. Ford Smith, the load might be safely increased. It appeared to him that at very low speeds the conditions affecting friction must be very different to those occurring at high speeds. Generally speaking, collar bearings seized at about 80lb. per square inch, but in one case he had found that the collar bearing of a drill spindle bore a pressure of 360lb. before seizing; this was, however, at a low speed, and the construction was such that the oil could flow outwards from the centre, but could not return inwards. It was remarkable what heavy loads were carried on lathe centres without causing seizing. In a large lathe the load carried by one centre was often 10 tons, and, as the area of the bearing surface was certainly not more than 1 square inch, the pressure must be at least 10 tons per square inch. In conclusion, Mr. Wicksteed said that he hoped further experiments would be made with variations in the conditions—for instance, with several discs, with different forms of pivot, and at lower speeds.

Mr. Veitch Wilson pointed out that previous experiments had shown that temperature had very much to do with friction. Had the temperature been noted in the case of the present trials? At different speeds a very considerable difference in temperature would be developed in a short time, and it seemed to him it was important that it should be observed. The influence of temperature on the friction of bearings was the result of the change in the viscosity of the lubricant produced by heating. From tests made by himself, he had found the viscosity of sperm and lard oil at different temperatures to vary as follows:—

Oil.	Temperature.	Viscosity.
Sperm	60°	50
„	120°	30
Lard	60°	100
„	70°	90
„	120°	29

It would be interesting to know whether, in reducing the friction by increasing the speed, power was economised, or whether the work required for producing the heat, which was the cause of the reduction, counterbalanced any advantage of that kind.

Professor A. B. Kennedy remarked that the report was given in a very condensed form, and might, without disadvantage, have been extended to twice its length. He noted that in the first two sets of experiments the coefficient of friction was much higher at the lower speed, while in the subsequent experiments this was not the case. The first trials were made with counted oil drops, while for the later ones continuous lubrication was employed. Did this account for the differences? In order to ascertain with certainty to what such differences were due, it was desirable that the lubrication should be the same at all speeds. It was, of course, quite possible that, apart from the method of lubrication, at low speeds (from 50 to 128 revolutions per minute) the coefficient decreased rapidly with an increase of velocity, while at higher speeds this did not occur. He agreed with Mr. Wicksteed in regard to the use of discs. It would be interesting to know whether the centre of pressure was really situated at $\frac{2}{3}$ of the radius measured from the centre of the bearing, and, if so, whether it remained constantly at this distance. Owing to the unequal velocity of different parts of the bearing surface, the outside would wear first, and this would cause a change in the centre of pressure. It was therefore possible that uniform wear, and not uniform pressure, should be taken into account, and in that case the centre of action would be at $\frac{1}{2}$ the radius. This was, perhaps, more an academical than a practical question, since for practical purposes, provided the assumption with regard to the centre was understood, it did not much matter where it was supposed to be. For narrow ring surfaces it was justifiable to take the radius of the centre of pressure as the mean of the inner and outer radii. With reference to the curves shown on Diagram 5, Professor Kennedy said that they did not represent anything in particular; the actual experimental points ought to have been recorded, and a continuous curve drawn between these, representing as nearly as possible the average results. Perhaps Mr. Tower, who had conducted the trials, would kindly do this by way of supplement.

Mr. Schönheyder said that many people seemed to imagine that a footstep bearing would carry any weight, and in consequence of this it so frequently happened that bearings became hot. A footstep was very much in the nature of a crosshead. Crossheads often worked under a pressure of 600lb. to 800lb. per square inch, but if the oil was wiped away at each stroke 40lb. to 60lb. was more like what should be used. He quite agreed with Professor Kennedy that the friction diminished with increasing speed, and also as to the necessity for a uniform method of lubrication. Mr. Wicksteed's remarks were, he thought, very much to the purpose, but if experiments

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were made with discs between the pivot and bearing some means would have to be taken for the uniform lubrication of all the discs. The small difference between the results observed with manganese-bronze and white metal was, to him, surprising; he should have anticipated a much greater divergence. The diagrams, in the forms shown, seemed of very little use. What was wanted was not inch-lbs., but the coefficient of friction, and this could not be ascertained directly from the diagrams, but would have to be worked out.

Professor Kennedy here made a supplementary suggestion to the effect that it would be interesting if some account could be added to the report of the experiments made with more than the two radial lubricating grooves.

Mr. Henry Davey considered the construction of bearing adopted a very favourable one. The bearing was carried on a point, and was, therefore, not rigidly fixed; in this particular it differed somewhat from ordinary practice. The heavy weights carried by lathes had always been a great puzzle to him. There was a considerable difference between the conditions occurring in a lathe and those in a footstep bearing. In a lathe nearly the whole load on the centre was carried by the top half of the surface, and this made the puzzle all the greater.

A member inquired if any experiments had been made without oil grooves. He himself had found grooves objectionable, the lubrication being better without them, and the inferiority of the results observed with four grooves to those obtained with two only tended to confirm his opinion. Grooves allowed the oil to escape outwards. Owing to the varying surface speed, and consequent irregular wear, the experiments ought to be continued for long periods in order to arrive at reliable results.

Mr. Lockart suggested that it was questionable whether flat surfaces were the best. Many other forms had been tried. He had himself tried a hemispherical surface working on a flat surface with success. If the pressure were excessive the oil could not get in between the surfaces. Trials ought to be made with discs without grooves.

Mr. G. Cawley, quoting from the paper, said that on page 3 it was stated that "the bearing proved to be a most efficient pump, causing a rapid circulation of oil throughout itself," while further on in the paper was the statement that "the manganese-bronze bearing heated and seized on one occasion with a load of 260lb. per square inch." He would like to ask Mr. Tower whether the pumping action of the bearing was reduced or ceased altogether when the reported seizing took place. As the temperature of a bearing affected the viscosity of the lubricant, he hoped that in future experiments the results would include the temperature of the bearing and viscosity of the lubricant, as well as the speed of the shaft and weight on the bearing per square inch.

Mr. Walker related his experiences in 1852 with an engine driving a large flax mill at Leeds as throwing some light on the subject of the pressure on bearings. This engine had an exceptionally heavy flywheel, and, in order to keep the bearings cool, it was necessary to have men always in attendance to watch them. He was consulted on the matter by the owners of the mill, and, after careful inspection, advised the substitution of a new shaft of good Yorkshire iron in place of that originally supplied, which was of inferior quality, and also that harder metal should be used for the bearings. His recommendations were carried out. Very hard chilled metal was adopted, and the work was executed with the greatest possible accuracy. When first re-started, the journals ran warm in an hour, but a pump for cooling was added, and no further trouble experienced. Engineers, in his opinion, were apt to overlook the great importance of speed and good material and workmanship in relation to the subject of bearings. In the case of lathes, referred to by previous speakers, he believed that hard material, low speed, and careful ubrication accounted for the heavy loads that could be lsafely carried. Generally speaking, he thought the most essential conditions for successful lubrication were good material and workmanship, large surfaces, and low speeds.

Mr. Schönheyder asked what was the load on the flywheel shaft mentioned by Mr. Walker, but Mr. Walker could not state this offhand. He would, however, subsequently furnish particulars.

Mr. Dolby inquired whether during the experiments forming the subject of the report any note was taken of the change in the form of the bearing surface. He further suggested the employment of "Magnolia" metal for the bearing, which, he stated, had been used with very good results on board steamships.

Mr. B. Tower, in replying to the discussion, said that the leakage past the oil ram was very small up to a pressure of 40lb. to 50lb. per square inch, and the arrangement in question could no doubt be successfully used up to a pressure of 100lb. The leakage was easily replaced by an occasional stroke of a hand pump. Mr. Ford Smith's bearing, which he had seen, was no doubt superior to that employed in the trials, but was essentially the same in principle. The intermediate values of the friction, between the highest load given in the tables at which lubrication was satisfactory, and the load at which seizing occurred, were not recorded, as it was necessary, in order to avoid trouble and delay, to be very careful that safe loads were not exceeded. To ensure this and avoid damage the bearing had to be very frequently examined shortly before the seizing point was reached, and accurate observations were thus interfered with. Professor Kennedy had referred to the effect of speed in reducing friction. This he—the speaker—attributed to more perpect lubrication. The rate of lubrication could not be regulated to make it uniform, as suggested by Professor Kennedy, as, with the apparatus used, there was what might be termed a natural rate of lubrication for each speed. Collar bearings were difficult to lubricate efficiently, and this accounted for the small loads they would safely bear. In marine practice the pressure on the collar bearings of screw shafts was generally low. As regarded lathes, he believed that seizing really took place, but that owing to the low speed very little heat was developed. The bearing must in that case actually wear; he could hardly think that with the great pressure exerted the oil could get in between the surfaces. The temperatures developed during the experiments were not recorded, because the subject had been previously thrashed out. Professor Kennedy had raised the question as to the wear of the bearing surface towards the outside, but his own idea was that no metallic wear took place, and that the footstep rested on a film of oil, while the pressure over the surface was uniform. With regard to the diagrams illustrating the results, the curves actually passed through the experimentally recorded points. The fact that the apparatus did not work so efficiently as a lubricator at low speeds would make it desirable in future to use a separate pump for lubrication. He thought that radial grooves were essential for good lubrication. As to the duration of experiments for the purpose of obtaining reliable results, the trials in question had involved working for five weeks, as great difficulty had been found in securing consistent observations; very frequently under apparently the same conditions the results varied widely. The use of a hard steel hemisphere working against a flat steel plate had been tried, but the results were unsatisfactory, and therefore not recorded. The bearing surfaces did not seize owing to a cessation of pumping, but in spite of it. Mr. Walker was quite right in his opinion as to the importance of good workmanship; bearings should have a perfect fit. As a matter of fact, no change of shape did occur in the bearing surface, as was proved by the fact that after the conclusion of the trials the marks of the scraping tools could still be seen here and there. Flat surfaces were adopted because they could be more accurately finished to template than any other forms.

Mr. Schönheyder at this point asked whether the friction of the pivot on which the bearing rested must not be deducted as a minus quantity from the observations.

Mr. Tower replied that this was so, but in the trials it was taken into account by moving the index both ways and taking the mean indication.

Mr. Wicksteed then stated it as his opinion that the use of many discs would not increase the load at which seizing occurred, but that all the discs would seize at once.

Mr. G. Cawley asked Mr. Tower whether, in a bearing with several discs—like that shown by Mr. Ford Smith—he considered all the discs to be in motion at one time, and the velocity of the shaft divided equally between them. For example, in a bearing having four discs, and the shaft running at 300 revolutions per minute, would the mean speed of each disc be 75 revolutions per minute or would only one disc be in action at a time? As the experiments showed that the coefficient of friction was much greater at slow than at high speeds, the supposition that all the discs revolved at once at a fractional speed of the shaft would go to show that the use of such discs increased the friction of the bearing, and that their chief value would be in connection with high speeds, where their action would virtually reduce the speed of the shaft in relation to the bearing surfaces.

Mr. Tower thought that the velocity was not divided up between the various discs, but that the advantage arising from their use was due to the fact that when one disc seized, another came into action, and thus each of the discs in succession had an opportunity of resting and cooling.

Mr. Tomlinson remarked that Mr. Ford Smith, owing to some error, had described his shaft as carrying some load which was ridiculously high. He agreed with Mr. Tower in believing that the discs would seize in succession. If there were no lubricant between the bearing surfaces no weight could be carried. In his long experience with locomotives he had found that not more than 2½ cwt. per square inch could be put upon the bearings without heating, and this value corresponded very well with that obtained in the trials. Mr. Walker, if he went into the matter, would probably find that the pressure on the bearings of the engine mentioned by him was over 300lb. per square inch. Mr. Tomlinson then cited the example of a winding engine in South Wales, the bearings of which had given much trouble, and said that on examination he found this was owing to the bearing surfaces being too small. Collar bearings he considered objectionable, and they nearly always gave trouble. An enormous power was transmitted through the shafts of marine engines, such as those of the "Umbria," and the collar bearing, which had to take the whole of the corresponding thrust, was comparatively so small that it was not surprising if it required close attention. It was no part of the duty of the Research Committee to recommend any particular form of bearing. The flat surface—as Mr. Tower had remarked—was taken simply on account of its being easy to fit accurately.

(To be continued.)

THE MEASUREMENT OF ELECTRIC POWER BY MEANS OF A VOLTMETER.

By J. Swinburne.

There are various well-known methods of measuring alternating powers. The electromagnetic wattmeter and the electrostatic wattmeter I had the honour of describing to the Physical Society are, as far as I know, the only direct reading power measuring instruments. There are various indirect, but accurate methods, such as double reading electrostatic instruments, Joubert's method, and calorimeter tests. There are a few other ways, such as the split dynamometer method, which can measure power only under particular conditions, and lead to erroneous results in such cases as that of a transformer, where the conditions never hold. Electrical powers can, however, also be measured by means of voltmeters.

If the quadrant electrometer connected up as a direct reading wattmeter be analysed, it will be found that the needle forms with each quadrant an idiostatic voltmeter. One quadrant is in connection with the needle, and thus exerts no force, so the instrument is really a combination of three voltmeters. One measures the difference of potential of the ends of the non-inductive resistance, one of the circuit under test, and one of the circuit and non-inductive resistance together. The Blondlot and Curie electrometer acts similarly, but needs two metallic connections, as it has a split needle. A similar result can be obtained by using three instruments.

Suppose the power taken by part of a circuit—for instance, a closed induction coil for testing iron, a transformer, or a condenser—is to be measured, it is put in series with a non-inductive resistance. In Fig. 1 *o a*

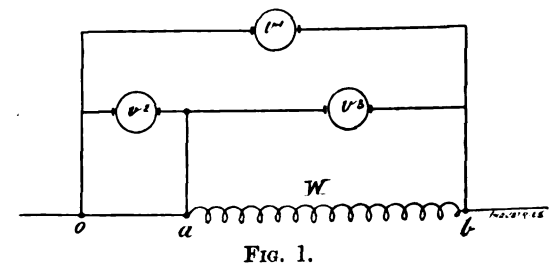


Fig. 1.

is the non-inductive resistance, and *a b* is the choking coil, or whatever is to be tested, which may be called *W*. A voltmeter v^1 is put in shunt to the whole arrangement, and voltmeters v^2 and v^3 are put in shunt to the non-inductive resistance and the work *W*. Let the voltmeters be graduated to read the square of the effective volts. Then, taking *o* as being at zero potential, the instantaneous potential at *a* and *b* may be called *a* and *b*. We then have three instruments. If *t* is half a period

v^1 reads $\frac{1}{t}\int^t b^2\,dt$

v^2 " $\frac{1}{t}\int^t a^2\,dt$

v^3 " $\frac{1}{t}\int^t (b-a)^2\,dt = \frac{1}{t}\int^t b^2\,dt - \frac{2}{t}\int^t ab\,dt + \frac{1}{t}\int^t a^2\,dt.$

Subtract the sum of v^2 and v^3 from v^1 and there remains $\frac{2}{t}\int^t a\,(b-a)\,dt.$

If the non-inductive resistance is *r* the instantaneous electromotive force $a = cr$, *c* being the instantaneous current; so

$$\frac{2}{t}\int^t a\,(b-a)\,dt = \frac{2r}{t}\int^t c\,(b-a)\,dt = 2rp,$$

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where p is the power supplied to W. Thus, if the resistance is half an ohm, to find the power with three voltmeters, square the reading of each, subtract those of v^2 and v^3 from v^1, and the result is the power in watts. This is independent of any curve of sine hypothesis, and is true whether W is inductive or not.

Interesting as this result is theoretically, it is still more important to find of what practical value it may be. In the first place it has been assumed that the voltmeters themselves take no current. This is practically true of electrostatic voltmeters. One voltmeter may be used with switches to vary the connections. This still means three readings, and as a Blondlot and Curie or my arrangement will read power direct, there is no advance in going back to a three-reading method. It allows those, however, who already possess idiostatic voltmeters to use them for measuring power.

The only other available voltmeter is the Cardew. Three voltmeters are now needed for each, for the instrument takes something like 20 or 30 watts at high readings, and putting it in shunt to different parts of the circuit would introduce large errors in such work as transformer testing. If three voltmeters are used simultaneously, the value of r must be found, taking into account the condition that v^2 is in shunt to it. From the power found, that spent in v^3 must be deducted.

This necessitates a knowledge of the variation of resistance of the voltmeter throughout its scale. The cost of three voltmeters, the trouble of calibrating them thoroughly throughout the scale, both for electromotive force and resistance, renders the method rather unpractical, more especially as the resistance does not depend on the reading of the voltmeter, but on the temperature of the whole instrument, which depends on what it has been doing. For testing very large transformers, however, which have losses enormously greater than that of the voltmeter, or, at least, so great that the errors are inappreciable, the method will, I hope, be valuable. The substitution of equivalent resistances also leads to temperature errors.

There is still another method of measuring power, which I understand has been invented by Dr. Sumpner and Professor Ayrton, who have communicated it to the Royal Society. If it should turn out to be the same as this, however, they should have credit for priority, especially as regards the use of the ordinary voltmeter for measuring power.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

I.

By the term "soap" is usually meant a compound of a fatty acid with an alkali, although, strictly speaking, it is equally applicable to all salts which are formed by the combination of a fatty acid with a metallic base. Thus, we have metallic soaps in which lead, copper, calcium, or iron act as the base. A lead soap (lead oleate, $Pb(C_{18}H_{33}O_2)_2$) is, under the name of "Emplastum Plumbi," used in pharmacy, but only the soaps of the alkali metals are soluble in water, and consequently applicable for washing or cleansing purposes.

The formation of soap can be most simply shown in the combination of a fatty acid, such as stearic acid, with caustic soda or potash, by the following equation :—

$$\underset{\text{Stearic acid}}{C_{18}H_{36}O_2} + \underset{\text{Caustic soda}}{NaHo} = \underset{\text{Sodium stearate (soap)}}{NaC_{18}H_{35}O_2} + \underset{\text{Water.}}{H_2O}$$

The reaction which generally occurs in the manufacture of soap is, however, somewhat more complicated than the above, inasmuch as the fatty acids do not occur as such (except to a small extent) in the neutral oils and fats commonly used by the soapmaker, but are combined with and replace a part of glycerine, in the form of glycerides. For instance, tallow is composed largely of the glyceride tristearin, or glycerine tristearate, which may be regarded as glycerine in which three hydrogen atoms are replaced by three molecules of the radicle $C_{18}H_{35}O$ of stearic acid :—

$$\underset{\text{Glycerine.}}{\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3} \qquad \underset{\text{Glycerine tristearate.}}{\left.\begin{matrix}C_3H_5\\3(C_{18}H_{35}O)\end{matrix}\right\}O_3}$$

Thus, in the saponification of a neutral oil or fat consisting of tristearin, the reaction with caustic soda would be as follows :—

$$\underset{\text{Tristearin}}{\left.\begin{matrix}C_3H_5\\3(C_{18}H_{35}O)\end{matrix}\right\}O_3} + \underset{\text{Caustic soda}}{3NaHO} = \underset{\text{Sodium stearate (soap)}}{3(NaC_{18}H_{35}O_2)} + \underset{\text{Glycerine.}}{\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}O_3}$$

A few years ago the whole of the glycerine, so produced by the saponification of neutral oils and fats, was thrown away as being useless, but this valuable substance is now almost invariably recovered from the waste liquids of the soapworks, and sold for the manufacture of nitroglycerine and for numerous other purposes.

The alkalies used as bases for the manufacture of ordinary soaps are soda and potash, either separately or in conjunction with each other. Soaps made exclusively from soda are usually hard, solid, and opaque, and contain less water than those made from potash, which are generally soft, transparent, and deliquescent. The hardness of soda soaps is also greater or less, as the original oil or fat consisted more largely of the glycerides of stearic or of oleic acid. Both soda and potash soaps are readily soluble in water and alcohol, but are insoluble in ether and petroleum spirit. Moderately concentrated hot solutions, on cooling, solidify to a jelly, which is opaque when water is the solvent, more or less transparent when alcohol is used, and forms in the latter case the jelly called "opodeldoc." When largely diluted with water, the neutral soap is decomposed to some extent, forming an acid soap and liberating free alkali, which, by combining with and removing oily or greasy matters, plays an important part in the operation of washing. The acid soap, being practically insoluble in cold water, is thrown down as a curdy precipitate.

The extent to which soaps are decomposed, and the amount of alkali thereby set free by a given quantity of water, has been investigated by Wright and Thompson, from whose results it appears that the amount of alkali liberated from soaps made from cocoanut, cottonseed, palm, and some other oils, is considerably greater than that liberated from tallow soap. The presence of free alkali in the sample, however, has the effect of preventing the hydrolysis in a marked degree, and so lessons the quantity of alkali liberated by the given amount of water.

Both soda and potash soaps are precipitated from their solutions by strong solutions of alkali, and the former are insoluble in a concentrated solution of sodium chloride or common salt, the addition of this substance throwing the soap out of solution in water, an important property which is made use of in the fabrication of hard soda soaps, to separate them from the glycerine, excess of water, &c. Potash soaps cannot, however, be separated from solution by the corresponding potassium salt, whilst, on the other hand, sodium chloride reacts chemically therewith, forming a soda soap and potassium chloride. Soaps made from cocoanut or palmnut oil require more salt to precipitate them from solution than do those made from other oils or fats, as the sodium salt of lauric acid, which forms the principal constituent of these oils, is somewhat soluble in brine, and hence cocoanut and palmnut oil soaps are largely used at sea, under the name of "marine soap."

Materials.—The materials used in the manufacture of soap, of one kind or another, are extremely various, there being hardly any form of animal or vegetable oil or grease which has not been, or cannot be, so employed. A detailed description of even a few of these is beyond the scope of these articles, but among the more important may be mentioned tallow, lard, palm oil—of which large quantities are now used—palm-kernel, cocoanut, cottonseed, linseed, and castor oils; besides rosin, bone fat, kitchen grease, and free fatty acids, such as oleic acid, obtained from candle works, or recovered from various kinds of waste liquors. Tallow is largely employed in conjunction with rosin for the manufacture of hard yellow soap, although it is now, to some extent, superseded by palm oil. This oil, which is obtained from the outer fleshy coating of the fruit of several species of palm, consists principally of tripalmitin and triolein, and when brought to this country has a colour ranging from dark yellow to deep red. It also varies enormously in quality, the oil from some localities containing not more than 1 or 2 per cent. of impurities, whilst other samples sometimes contain as much as 30 per cent. or more of dirt and water. Samples of palm oil should therefore always be submitted to analysis before purchasing. A certain amount of crude oil—called "red oil"—is used along with bone fat and other forms of dark grease, for the manufacture of brown soap; but the bulk of it is bleached, and employed as a substitute for tallow, in making ordinary pale and mottled soaps. A method of bleaching commonly employed is to treat the oil (previously melted and decanted from dirt) with a mixture of potassium bichromate and hydrochloric acid in wooden vessels. The oil is at the same time agitated and rapidly becomes black, changing to green, while a froth forms on the surface, showing the end of the reaction. Palm oil, bleached in this way, is white, with a greenish tinge, due to traces of chromic oxide, and has the consistency of fairly hard tallow. Palm-nut or palm-kernel oil, derived from the kernel of palm nuts, is, at ordinary temperatures, a white solid oil, very similar in appearance and character to cocoanut oil, and, like the latter, consisting largely of the glycerides of lower fatty acids. Linseed and hempseed oils are employed only in the making of soft soap, along with cottonseed and other oils. Large quantities of cottonseed oil are also used in the manufacture of hard soda soaps, while castor oil is generally converted into transparent soap.

The character of the water employed in a soapery is a matter of some importance; soft water, free from suspended impurities, being almost a necessity. If hard water be used, the salts of calcium and magnesium present therein, and constituting the hardness, combine with the fatty acids, forming insoluble calcium and magnesium soaps. Where only very hard water can be obtained, and the hardness is due to the carbonates of calcium and magnesium, it is better to soften it by the Clarke or Porter-Clarke method of agitating with slacked lime, and allowing the precipitated chalk to subside, but of course care must be taken that the lime is not added in excess.

(*To be continued.*)

NOTES ON OILS.

I.

In 1890 those interested in the oil trade had cause to be satisfied with the development of many branches of their business, and the present year has good prospects in both the mineral and seed oil branches. The Scottish Mineral Oil Association has apparently justified the purpose for which it was established, in regulating prices for paraffin oil and wax, and in enabling the Scotch manufacturers to successfully compete against the importation of American and Russian petroleum. Meanwhile we find new sources of "rock oil" being discovered. The Salt Union are engaged in boring for petroleum in Cheshire with good hopes of success. From India comes a confirmation of the discovery of mineral oil in the Shirani country by the Zhob expedition, although the amount is stated to be small. From South Africa, too, we hear of the discovery of bituminous shale in the Silurian formations in the Transvaal, and a report by the Government Analyst of Natal excites hopes of borings being profitable in these deposits.

Amongst recent scientific work connected with mineral oils and petroleum we find a report by Kast and Künkler on the Egyptian petroleum discovered some years ago at Gemsah, on the Red Sea. The general conclusions of the authors point to the crude oil being unsuitable as a source of illuminating oil, but valuable for the manufacture of lubricants. Professor Orton has contributed to the literature relating to the origin and formation of petroleum in a pamphlet on "Limestone as a Source of Petroleum and Inflammable Gas," in which he draws very different conclusions as to its origin to Mr. Peckham and other authorities on this subject. An article by A. Vieth appears in the *Chem. Zeit.* (14, 1368) on the formation of petroleum, in which he supports the results arrived at by Engler as to petroleum being of animal origin, but differs as to the manner in which the fatty acids from the animal matter are decomposed. He considers that of the products of the dissociated fat—viz., glycerine and fatty acids—the former is converted by heat and pressure to acrolein, which by elimination of water and by condensation becomes benzene, whilst the latter under the same circumstances are converted into hydrocarbons and carbon dioxide. This carbon dioxide is reacted upon by the dissociated (liquid or solid) hydrocarbons, with the ultimate formation of gaseous hydrocarbons. Vieth thus comes to the conclusion that when gaseous hydrocarbons are found in petroleum they are formed in the above manner from carbon dioxide, whilst their absence points to the carbonic acid having been utilised for the formation of carbonates.

The Board of Trade returns show an increased importation of American and Russian petroleum for the past year, although its average value has ruled lower—

	1889.		1890.
Gallons	102,647,478	...	104,809,146
Value.....	£2,593,173	...	£2,389,269

In the fixed and seed oil trade the most remarkable feature which presents itself is the enormous increase in the output of American cottonseed oil. In 1888 the value of this trade was comparatively very small. Now, as compared with 1889, it represents an increase of over 400 per cent. :—

	1889.		1890.
Value exported ...	£189,252	...	£794,205

The major portion of the oil comes to England, France, and Germany.

A new use is expected for boiled linseed oil, which may have an important application. The tendency of paints upon ironwork to scale is generally known. It is proposed to coat the iron previous to painting with boiled oil, which removes any irregularities, and presents an even surface to paint on when dry. The results are said to be very satisfactory.

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E. Gérard has recently announced the discovery of a new fatty acid in the oil from ordinary thorn-apple—*Datura oliamonium*. By saponification with litharge, linoleates and oleates are obtained soluble in ether; the residue contains lead palmitate and the lead soap of the new acid. These are separated by fractional precipitation with barium acetate. The new acid melts at 55° C., and the author proposes to call it "daturic acid," assigning to it the formula $C_{17}H_{34}O_2$. This would place it between stearic and palmitic acids, though it has a melting point considerably lower than either. Fatty acids said to be of this composition have been previously described, but they differ in melting points. One described by Becker in 1857 melted at 52° C. Heintz soon after isolated one melting at 60°, whilst Krafft in 1879 also described a similar fatty acid whose melting point was 60°. A recent paper by Dr. Unger, in the *Pharm. Zeit.*, contains the results of some experiments on the alteration of cod-liver oil with age, from which it appears that the free acidity of the oil is slowly increased by keeping. He reports very favourably on the oils yielded by the 1890 fishery, and contrasts them with the 1889 supply, which was of inferior quality.

MODERN CHEMISTRY IN ITS RELATION TO SANITATION.

Dr. Tidy, in his third and concluding lecture, first discussed the means of disinfection best adapted to the sick room. It is important in this connection to bear in mind that the air of a room can only be efficiently disinfected by a gaseous or volatile disinfectant, and that therefore Condy's fluid — being a non-volatile compound—is useless for this purpose. If the patient has been removed, all draperies and wall paper should be burnt, and of the gaseous disinfectants sulphurous acid is, perhaps, the most economical and reliable to employ. Notwithstanding Koch's latest experiments, which show that the anthrax bacillus is not killed by the action of this gas even after twenty-four hours' exposure to its influence, the ancient reputation of sulphurous acid as a disinfectant seems to be well merited. From Homer's time it has been used for fumigation and disinfecting purposes with very beneficial effects, and its well-known effects upon plant life and for destroying germents cannot be ignored. The halogens also rank as valuable gaseous disinfectants, but here, again, it is noteworthy that the conditions of success must be carefully considered. Chlorine acts as a disinfectant in the same way as it bleaches—*i.e.*, moisture must necessarily be present. An atmosphere containing 50 per cent. of dry chlorine has no action upon the anthrax bacillus, whilst 4 per cent. in a moist air kills in half an hour. The activity of chlorine thus depends more on the extent of moisture saturation than on the quantity of chlorine present. Bromine is likewise a good disinfectant, but has the disadvantages of being expensive and exceedingly difficult to manage. When sulphurous acid is employed a convenient rule to observe is to use 1½oz. of sulphur per 100 cubic feet of air space to be disinfected, and with chlorine, being a heavy gas, it is important to liberate it not far below the ceiling, so as to ensure its rapid admixture with the air of the room.

For the floors and articles that can be washed lime and alkaline soaps are to be recommended, as recent work has clearly established that alkalinity is a true germicide. All the alkalies, lime, and baryta have a disinfecting action equivalent to their alkalinity value. Carbolic acid is of much repute, but it usually acts by arresting the growth of bacteria, and by preventing spores from becoming active. One part per 1,000 is sufficient for this purpose, but a 1 per cent. solution is required to destroy the organisms, and a 5 per cent. solution may not kill the spores, even after twenty-four hours' exposure. The solid and pure acid when dissolved in alcohol yields a stronger solution than can be obtained by the use of water, but it does not appear to have any greater value as a disinfectant. In fact, a dilute solution in water is the best form of this reagent to employ. Carbolic acid, according to Dr. Tidy, has been overvalued as a disinfectant.

When a sick person cannot be removed from the room, volatile oils, scents, and camphor may be employed, as most of these bodies, by slow oxidation, under the influence of light, cause the production of ozone, which, as has already been seen, is one of nature's most powerful disinfecting agents. An alcoholic solution of thymol was found to have no action upon anthrax bacillus, but when diluted with thirty times its bulk of water it was exceedingly active. In the form of spray this dilute thymol solution forms a convenient disinfectant for the air of a sick room, and if plenty of ventilation also accompany its use leaves little to be desired. Sawdust, impregnated with carbolic acid, may also be used, if the sawdust be re-saturated with the acid every day. Garments and linen may be washed in a dilute solution of Condy's fluid, but everything that can be burnt should be destroyed.

Dry hot air has been recommended for the disinfection of bedding, but a short exposure to its action is useless, and a longer time is destructive to the material. Steam is a far better agent to employ in the disinfecting chamber, Koch having demonstrated that steam under pressure destroys the most resistant of spores in less than one hour. Even steam under atmospheric pressure can be relied upon if the duration of the exposure to its action be allowed for three hours.

In conclusion, Dr. Tidy pointed out that the real difficulties in this subject were due to the fact that we know so little, and that the gaps in our knowledge are at present so wide, that mankind must be content to wait before the complete solution of these problems can be arrived at.

Notes.

EXHIBITION AT SAN PAULO.

An International Exhibition is to be held at San Paulo, Brazil, in January, 1892. Full particulars can be obtained by intending exhibitors by applying to the Secretary of the French Chamber of Commerce at Rio de Janeiro, Brazil.

INTERNATIONAL ELECTRICAL EXHIBITION AT TOULOUSE.

An International Electrical Exhibition will be held at Toulouse during the present year. The Exhibition will be open for a period of four months, from the 15th May to September 15th next, and will comprise the following sections:—Electricity and Electric Lighting; Electricity as applied to Engineering; Industrial and Commercial Chemistry; Hygiene. Full particulars may be obtained by applying to the secretary of the Exhibition at Toulouse.

JAPANESE COAL FOR STEAMSHIPS.

From reports which have reached us recently, it would appear that some kinds of Japanese coal are well suited for steamship requirements. That obtained from the Miike mines, owned by Messrs. Mitsui & Co., is now largely used in steamers calling at the Chinese and Japanese ports. One large shipping firm report very favourably of this coal. In referring to it they state: "Our ships used it on several occasions when in China and Japan, and the captains and engineers reported most favourably as to its steaming power and the quantity burnt per diem. In fact, they considered it almost equal to the best Welsh coal."

ALKALI MANUFACTURE IN RUSSIA.

The Russian Chemical Society has recently received a sample of the first output of Russian bleaching powder from P. K. Ushkoff, of Elabouga, in the province of Viatka, who has started manufacturing bleaching powder on a large scale from native products. This is considered a very important step in the growth of Russian chemical industry, as the whole of the bleaching powder hitherto required for home industries had been imported from abroad (about 10,000 tons per annum). The same manufacturer has nearly completed his arrangements for manufacturing soda ash and caustic soda by the Leblanc process.

AGRICULTURAL EDUCATION IN WURTEMBURG.

The agricultural education of the people is by no means neglected in Wurtemburg, being cared for by numerous schools and societies, and appears to be fully appreciated by the peasants and others. Almost every institution of this sort had greater demands made upon it in 1889 than in the previous year. To enumerate briefly some of the most important:—The Agricultural and Gardening School had its normal number of students. The School of Vineyards, in consequence of increasing demands for tuition in this branch, was again forced to exceed its statutory number of pupils. The Agricultural Winter School was attended by 103 scholars, being an increase of six on the previous year. A sixth school was added to the five already in existence for teaching country girls and young women farmhouse and dairy work. The travelling teachers of husbandry, as well as those specially devoted to orchards and vineyards, were in great request amongst local societies and by the communal authorities. Sixty-four students attended the lectures upon orchard cultivation. Ninety-two farriers were taught at the various veterinary colleges and schools throughout the country. The winter evening agricultural schools, reading clubs, and local libraries all showed a considerable increase both in numbers and in attendance. Altogether some 23,400 persons attended agricultural schools or lectures on husbandry during the year. This is rather more than 1 per cent. of the total population of the country, and is good evidence that the people as a rule do not neglect the opportunities given them of becoming successful agriculturists.

PROGRESS OF THE BENARES WATERWORKS.

In the report of Mr. Wilson, the resident engineer, for December, it is stated that the earthwork of the embankment and excavation of the settling tanks have been nearly completed. The water in Nuneriah-pokhra having been exhausted, the steam pump has been removed to Sankhudharra tank. The laying of the pipes of the rising main from the Ganges has now been commenced, and when these have been laid an ample supply of water for the works at the distributing station will be obtained. The concreting and brickwork of the tanks is now in hand, and arrangements have been made for stone ballast for the concreting, as being superior to brick ballast. In filter No. 1 about 20 per cent. of excavation has been done; in filter No. 2, concreting under main walls and central drain is completed; in Nos. 3 and 4, about 90 per cent. of excavation is finished; in No. 5, concreting under main walls and drain is completed, and about 2ft. of brickwork in main walls and the central drain built; in No. 6, concreting under main walls and drains completed, and brickworks on three sides of main walls in progress; No. 7, concreting under main walls is completed, and about 3ft. of brick ventilators is being fixed. In the reservoir some 600,000 cubic feet have, according to the *Indian Engineer*, been excavated to an average depth of 10ft. Pipes of different diameters are arriving in large quantities daily, and have been delivered at the distributing station and along the rising main. The land for this latter between Bhadaini and the distributing station has been made over by the civil authorities, and the laying of the 24in. pipes has been taken in hand at the unfiltered water pumping station at Bhadaini. The work of clearing the site has made good progress, and the contractors have promised to shortly deliver a wrought-iron well kerb of 26ft. 8in. diameter on the suction well.

THE NEW WET DOCK AT BOMBAY.

The new dock will occupy the old Customs Basin at the northern extremity of the Government Dockyard, and in order to enable the work to be commenced the contractors, Messrs. Bulkley & Co., recently began to raise a dam between the dockyard quay and the Customs Bunder to close the communication between the basin and the harbour proper. To secure a complete enclosure of the site selected for the new dock it was, of course, necessary to raise the huge earthern dam in question; and for the purpose of its construction no fewer than between 30,000 and 40,000 cubic yards of ballast and stones had to be provided. The Island of Elephanta, states the *Indian Engineer*, was chosen as being best able to supply the requisite material, and during the past two months a fleet of something like fifty country boats of various descriptions have been kept constantly plying day by day between the dockyard and Elephanta to convey it, while not less than about 1,500 men have been engaged in loading and discharging it. No. 1 dam is completed. This dam completely shuts out the sea both from the old Custom House Basin and the Duncan Graving Dock, and as soon as the few feet of water at present lying in the basin have been pumped out, the floor of the new dock, which will monopolise some five acres of ground, will be excavated to a depth sufficient to easily accommodate the largest of the Royal Navy vessels that frequent Bombay and the ships of the Indian marine. Advantage is also to be taken to lengthen and deepen the Duncan Dock to enable it to take in the Indian troopers and ships of the Royal Navy, both docks being exclusively for the use of Government and the Indian marine. The scheme of improvement, however, does not end here, for a second dam is shortly to be raised, which is to exclude the water from the works for an improved wet basin for the joint use of the Arsenal and the Port Trust. This will be constructed in close proximity to the Customs Bunder. The cost of the new wet dock and the improvement of the Duncan dock is estimated at about thirteen lakhs of rupees, and the time allowed Messrs. Bulkley & Co. for the completion of the entire work is two years from the 16th of December last, but the contractors are hopeful of getting it finished at a considerably earlier date.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

9th March, 1891.

4159. Bayly, J. P. ..... Draught appliance for locomotive engines (*Lindsley*).
4164. Lea, J. ..... Typewriting machines.
4165. Lindemann, O. ..... Water jet condensers.
4172. Eastwood, S. ..... Carding machines.
4173. McIntyre, R. ..... Apparatus for welding furnace shells for steam boilers.
4174. Scott & Scott..... Steam boiler furnaces.
4193. Schutte, G., Jun..... Steering gear for torpedo steamers.
4208. Hooper-Rastrick, R. J. Evaporating apparatus.
4209. Nilsen, A. B. E. ..... Machinery for making casks.
4210. Redfern, G. F. ..... Flexible couplings for toothed wheel gearing (*Wolseley*).

10th March, 1891.

4216. Bush & Powers ..... Steam boilers.
4218. Richards & Cooley ..... Automatic grain-weighing and bagging machines.
4219. Melling, J. W. ..... Regulating and reversing gear for steam engines.
4220. Brown, A. E. ..... Friction clutches.
4222. Lanchester, F. W. ..... Gas engines.
4224. Spencer, G..... Friction clutches.
4229. Hirsch, R. ..... Apparatus for separating gases
4230. Lanchester, F. W. ..... Gas engine starting mechanism.
4231. Arundale & Cooper ... Pickers of looms.
4238. Luce, C. J. ..... Car brake and starter apparatus.
4250. Jensen, C. A..... Car couplers (*Gould*).
4268. Gray & Richter ..... Metal planing machines.
4283. Charnley, R. ..... Looms.
4289. Förste & Tromm ..... Ruling machines.
4301. Thompson, W. P. ..... Wire cutters (*Arnold*).
4302. Boult, A. J. ..... Hydraulic lifts (*Pifre*).
4303. Jarvis, G. A. ..... Blast machines.
4308. Caird & Rayner ..... Surface condensers.
4312. Craig, T. (of the Firm of Isaac Holden & Sons) Apparatus for preparing and combing wool.
4315. Thompson, W. H..... Crushing machinery.

11th March, 1891.

4319. Bell & Sauter ..... Apparatus for working ships' boats.
4322. Sharpe, W. H. ..... Railway chair.
4326. Lake & Crawshaw ..... Pneumatic hammers.
4327. Garstang, J. ..... Warp dressing machines.
4331. Barker, R. W. ..... Rolls for manufacturing car axles (*Evans*).
4340. The Gaseous and Liquid Fuel Supply Company, Ld. ..... Steam boiler furnaces.
4343. Ford, J. ..... Self-binding reaping machines.
4344. Cameron, M. H..... Machines for cropping and shearing various sections of iron bars, &c.
4345. Barker, G. ..... Carbonising and drying machine (*Cole & Pedder*).
4349. Mountain, R..... Brick-making machines.
4355. Campbell, H. ..... Gas engines.
4357. Robertson, E. J. ..... Railway chair and fish plate combined.
4359. Brown, D. ..... Apparatus for making wood screws.
4360. Munns, W. H. ..... Driving mechanism for elevators (*Reedy*).
4363. Munns, W. H..... Apparatus for washing barrels (*Bidwell*).
4370. Krüger, R. O. ..... Printing machines.
4386. Inwood, C. ..... Rotary fans.
4395. Siemens Brothers & Co., Ld. ..... Shaft couplings (*Siemens & Halske*).
4400. Lake, H. H. ..... Brush-making machines (*Flematti*).
4402. Hopkinson & Hopkinson Valves for steam boilers.
4403. Boult, A. J. ..... Air pumps (*Reinmann, Dittmar, & Falkenhausen*).
4411. Horn, W. W. ..... Valves (*Kelly & Jenckes*).

12th March, 1891.

4438. Wilson, A. ..... Marine engine governor.
4450. Atkinson, J. ..... Pumps for vapours.
4461. Kosinski & Kisielnicki Steam boilers.
4473. Hopkinson & Hopkinson Safety valves.
4481. Redfern, G. F. ..... Car couplings (*Luard & Lindsley*).
4488. Gessner, E..... Condensers for carding engines. (4th September, 1890.)
4489. Basset, W. B..... Ordnance.

13th March, 1891.

4495. Livesey, Sen., & Livesey, Jun. ..... Looms.
4496. Renold, H. ..... Chain gearing.
4498. Hoyle & Dobson ..... Ring spinning or doubling frames.
4500. Jones, F. J..... Gas purifiers.
4505. Rigby, W. F. ..... Tools for making steel wire file-cleaning brushes.
4512. Stant, J. ..... Water motors.
4522. Huelser, C. ..... Brick presses (*Mühlenbauanstalt, Machinenfabrik and Eisengiesserei, vorm., Gébr. Seck*).
4524. Bayer, R..... Rotary slide valve for steam and other engines.
4535. Griffin, S. ..... Gas engine governor.
4542. Longridge, Cawley, & Austin..... Fluid pressure engines.
4549. May, W. E. ..... Apparatus for casting and working metals.

14th March, 1891.

4559. Parker, J. H..... Apparatus for dyeing fabrics.
4560. Parker, J. H..... Apparatus for dyeing woven fabrics.
4561. Reader, W..... Rotary colour printing machine.
4563. Wells, C. ..... Steam engines.
4580. Royston, E. R. ..... Valve seats for double poppet-valves (*Barclay*).
4581. Stewart, G. ..... Water gauge cocks.
4585. Thornton, T. ..... Railway chairs and keys.
4591. Lyall, J. ..... Steam boilers.
4618. Cauderay, J. ..... Air and vapour meter.

ELECTRICITY.

12th March, 1891.

1051A. De Ferranti, S. Z. ... Testing electrical transformers and dynamos. (20th January, 1891.)

9th March, 1891.

4170. Willatt, W. H..... Electrical distribution.

10th March, 1891.

4214. Bennett & Hides ..... Telephones.
4215. Macdonald & Dodd..... Automatic electrical block signalling on railways.
4235. Fletcher, G. E..... Telegraphic transmitter.
4256. Nash, F. J. ..... Insulation of electric conductors.
4259. Lake, H. H..... Electric motors (*The Giant Electric Motor Company*).
4263. Wright & Wilson ..... Preventing induction in telephones.
4269. Nash, F. J. ..... Insulated electric wires.
4271. Newton, P. A. ..... Railway signalling (*The American Electric Railway Signal Company*).
4306. Boggett, W. ..... Dynamos.

11th March, 1891.

4367. Munns, W. H..... Signal and search light lantern (*Martin & Knight*).
4410. Horn, W. W. ..... Telephone enunciator (*Lawrence & Oakwood*).

12th March, 1891.

4479. Morgan-Grenville, L. F. H. C. ..... Insulating underground conductors.
4482. Prickett, C. J. ..... Telephonic switch boards.

13th March, 1891.

4554. Redfern, G. F. ..... Armatures for electrical machinery (*W. Lahmeyer & Co.*).

14th March, 1891.

4583. Perry, J. ..... Electric supply meters.

CHEMISTRY.

9th March, 1891.

4184. Wilson, F. ..... Method of treating picric acid as an explosive.

10th March, 1891.

4243. Chancellor, C. W. ..... Method of and apparatus for treating sewage.

11th March, 1891.

4396. Strap, J. ..... Separation of copper, nickel, and silver from matts.

12th March, 1891.

4487. Ancizar, R. ..... Manufacture of sulphate of quinine (*Zerda-Bayon*).

13th March, 1891.

4547. Anderson & Brand ..... Manufacture of carbonates of sodium and potassium and of chlorine.

MISCELLANEOUS.

9th March, 1891.

4152. Russell, H..... Valves for taps and pipes.
4156. Rhodes, G. G..... Method of constructing web cranks for steam engines.
4186. Hickton, R. J. ..... Means for preventing driving belts from slipping.

10th March, 1891.

4236. Bate, C. McG. ..... Spanners.
4244. Clarke, F. J. ..... Preventing incrustation in steam boilers.

11th March, 1891.

4350. Randle, C. O..... Boat lowering apparatus.
4384. Von Ehrenwerth, J. ... Manufacture of iron and steel.
4388. Napier, J. M..... Speed indicators.

12th March, 1891.

4418. Taylor, J. W. ..... Milling and grinding of radius and other circular cutters.

14th March, 1891.

4613. Silverman, L. ..... Manufacture of tubes for boilers.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

694. Clegg.
3743. Scorer.
3894. Home.
3923. Mostyn.
4094. Walsh.
4153. Simonet.
4236. Smith (*Bray*).
4320. Jones.
4360. Robertson.
4475. Lay & Owen.
4516. Aston, Aston, & Aston.
4583. John Reimann (Administrator of the late Benno Reimann).
4924. Dewrance & Wall.
5117. Wilson & Welsh.
5380. St. George.
5434. Williams.
5441. Parkinson & Smith.
5479. Lanchester.
5545. Turner, Baird, & Baird.
5657. Booth.
5797. Mohrdieck & Siegelberg.
5930. Perry.
5999. Cole.
6202. Stepanow.
6234. Gare.
6563. Ash.
6623. Warden & Smith.
6698. Davis & Davis.
6719. Huelser (*Quast*).
6771. Morier.
6773. Morier.
6848. Thomason, & Thomason.
6960. Neill.
6990. Butler.
7108. Bayly (*Conway*).
7129. Danton.
7141. Marshall & Wigram.
7171. Schmidt.
7172. Carruthers.
7196. Greffen.
7236. Miller & Hawkins.
7245. Haddan & Slade.
7275. O'Donnell, Smith, & Timmis.
7345. Swithenbank.
7365. Bonne (*Zeigler*).
7382. Vacherat.
7421. Holliday.
7428. Göbel.
7469. Tovey.
7477. Mathers.
7507. Thompson (*Defraigne*).
7520. Johnson & Phillips.
7524. Druckenbrodt.
7545. Bayly (*Perkins*).
7547. Rigby.
7583. Jones.
7624. Kingdon.
7635. Willoughby & Horsfield.
7643. Bury & Booth.
7653. Kendrick.
7687. Crabtree & Gough.
7740. Stevenson.
7792. Olson.
7879. Lycoudis.
7929. Galloway & Beckwith.
8131. Hall & Lane.
8255. Mills (*Gathmann*).
8517. Dilitz & Kretschmann.
9305. Thode.
9546. Edgar.
9705. Bath.
9934. Stock.
11451. Wilks.
11615. Moore.
11864. Pitcher, Dewhurst, Pennock, & Allen.
1015. Ellershausen.
3872. Peyman.
3900. Pyke & Barnett.
3992. Horsley & Wilson.
4097. Cox.
4178. Balagny.
4309. Foster.
4346. Clipsham.
4388. Lewis Alfred Haslewood & James Borland.
4702. Mayoh.
4722. Edwards.
4815. Smith & Heath.
5038. Trott.
5249. Seddon.
5409. Cappilleri Kurmayer Goldberg & Latzko.
5477. Lake (*Kaiser*).
5511. Morton.
5562. Emmott & Rider.
5607. Wright.
5688. Thorn.
5868. Blair.
5880. Birt.
5932. Rief & Weber.
6082. Waller & Manville.
6223. Ancizar (*Zerda-Bayon*).
6522. Penney.
6589. Walker.
6672. Lake (*Garnier & Weil*).
6704. West.
6741. Barker & Barker.
6772. Morier.
6821. Vivian.
6859. Care.
6924. Eagar & Milburn.
6968. Ebden.
7072. Myers.
7116. Astbury.
7133. Marsh.
7154. Wilkinson & Wilkinson.
7178. Reade.
7228. Knowles & Philipson.
7241. Mossop.
7262. Tarbet & MacDonald.
7299. Fletcher & Craven.
7301. Lundholm & Hosie.
7349. Alley.
7374. Nobbs.
7397. Pain.
7422. Bryan.
7457. Stewart.
7472. Sugden & Hardaker.
7485. Plant & Brown.
7508. Thompson (*Bornet*).
7521. Siemens.
7539. Hornsby, Innocent, & Smith.
7557. Stonebam.
7598. Richardson.
7628. Groombridge & South.
7636. Resuche & Vailly.
7640. Baynes, Topping, & Whittaker.
7686. Oldfield.
7725. Challis & Graham.
7744. Dubaut.
7797. Hood.
7909. Smith.
7948. Griffiths.
8215. Hall.
8342. Bentall.
8709. Mason.
9151. Reynolds.
9342. Wilkinson.
9690. Laing.
9760. Howard.
11395. Boult (*Saltzkorn & Nicolai*).
11646. Pain.
11944. Bruno & Barbosio.
12638. Frank.

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12648. Hollingworth.
12868. Heys (*McDonald*).
12897. Hart.
13723. Molesworth.
14524. Huelser (*Otto*).
15025. Morgenstern.
15841. Peck. (3rd March, 1890.)
15843. Peck. (3rd March, 1890.)
15849. Peck. (3rd March, 1890.)
15850. Wells.
16004. Vosper & Rafarel.
16098. Benoit.
16762. Thompson (*Mason & Wilson*).
17573. Dunnachie.
17738. Boult (*Saltzkorn & Nicolai*).
18300. Huelser (*Möller*).
18979. Thomson.
19160. Dejouge.
19272A. Carpenter. (21st June, 1890.)
19787. Fulmer. (6th May, 1890.)
20585. Fales.
20960. Thompson (*The Rochester Lasting Machine Company*).
21243. Lake (*Burpee*).
21281. Thompson (*Worden*).
12758. McLeod & Claringbould.
13611. Eickershoff.
14493. Kenyon & Durant.
14844. Appleton & Joseph.
15228. Brown.
15842. Peck. (3rd March, 1890.)
15848. Peck. (3rd March, 1890.)
15867. Gannaway, Maitland, & Hands.
16080. Inshaw.
16157. Newsone & Wright.
17208. Laxton.
17588. Robinson & Rhodes.
17730. Morris.
17868. Edwards (*Hilb*).
18119. Brodbeck.
18753. Whalley.
19082. Düer.
19164. Johnson.
19786. Lockwood. (31st May. 1890.)
20002. Dauber.
20537. Boult (*Dock*).
20984. Lake (*Corsa*).
21088. Bellis.
21129. Hans Christian Wilhelm Harmsen.
21298. Huntoon. (19th July, 1890.)

1891.

257. Hobson.
433. Brunckr.
463. Lake (*Brown*).
736. McCool.
942. Gedge (*Hesse*).
1028. Johnson & Porter.
1273. Martin.
1460. Curtis & Himrod.
1954. Loring.
2090. Whitehead.
2232. Ritchie.
2277. Munns (*Gibson*).
2313. Golding.
2330. Goodall (*Blümlein*).
2421. Lownes.
2492. Wirdemann.
2593. Binns & Snowden.
330. Bell.
448. Couves.
657. Lake (*Lord*).
828. Wüst-Guyer.
953. Bogle.
1214. Burkhardt & Schülf.
1308. Pirlsticker.
1876. Goodenough.
1974. Bickle.
2108. Rown.
2272. Munns (*Stewart*).
2297. Hazeltine. (9th July, 1890.)
2376. Morton.
2455. Martinot.
2558. Roberts.
2594. Giorgio.
2725. Sanders.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Engine Governors.—*J. H. Dales, Leeds.*—In the accompanying illustrations, Fig. 1 is an elevation showing the apparatus for the above purpose, Figs. 2 and 3 being front and side elevations respectively of an enlarged detail thereof. Referring to Figs. 2 and 3, a spring A is stretched between a lug B, which is placed on the bracket arm C of the governor head, and a similar lug B¹, which is placed on the ball arm D of the governor. This spring is placed in the line of the resultant of the parallelogram of forces

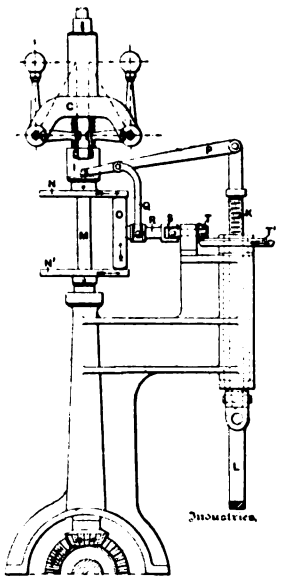


FIG. 1

shown in dotted lines, and is duplicated on the opposite side of the centre line of the ball arm D. A shaft E is passed through the ball arm D and secured therein, and the outer ends of the shaft E project clear through holes in the bracket arms C of the governor, so as not to touch the said holes. Slots are provided in the spindle E for the springs A to stretch through, but quite freely. Between the projecting ends of the spindle E and lugs F a second set of springs G are stretched, one on each outer side of the bracket arms C. These springs are in tension when the governor is working, and they counteract the centrifugal force of the governor arms generally, as distinguished from the lever action of the governor arms. The horizontal limbs H of the governor arms are connected to the slider I by means of flat springs J. Referring to Fig. 1, I is connected to the differential lever P, carrying on its outer end the controlling screw K connected at its lower end to the valve connecting rod L. The governor spindle or shaft M carries and drives a pair of friction discs N N¹, in contact with either of which the friction wheel O may be placed by the action of the governor through the lever P and connecting link Q, thus imparting rotary motion to the shaft R, "Hooks" joint S, and bevel gear T T¹, which is mounted and fixed on the head of the long nut of the controlling screw K. Assuming that the shaft M is driven in the direction of the arrow, the governor, in performing its functions, raises or lowers the shaft R, and thus places the friction wheel O in contact with one

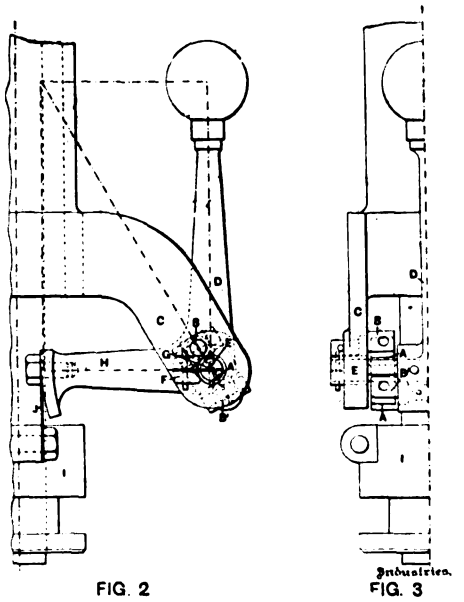


FIG. 2

FIG. 3

of the rotating discs N or N¹, which produces a motion of the screw K in the opposite direction to that of the governor slider I, and in so doing takes off the friction pressure of the friction wheel from the disc with which it was in contact, and the further motion of the screw K consequently ceases. If the screw by any means should over-act it places the friction wheel O in contact with the opposite disc, which will reverse the over-action of the screw. Five claims are made, embracing the engine governing apparatus substantially as described, and also the combination therewith of a differential pressure apparatus as described in a prior patent, No. 14216 of 1888.—No. 2703. February 19th, 1890. 8*d*.

Veneer Cutting Machinery.—*G. A. Oncken, Chicago, Illinois, U.S.A.*—A machine for the above purpose is shown in the annexed illustrations, of which Fig. 1 is a part sectional plan, Fig. 2 a front sectional elevation, and Fig. 3 a transverse section of Fig. 2. The presser-bar A is attached to a slide B guided in the frame C by means of two bars D sliding in sockets E E¹. These rods are screw-threaded at their outer ends and

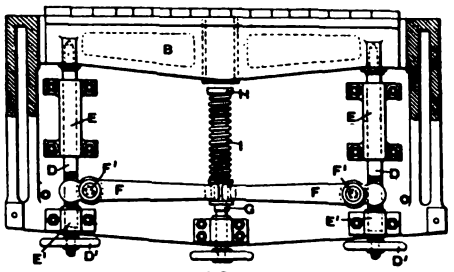


FIG. 1.

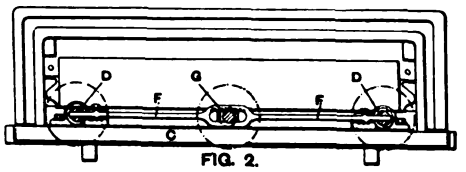


FIG. 2.

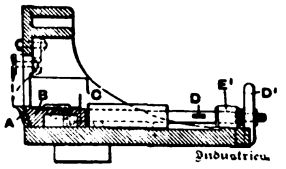


FIG. 3.

receive hand-wheels D¹ for regulating the position of the presser-bar. Two levers F are pivoted at F¹, and the short arms thereof project into slots in the rods D. The longer arms of these levers project between flanges on a sliding collar G on a screw rod H which also carries a helical spring I. By means of the above-described arrangement the presser-bar will "give," so allowing any irregularities in the wood to pass. The presser-bar may be constructed in a number of parts each attached to the slide B by suitable bolts with some elastic material between. Several other structural modifications are described. Seven claims are made.—No. 3086. February 26th, 1890. 8*d*.

Drawing Metal Tubes.—*H. Imray, London.* (*H. Moerchen, Alten, Germany*).—The inventor's object is to reduce the thickness of tubes along the whole length, or to produce varying thicknesses at different parts in the length of the tube. For these purposes the interior of the tube is closed by hammering, pressing, or rolling, or by means of malleable plugs, after having been filled with a pulverulent material of a mobile or plastic nature. The tube so filled, after being heated to a suitable temperature, is passed through grooved rollers so as to be extended longitudinally, while the diameter and thickness are also reduced. If it be desired to produce tubes with greater thicknesses at certain points, the tube, before being filled, has its diameter reduced at the said points. Claims: (1) The process for drawing tubes of reduced thickness by filling the tube with a pulverulent mobile or plastic material, closing the ends of the tube, and then rolling as described; (2) the process of drawing tubes of varying thicknesses by first reducing the external diameter at the parts where the thickness is to be increased, then filling the tube with a pulverulent, mobile, or plastic material, closing the ends of the tube, and rolling as described.—No. 176. January 4th, 1890. 6*d*.

Looms.—*J. & A. Moss, Hebden Bridge, Yorkshire.*—The invention relates to an improved picking motion for looms, in which the shuttle is propelled across the loom by means of a helical spring. The apparatus operated in this manner is shown in the annexed illustrations, of which Fig. 1 is an elevation, Fig. 2 a rear elevation, Fig. 3 a plan, and Fig. 4 details. The crank shaft A, connected by crank arm A¹ to the slay B, carried by the lathe sword C, are arranged as usual. Revolving in brackets on B is a pin D, on which is formed a slotted lever arm E, in the slot in which passes a stud F, fixed to a bracket on the loom frame. On D is also fixed, by means of a suitable crank arm, a hooked arm G, arranged to operate the ratchet wheel H, the spindle of which runs in bearings on the underside of the shuttle-box, and carries a star wheel I (Fig. 4) arranged to operate a spring catch J bolted to the slay, and so release the picker lever K, which is then drawn inwardly, so actuating the shuttle, by means of a spiral spring L, which had been previously compressed, and to which it is attached by means of rods L¹ and sliding flange L². The lever K is forced back to the position shown by means of a lever M, also attached to pin D, which pin is operated by the action of the fixed stud F working in the slotted lever E, each time the slay beats up the weft thread. The star wheel I is also operated by the same

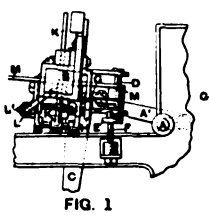


FIG. 1

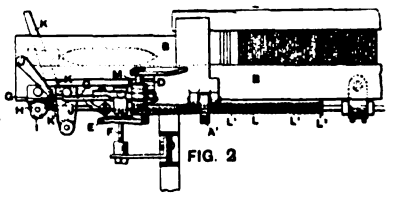


FIG. 2

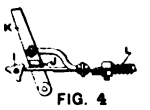


FIG. 4

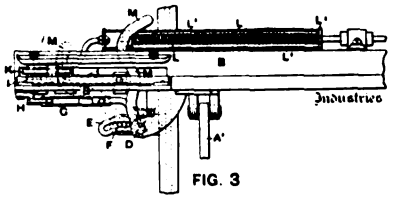


FIG. 3

movement of D, but as the ratchet wheel H has twice the number of teeth as I the latter is only operated once during two beats of the slay. In five claims the inventor embraces the above-described loom-picking motion, together with a modification.—No. 2582. February 18th, 1890. 8*d*.

Steam Boiler Furnaces.—*W. Ackroyd & T. H. Ackroyd, both of Birkenshaw, & J. Willoughby, Gomersall, all of Yorkshire.*—The inventors' object is to cause more complete combustion of the fuel in steam boiler furnaces. For this purpose a pipe of a suitable diameter is carried along the bottom of the flue of the boiler, the front end being bent upwards, and has an L piece of tube hinged to its end; the other end of this L piece is connected to an opening in the door of the furnace. The free end of this pipe is carried part of the way up the chimney of the boiler, and terminates in a trumpet mouth open to the atmosphere. Another smaller tube connected to the upper part of the front end of the boiler is bent downwards and enters the larger tube, and passes through nearly the whole length of same. Just below the trumpet mouth, however, this steam pipe passes out of the larger or air pipe, and is bent round so that its end projects into the trumpet mouth. A strong current of air is thus induced through the larger pipe, which, as it passes through said pipe, becomes highly heated, and ultimately enters the front end of the boiler. Suitable valves are placed in the steam and air pipes to govern the supply through each. Four claims are made.—No. 5453. April 10th, 1890. 11*d*.

Releasing Gear for Boats.—*R. J. Gant, Wiveton, Norfolk, & G. L. Moy, Newclee, Grimsby, Lincoln.*—The invention relates to a method of detaching the supporting chains of ships' boats after the boat has been lowered. Fixed on each end of cross-pieces in the boat are brackets between two vertical arms, of which and at one side thereof is pivoted a pin. At the other side of these arms are formed two corresponding holes, into which a pin can be passed, and which, when the pivoted pin is turned into a horizontal position, holds the said pin in that position, and consequently prevents a ring, which is fixed to the supporting chain or rope of the boat, and which is placed on the hinged pin, from slipping off. The heads of the detention pins are all placed in one direction, and are connected with a central rope, so that by pulling the rope after the boat has been lowered the hinged pins, and consequently the supporting chains, will be released. In a method of releasing the canvas covering the ship's boats the inventors provide said canvas at both ends and at opposite sides with a link of rope or a short chain terminating in a ring. In the stem and stern post of the boat apertures are made sufficiently wide to receive the rings of the front and stern ropes. Pins attached to the aforementioned central rope and passing in holes through the apertures in the stem and stern of the boat overlap the rings therein, so holding them until the central rope is pulled. Claims: (1) In gear for securing and releasing boats and the covers thereof, the employment of a "tumbler" catch,

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constructed as described, and adapted to secure the boat and its cover; (2) the general arrangement and construction of parts constituting the improved gear substantially as described. —No. 1311. January 25th, 1890. 8*d*.

WIRE STITCHING MACHINES.—*W. R. Bacon, London.*—The machine embraced by this invention is for the purpose of attaching together a number of tickets, labels, or the like, and is shown in the annexed illustrations, of which Fig. 1 is a side part sectional elevation, Fig. 2 a front elevation, and Fig. 3 a plan. Running in suitable bearings in a frame fixed to the table A is a hollow spindle B revolved at a high speed by driving cord passing

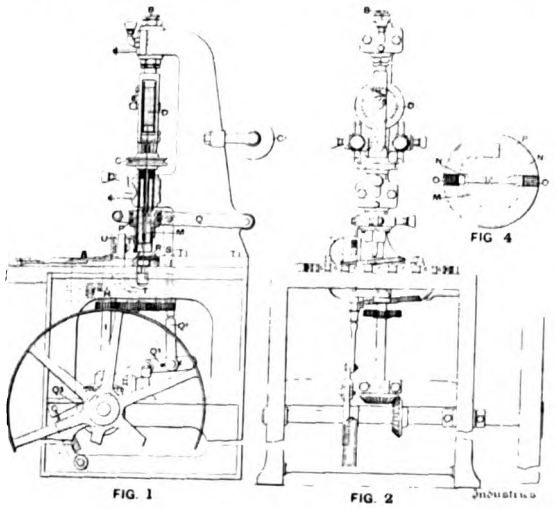


FIG. 1

FIG. 2

FIG. 4

around pulley C and guide pulleys C¹. The upper part of B is slotted and carries the wire-containing reel D. A notched ring E is supported on A by means of a flange on its underside running in an annular groove in A, and is driven intermittently by means of a ratchet and pawl F, vertical rocking shaft G, and cam H carried on a vertical shaft I, driven from the main shaft of the machine by bevel gearing. The notches of this ring are made to receive the packages to be stitched, a pusher J being so arranged and operated by means of levers K K¹ and cam L on shaft I as to push the packages out of said slots after the stitching operations. The wire is fed downwards through B from D by means of a sliding block M, furnished with serrated jaws N (Fig. 4) adapted to grip the wire, and engaging with the points of screws O fixed in a sleeve P. This sleeve, and so the sliding block, is given a vertical reciprocating motion by lever Q, rod Q¹, lever Q², and cam Q³. The shearing of the wire is effected by means of a movable blade R, which receives a horizontal reciprocating motion from a cam S operated by spur gearing from I. Two rollers T are arranged in suitable bearings above and below A, the periphery of the lower roller projecting slightly through a slot in A, and the bearings of the upper roller being arranged to slide in guides U and to be pressed downwards by suitable springs. The various parts are so arranged that as the wheel E revolves the wire is first driven through the packages, then sheared off, leaving ends projecting on both sides. The packages are then passed between the rollers T and the projecting end of the wire bent over, the packages afterwards being discharged by pusher J. Claims: (1) In a machine for the above

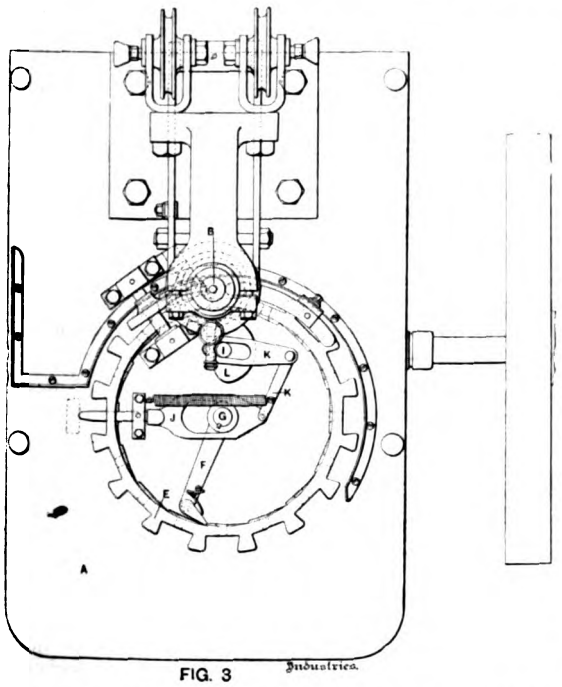


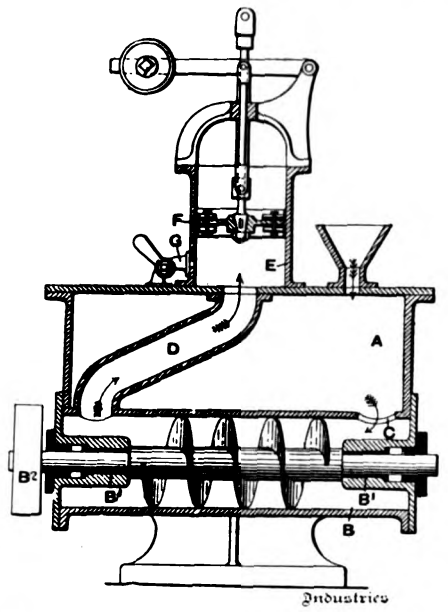
FIG. 3

purpose, the means of driving wire through sheets of paper or cardboard and the provision of mechanism to cause the wire to revolve rapidly so as to prevent its bending: (2) in a machine such as described, the combination of the general arrangement of parts as described, with the provision of mechanism to cause the wire to revolve at a high rate of speed whilst being driven through the tickets, so as to prevent the wire from bending.—No. 2010. February 7th, 1890. 11*d*.

BACK PRESSURE VALVES.—*R. G. Brooke, Salford, Manchester.*—According to this invention, the back pressure valve is, as usual, screwed at the inlet end to receive the pipe conducting the water or other fluid, but this screwed portion is made separate from the body part, but so arranged that, by screwing, it may be suitably attached to the body part. So, when this separate piece, forming the inlet and valve seating combined, is unscrewed from the body portion of the back pressure valve, the latter may be withdrawn together with its seating. The valve is also provided with a projection on its further side to act either as an additional guide or as a stop to limit the rise of the valve. Claims: (1) The arrangement and construction of the screwed portion of the back pressure valve comprising a valve seating, guide, and connection to inlet pipe as described; (2) a stop in the main casing of the valve; (3) the combination with a stop valve of any of the kinds of withdrawable valves and seating as described; (4) the arrangement of a recessed flange to receive the protruding portion of the withdrawable seating as described in a modification.—No. 4856. March 28th, 1890. 8*d*.

SPEED VARYING GEAR.—*W. J. Munden, London.*—The invention relates to apparatus for enabling the speed of a driven shaft to be varied from that of a driving shaft at will, and consists of a worm-wheel, of a pitch varying from one end of the tooth to the other on the driving shaft, and a similar wheel gearing with the first upon the driven shaft, which latter is placed at an angle (preferably of 90 degrees) with the driving shaft and with their axes in different planes. The width of the rims of these wheels is greater than that of the band of actual contact, and consequently by sliding each wheel longitudinally upon or with its shaft a different part of the teeth can be caused to engage, and so the speed of the driven shaft varied. A rod is journalled in a suitable framework embracing the two shafts, and has formed on it radial arms, studs on the ends of which project into annular grooves formed in collars on one end of each of the worm-wheels, so that by suitably revolving said rod the position of the two wheels can be altered as desired. Seven claims are made, embracing the arrangement substantially as described, together with modifications.—No. 3128. February 27th, 1890. 8*d*.

ENGINE GOVERNOR.—*R. Martin, Liverpool.*—A governor constructed according to this invention is shown in sectional elevation in the annexed illustration. Formed in the lower end of



the casing A, which is filled with water or any other suitable fluid, is a circular casing B, in which revolves an archimedean screw journalled at B¹, and driven by means of a pulley B² from the main shaft of the engine to be governed. The interior of B is connected to the interior of A at one end through opening C, and at the other end through a pipe D, with the interior of a cylindrical chamber E, in which works a loaded piston F connected by suitable rods or levers with the throttle valve or other parts regulating the admission of steam or other fluid to the engine. The interior of E is also connected to the interior of A by a pipe G governed by a suitable tap. The action is as follows:—As the water is forced from A into E the piston in the latter is forced upwards, so gradually cutting off the supply of steam to the engine until the supply to E through D is equal to that escaping through G. Should any variation of the speed of the engine occur the piston will be either raised or lowered, and so the engine supply valve either opened wider or gradually closed, as the case may be, until the engine has again attained its normal speed. Claims: The inventor in five claims embraces the governor substantially as described.—No. 4912. March 29th, 1890. 8*d*.

STEAM TRAPS.—*W. A. Clark, Charlton, Kent.*—According to this invention the vessel for receiving the water of condensation is of a rectangular shape, and has connected to one side of it a second chamber, communication being made between the two through a balanced slide valve situated in the first-named vessel and a cooling coil of thin tubing, one end of which is connected to the outlet of the valve, whilst the other end opens into the second chamber. The balanced slide valve consists of a tube, one end of which is connected with the end of the tube coil. The other end, which projects into the first vessel and is closed, has formed in its upper surface a port, over which slides a suitable slide valve, which is connected to one arm of it and is operated by means of a bell-crank lever, the other end of which is fixed to a float. This bell-crank lever is pivoted immediately above the port in the tube in a suitable arm projecting from the side of the first vessel, so that as the float rises the valve opens the port and forms communication between the first and second vessels. A suitable air valve is placed in the cover of the first vessel, which automatically discharges all air when the steam is turned off. Claims: In a steam trap an automatic equilibrium valve having a seat formed of projecting ridges and an adjustable lever actuated by a float; (2) an air valve in the chamber for receiving the water of condensation, with arched metal expansion band and studs; (3) a cooling coil formed of thin metal tubing; (4) a steam trap constructed and arranged substantially as described.—No. 3063. February 26th, 1890. 8*d*.

TUBULAR BOILERS.—*E. Vigers, London.*—The boiler embraced by this invention is constructed as follows:—Each end of the boiler consists of a water casing of rectangular section with arched top. These two casings are connected at their tops by a cylindrical steam space, on each side of which and communicating with it somewhat lower down there is a water tube connecting the two casings, whilst near the bottom there are two other water tubes connecting the end casings. Thus there are four water tubes connecting the two end casings—two at a low level and two at a high level. The upper and lower of each pair are connected by small water tubes, which are bent so as to accommodate increased length in the space and to give narrow passages between them for the products of combustion on their way to the chimney. The whole is enclosed in a casing lined with material which is a bad conductor of heat. Claim: A tubular boiler consisting of two end water casings connected by a central cylindrical steam space and by an upper and lower cylindrical water space on each side of a central fire, the upper and the lower water spaces on each side being connected by small bent water tubes as described.—No. 6668. April 30th, 1890. 6*d*.

NAIL-MAKING MACHINERY.—*H. Campbell, London.*—The inventor's object is to construct a machine for forming and driving brads or nails at one operation. Such a machine is shown in the annexed illustrations, of which Figs. 1 and 2 are elevations of

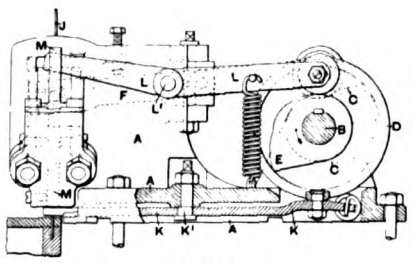


FIG. 1

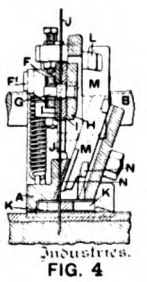


FIG. 4

both sides, Fig. 3 a part sectional plan, and Fig. 4 a part sectional end elevation. Running in a suitable framework A is the main driving shaft B carrying cams C D and E. Pivoted at F¹ is a lever F, one end of which embraces a stud G on a slide H, moving in suitable slide ways in A. This lever is actuated in a vertical plane by cam C so as to carry the slide H up and down, and in a horizontal plane so as to press two collars I placed on the stud G, and between which the wire J, passing through G for forming the brads, passes, by means of cam faces C¹ on C, acting on a flange on the roller on the end of F. Pivoted beneath A at K¹ are two levers K, one pair of ends of which are forced together to grasp the wire J by means of cam D acting on rollers on the other ends. Pivoted at L¹ is another lever L, one end of which is given a vertical reciprocating motion by means of cam E. The other end of this lever is embraced by the slide M carrying the knife N working against a stationary plate N¹. This slide is given first an oblique motion, and then a vertical motion, by means of the ends of stationary set screws projecting into suitable grooves formed in the sides of the slide. The operation is as follows:—The wire is first drawn down by means of gripping collars I; the levers K then hold that part of the wire between them which is to form the brad. Whilst so held the wire is sheared obliquely, and the top part bent over on to the face of one of the levers K by means of the knife N. The part sheared

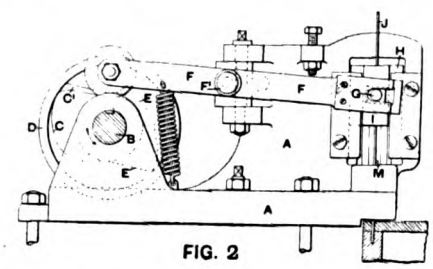


FIG. 2

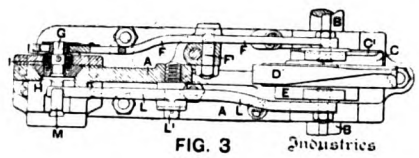


FIG. 3

off is then released and driven into the wood by the latter part of the movement of the knife N. In the meantime the collars I have been released and carried upwards preparatory to a second and similar operation. The inventor also describes a modified machine operated by hand-power. Four claims are made.—No. 3511. March 5th, 1890. 8*d*.

WATER PURIFIERS FOR STEAM BOILERS.—*J. B. Barnes, Springfield, Illinois State, U.S.A.*—The object of the inventor is to free the water from its impurities by heat after it enters the boiler, but before it comes in contact with the flues or any part exposed directly to the fire. The outer shell is formed as usual, and has fixed inside of it by means of segmental rings a second shell, the upper part of which extends only 3in. or 4in. above the crown of the firebox, the edges of the inner shell being bent over towards the interior of the outer shell so as to prevent any solid matter escaping from the annular space between the two shells into the interior of the inner one. An oblong frame made of angle iron is placed on the bottom of the outer shell and supports the inner one. This supporting frame is pierced at intervals along the lower part with semicircular openings, through

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which the sediment may pass to an opening formed in the lower part of the outer shell, closed by any suitable form of mudhole. Opening into the front part of the annular space between the two shells are the feed-water openings, the water entering through which is caused to flow downwards by means of segmental rings and suitable bars placed across the upper edge of the inner shell and the interior of the outer shell. The segments of the ring do not, however, extend quite to the oblong supporting frame, so that the water, after travelling downwards, passes through an opening between the end of the former and the side of the latter, and escapes into the other part of the annular chamber, and gradually rises and overflows into the interior of the inner chambers. Three claims are made.—No. 20217. December 11th, 1890. 8*d*.

ELECTRICITY.

Telegraph Printing Apparatus.—*H. O. Rudolph, London.*—Fig. 1 in the annexed illustrations is a transverse section, and Fig. 2 a rear view of a transmitter. Figs. 3 and 4 show a plan and front elevation of a receiver, both constructed according to this invention. Referring to Figs. 1 and 2, two rows of levers A A^1,

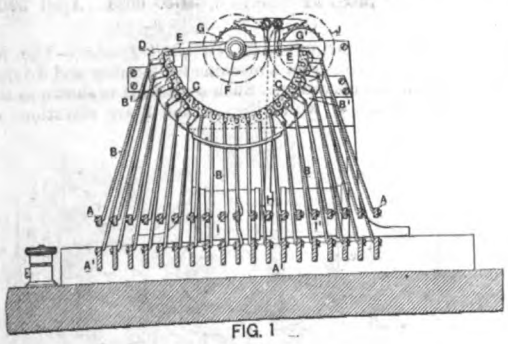


FIG. 1

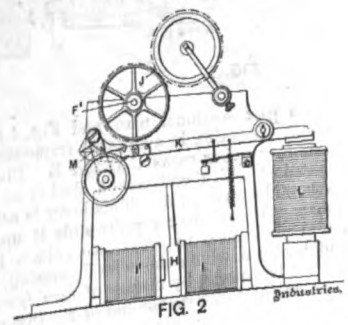


FIG. 2

pivoted as shown, are connected at one end to the keys of a suitable key-board (not shown), and at their other ends to levers B, the upper ends of which are arranged to force pins C out of slots in a segmental frame D, in which they are normally held by suitable springs when operated either directly or by means of bell-crank levers B^1. Revolving above D are two arms E fixed to a spindle F geared to a second spindle F^1, both of which carry ratchet wheels G G^1 operated by means of pawls on the end of lever H, the lower end of which carries an armature and swings between electromagnets I I^1. This armature lever H, as it swings, operates a switch, which opens and closes the circuits around I I^1, so main-

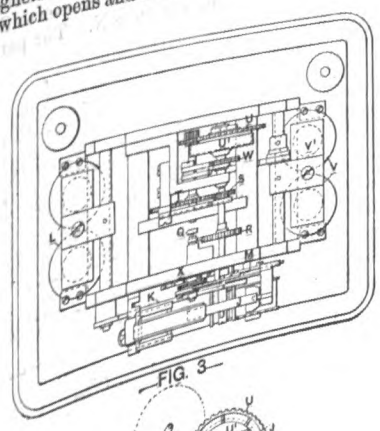


FIG. 3

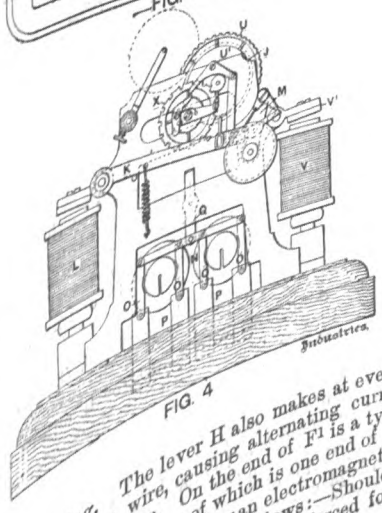
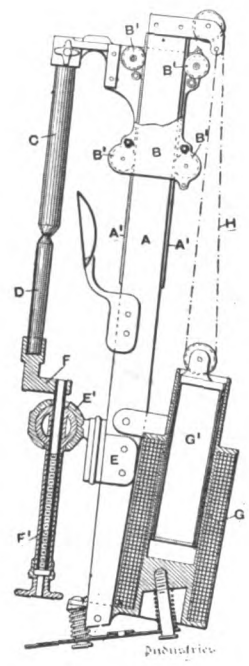


FIG. 4

taining H swinging. The lever H also makes at every stroke a contact with the line wire, causing alternating currents to be sent to the receiver. On the end of F^1 is a type-wheel J the periphery of which is one end of a lever K, which projects over an electromagnet L in series with the line. The action is as follows:—Should one of the pins C will be forced forward and will be struck by one of the arms E, so temporarily checking its motion. This causes a continuous current to be transmitted to the receiver and the magnet L to be excited, so operating K and pressing a strip of paper on the end thereof against the lowest letter on J, which letter corresponds with the key operated. The paper is fed forward on a knife on a lever M operated by the end of K as it is raised and lowered. Referring now to Figs. 3 and 4, the printing mechanism is constructed substantially as that of the transmitter; the movement of the type wheel, however, is effected as follows:—Two electromagnets N, in circuit with the line, have presented to them four iron bars O pivoted to the poles of two permanent magnets P. These bars are alternately attracted, so causing a reciprocating motion of the rod Q, to which they are all attached. A pawl on the upper end of Q governs the rotation of a ratchet wheel R, on the spindle of which is a wheel S gearing with a spindle T, which in its turn is driven from gearing U actuated by a coil spring in the barrel U^1. The action of this arrangement is similar to that of the transmitter. At the same time as the printing mechanism is operated, a second electromagnet V in the line circuit is excited, and its armature V^1, which is on a lever having a pawl engaging with the ratchet wheel W on the spindle of the spring in U^1; thus at each operation the spring is partially rewound. The receiver is also synchronised with the transmitter by means of the star wheel X governed by suitable mechanism operated from the lever Y carrying the printing pad. Five claims are made.—No. 2219. February 11th, 1890. 11*d*.

Arc Lamps.—*C. A. Parsons, Newcastle-on-Tyne.*—Referring to the accompanying illustration, which is a side elevation partly in section of an electric arc lamp suitable for use in search light projectors constructed in accordance with this invention, the steel bar A has formed upon it feathers A^1, and the carriage B moves freely on the bar by means of the four grooved wheels B^1. The carriage B carries the upper carbon C, while the lower carbon D is attached to the lower part of the bar by a bracket E, a ball and socket joint E^1, and a holder F. This holder has a screw F^1, which allows of vertical adjustment, and the ball and socket



joint, together with the cranking of the holder F, permits of ready lateral adjustment. The solenoid G is also attached to the bar A, and its core G^1 acts upon the movable carriage B by the cord H, which passes over suitable pulleys, and is attached to the carriage and the frame of said pulley. The slide is so arranged that it moves in a line at an angle of about 10 degrees to 15 degrees to the vertical plane. The arc is maintained in the lamp in the usual manner by the action of the solenoid G and the core G^1. Claims: (1) In an arc lamp which requires to be moved angularly or moved to varying degrees of inclination, securing a constant or nearly constant difference of weight pull between the carriage and solenoid by the arrangement of carbon carriage, so that its line of movement and the line of movement of the solenoid core are inclined from the vertical plane, and the angle of the solenoid core is greater than the angle of the line of carriage travel as described; (2) the arrangement of upper carbon carriage and holder travelling on a feather or key by grooved pulleys to secure free movement; (3) the arrangement of bottom carbon holder with adjusting screw and ball and socket joint as described; (4) the arc lamp as described.—No. 2659. February 19th, 1890. 8*d*.

Insulating Shaft Couplings.—*C. J. Barley & H. Stevenson, London.*—The invention relates more particularly to the coupling of the armature shaft of a dynamo or other electrical machine to the shaft of a steam engine. The insulated connection is made as follows:—Between the two parts to be connected a disc of insulating material is placed. Through the parts to be connected and through the insulating material taper holes are made, and in these holes are placed taper bolts or screws having fitted over them taper sleeves of insulating material, and which bolts draw and hold the said parts to be connected firmly together. The invention can be applied to the attachment and insulation of parts in electrical apparatus generally. Claims: (1) The means for coupling two parts together and at the same time insulating them from each other as described; (2) the connection and insulation of a spindle to and from a plate by a taper part of the spindle covered with a sleeve of insulating material entering a taper hole in the plate, and a nut with an insulating washer; (3) the use of taper bolts having taper insulating sleeves as described.—No. 4086. March 15th, 1890. 6*d*.

Electric Tension Regulator.—*J. Kalb, Leipsic, Germany.*—The apparatus for the above purpose embraced by this invention is constructed as follows:—Arranged to run vertically on an upright piece of board are a number of resistance coils of German silver, which are connected together in a closed series by contact plates connecting the several coils at the opposite ends thereof so as to form the continuous series, the series being finally connected at each end to terminal screws. The said coils are connected to wires, which project downwards in pairs to varying distances, and are connected by two series of wires with the coils between the same, one wire of each pair leading from, say, the upper connecting plate or the like of the coils, and the other wire of each pair leading to the opposite connecting plate, so that more or less of the coils can be switched in or out to increase or diminish the resistance in accordance with the current. The downward projecting ends are arranged to dip into a mercury bath carried on the end of a suitable iron rod forming the core of a solenoid in the main circuit. The said rod and mercury pot are balanced by suitable weighted levers, and the end of the former is connected to the rod of a suitable "dash pot." Three claims are made, embracing the construction of an electric tension regulator, substantially as described.—No. 5678. April 15th, 1890. 8*d*.

CHEMISTRY.

Treatment of Sewage.—*W. E. Adeney & W. K. Parry, both of Dublin.*—The process embraced by this invention is as follows:—The sewage is first run into a tank of suitable dimensions, wherein the heavier matters in suspension may be deposited. The effluent from this tank flows into a second tank, wherein the liquor is mixed with one or more inorganic oxygen compounds such as potassium, or sodium nitrite, manganate, permanganate, calcium nitrate, manganate or permanganate, or perchlorate, or sulphate, or peroxide, &c., in quantity varying according to the nature of the liquid to be purified. The effluent from this mixing tank is conducted into a third tank of comparatively large dimensions, and there raised to and maintained at a temperature of 75° to 95° Fahr. Under these conditions the micro-organisms in the effluent develop and multiply with rapidity. As a consequence, the soluble organic matters in the liquid become converted into harmless inorganic substances as carbon dioxide and ammonia, and the liquor becomes so much purified that it will not suffer from after-putrefaction. Claims: (1) The purification of sewage and other waste liquors containing organic matters by adding to them an inorganic oxygen compound and maintaining them at a temperature of 75° to 95° Fahr., as described; (2) the purification of acid or alkaline sewage containing organic matters by rendering them neutral or slightly alkaline, adding inorganic oxygen compound, and heating them, as described.—No. 3312. March 1st, 1890. 6*d*.

Colouring Matters.—*J. Imray, London.* (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, Paris, France.*)—This invention relates to the manufacture of certain colouring matters by treating fuchsine, dimethylaniline violets, and methyline blue with a mixture of sulphuric and nitric acids, in the following manner:—40·75 kilos. of crystallised dimethylaniline violet are dissolved in 250 kilos. of sulphuric acid at 66° Bé.; the solution is cooled to 0° C., and to it is added in successive doses a similarly cooled mixture of 10 kilos. of nitric acid at 63 per cent. and 20 to 30 kilos. of sulphuric acid at 66°. The whole is left several hours in repose, and then poured into 4,000 litres of water. The sulphuric acid is neutralised by soda or carbonate of magnesia, and the base of the nitrated colouring matter which precipitates is collected on a filter. To convert it into hydrochlorate, this base is mixed with 110 to 120 kilos. of hydrochloric acid at 35 per cent., and the mixture is evaporated to dryness. For nitrated rosaniline, 33·75 kilos. of fuchsine or 32 kilos. of rosaniline are treated in the same way as the dimethylaniline violet, giving a nitrated colour which dyes garnet, being preferably employed as a paste. For nitrated methylene blue, 31·95 kilos. of methylene blue are employed instead of the crystallised violet; the base of the colouring matter produced is dissolved in hydrochloric acid and has bay salt added to it, whereupon is precipitated the nitrated colouring matter which dyes bluish-green. Claims: (1) The process described for nitrating to a greater or less degree fuchsine and other colouring matters by treating them with mixtures of sulphuric and nitric acids; (2) the nitrated colouring matter produced by the said process, with modifications.—No. 6486. April 28th, 1890. 4*d*.

MISCELLANEOUS.

Process for Refining Raw Tin.—*T. Teague, Pinewood, Devoran, Cornwall.*—The inventor treats the raw tin as follows:—The raw tin is run into a suitable receptacle and maintained at the necessary high temperature to keep it in a molten state; suitable pipes of fireclay or other refractory material are inserted into the molten metals, and these pipes are connected with any suitable blowing apparatus, and a current of air, either heated or cold, passed through the metals. This action in the first place oxidises and burns the arsenic, which volatilises as arsenious acid, and may be collected. The iron, if any be present, is oxidised, and forms a small slag; the nickel and cobalt, if present, being deprived of the arsenic, and most of the sulphur separate from the tin, and remain in the vessel in the form of "speiss" after the molten tin has been run out. The same action may be accomplished by means of the addition of Chili saltpetre to the molten mass. Claim: To refine raw tin and expel the arsenic by means of passing a current of air through the metals when molten, and by this means recover the nickel in form of "speiss" and the tin in a practically pure state quite fit for the market, and to produce the same effect by adding Chili saltpetre to the metals when molten.—No. 4860. March 24th, 1890. 4*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The publisher must be remitted, together with a sum sufficient to cover the postage which may be reckoned at 1d. for every 10d. Remittances exceeding one shilling must be sent by Postal Order.*

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IMPROVED SLOTTING MACHINE.

The rapid-acting slotting machine shown herewith has been designed by the Northern Engineering Company, Limited, Halifax, for slotting such work as small links, stops for looms, and small motion work generally. It can be fitted with removable tool-holders specially arranged to hold two tools and furnished with right and left hand screws; two sides of a piece of work can thus be slotted down simultaneously. When fitted with a dividing chuck, hexagons can be finished in three movements of the dividing chuck. The jaws of the chuck can be arranged to hold set screws up to 1¼in. diameter in the shanks. The construction of the machine is simple, gearing being dispensed with. A large cone pulley combined with a fly-wheel enables the machine to be run at a high speed without noise, and ensures a smooth cut. The longitudinal and transverse slides are both self-acting and can be used separately or together. The table is circular, and is rotated by machine-cut worm-wheel and worm.

THE INSTITUTION OF MECHANICAL ENGINEERS.

(*Concluded from page* 306.)

A paper was read on the 19th ult. by Mr. Edward H. Carbutt, Past-President, and Mr. Henry Davey,

On Recent Trials of Rock Drills.

The trials referred to were carried out in the summer of 1890, in connection with the Exhibition of Mining and Metallurgy held at the Crystal Palace. The drills were all of the percussive type, and may be broadly divided into three classes:—(1) Drills in which the valve is worked by air pressure; (2) drills having the valve worked through mechanical connections by tappets or cams; (3) valveless drills, in which the main piston itself performs the office of valve. The drills which took part in the competition were the following:—McCulloch's "Rio Tinto," Stephen's "Climax," Bickle, Ingersoll-Mayne, Daw, Coles, Hathorn's "Eclipse," Ingersoll hand-power, and Bromfield-Ingersoll hand-power.

In the paper the construction of each of these machines was described with the assistance of illustrative diagrams, but as we may subsequently publish the paper in full, it is unnecessary to reproduce these descriptions here. The air meter employed for measuring the consumption of air by each drill was one of Messrs. J. Tylor & Sons' inferential water meters. Among the conditions laid down for the competition were the following:—

"Each machine to bore two holes in a granite block, one hole on each side of a centre line which will be marked on the block. Each machine will be required to bore a hole of a diameter equal to half the diameter of its cylinder. After boring, the cubic quantity cut will be measured by pouring water into the hole, or by such other means as the judges may think best. The air used by each machine will be measured by a meter and supplied as nearly as practicable at 60lb. pressure per square inch. Two minutes will be allowed for each drill to bore one hole. Each competitor may use whatever shape of bit he considers best."

The results of the trials were given in a tabular form, and included the depth drilled, volume drilled, air used per minute, granite bored per cubic foot of air. In each case the dimensions and weight of the machine were stated.

On Friday evening, the 20th ult., the discussion on the above-mentioned paper was opened by Mr. Carbutt, who said he regretted that the exhibition of mining machinery at the Crystal Palace had not received more attention, as it was well deserving of study. The trials referred to in the paper were, as far as he knew, the first of their kind, and might be considered as standing in much the same relationship to mining machinery as did the trials of engines at agricultural shows to agricultural machinery. He believed that if such competitions were repeated they would be as beneficial to mining interests as the agricultural contests had been to agricultural interests. All the exhibitors had been very well satisfied. The results of the trials did not enable him to say which was the best drill, since one class of drill was good for one purpose, while another class was equally good for another purpose. He was confident, however, that such trials would do good. As stated in the paper, to form a standard of comparison with the hand-power drills, a hole was bored with mallets and chisels, one man holding the chisel and two striking.

Mr. Le Neve Foster remarked that Mr. Carbutt was mistaken in supposing the trials in question to be the first. As far back as 1866 he had attended a trial of rock drills in Cornwall, and since then various others. He was also present, fifteen or sixteen years ago, in Cornwall, at some comparative tests of ordinary with hand-power and compressed-air drills. Mr. Carbutt had laid stress upon the value of competitions such as those held at the Crystal Palace, but he was not inclined to agree with him that such short trials were of much practical use. The conditions under which a rock drill worked at the surface were so different to those which obtained underground. To form an opinion on the merits of a drill from its behaviour at an exhibition trial was like judging of a man's capacity for endurance in a long-distance contest from his performance in a race of a quarter of a mile. In other respects he was pleased with the paper.

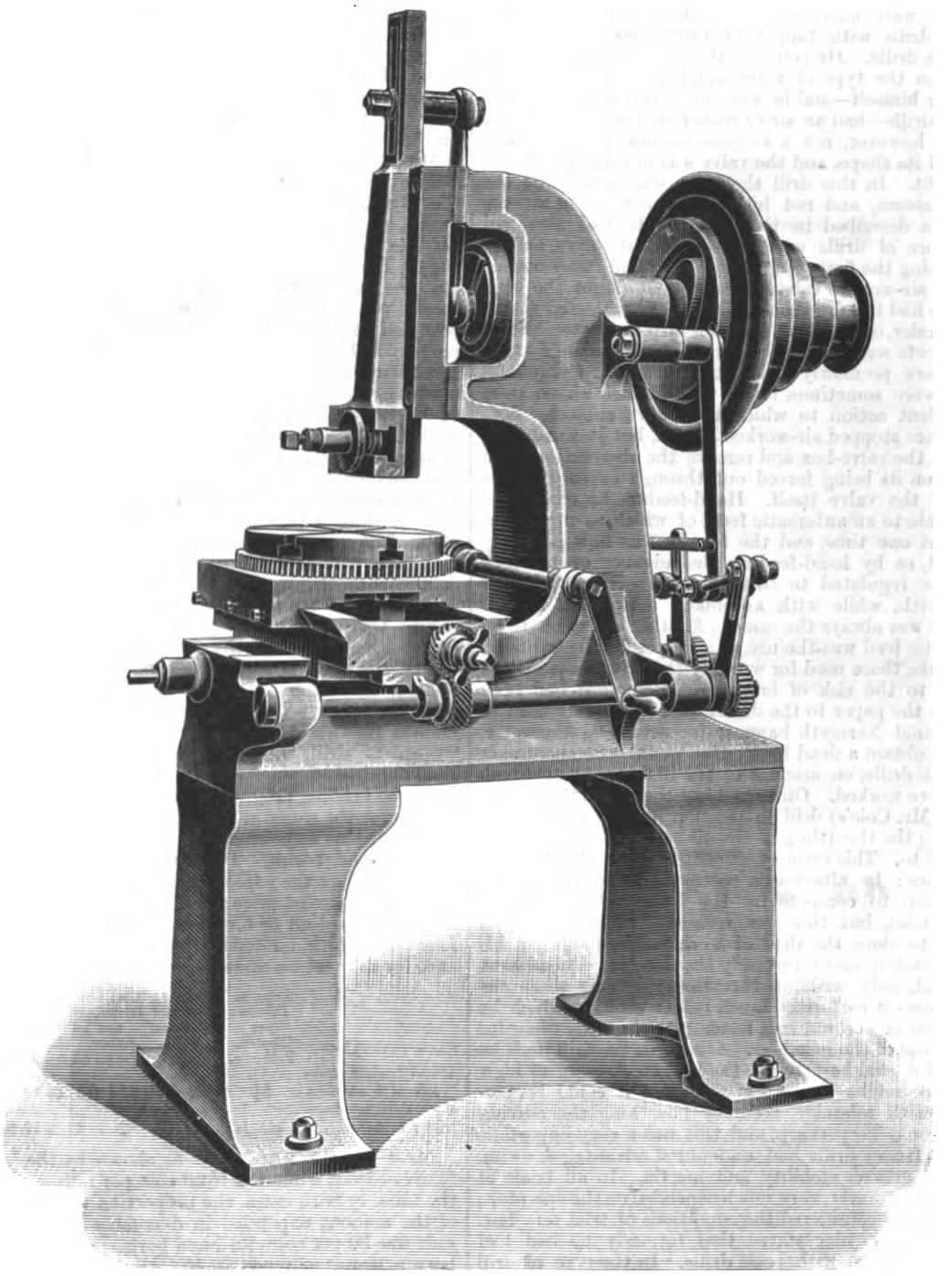
Mr. Collins corroborated Mr. Foster's statement as to trials of drills carried out in Cornwall, which resulted in the early use of such machines in that county. Although he agreed with Mr. Foster's remarks about trials made on the surface, still he thought exhibition trials had some advantages, such as getting together a number of drills of different construction for comparison of their mechanical design. It would be a good plan if competitions could be carried out in an underground level under practical conditions, and he saw no insuperable difficulty in the way of this. The drills should be tested working both upwards and downwards. To work downwards only, as in the Crystal Palace trials, gave an unfair advantage to heavy drills which they did not possess when working upwards. The capacity for wear was an important quality in rock-drills, but in many instances easy replacement of any part would compensate for rapid wear. Economy of power was not always the first consideration with such machines, as in mining districts where water was plentiful power could often be obtained for next to nothing, and then the handiest drill was the best.

The President informed the meeting that the previous speaker, Mr. Collins, had some time ago been honorary secretary to the Institution, and had travelled a considerable distance in order to be present that evening, for which he, the President, and the other members were indebted to him.

Mr. Addy said that he considered the paper a valuable one, but there were some important matters which it did not touch. One of these was the shape of the drill or chisel itself. Among the competing drills he noticed that only one, the "Ingersoll," had a cutting edge of cross form, while all the others were different. He thought it very probable that the breakage of the Ingersoll drill during its trial was due to the form of the cutter. The cross-shaped edge was very suitable for soft stone but did not answer for granite. It was well known that, after its removal from the quarry and exposure to the air, granite became much harder, and possibly this had not been taken into account by the makers of the Ingersoll drill, who had been accustomed

IMPROVED SLOTTING MACHINE.

Constructed by the Northern Engineering Company, Limited, Halifax.



General View.

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to deal with granite in a comparatively soft condition in the quarry. He should be glad to know whether this had anything to do with the failure. It was a pity the broken drills were not shown to the meeting. Was the quality of the steel in fault or the construction of the drill, or a combination of both?

Mr. Coles, after referring in complimentary terms to the value of the paper, remarked that in it three classifications were mentioned—viz., drills with air-worked valves, drills with tappet or cam-worked valves, and valveless drills. He believed the discussion would turn chiefly on the type of valve employed. The first drill made by himself—and he was one of the earliest makers of rock drills—had an air or rather steam-worked valve. It was, however, not a success, because the valve-box changed its shape, and the valve was in consequence too loose a fit. In this drill the valve was worked by the "live" steam, and not by the exhaust, as in all the machines described in the paper. He had also had experience of drills with tappet-worked valves, among these being the first "Ingersoll" drill, and many others, but the air-worked valves were without doubt the best. Tappets had the drawback that, as they projected within the cylinder, on breaking they fell into the latter. Since the tappets were always constructed of hardened steel, they were peculiarly liable to fracture. Cylindrical valves were sometimes liable to lose their shape from the violent action to which they were subject. Dirt sometimes stopped air-worked valves, but it was better to open the valve-box and remove the obstruction than to rely on its being forced out through excessive pressure by the valve itself. Hand-feeding he considered preferable to an automatic feed, of which so much was heard at one time, and the former was now generally adopted, as by hand-feeding the advance of the drill could be regulated to suit the character of the rock dealt with, while with automatic action the rate of advance was always the same. Another objection to an automatic feed was the use of a tappet in the cylinder, which, like those used for working the valves, was always subject to the risk of breakage. Reference had been made in the paper to the device of a "kicker," used in the original Nasmyth hammer for actuating the valve, so as to obtain a dead blow; this would scarcely answer for rock drills, on account of the high speed at which they were worked. On page 14 of the paper the failure of his (Mr. Cole's) drill to develop its full capabilities, owing to the throttling of the air at the inlet cock, was referred to. This error of construction was due to overconfidence; he afterwards rectified it, and applied for permission to compete on the following day in the tripod trial, but this was refused. Subsequently he offered to show the drill at work to the judges in his own workshop under precisely the same conditions as at the trial, only without throttling. Under these circumstances it performed much better work, of which he had given an account in a letter placed on the table for the perusal of the members. As regards the drill itself he believed it paid best to use the best steel, however high the price might be. From the price it could be predicted with tolerable accuracy how long the cutting edge would keep sharp, and this was a very important point. Heavy drills had undoubted advantages, owing to their greater stability and inertia. In all trials of this kind, however, very much depended on the operator; otherwise he considered the conditions of trial very fair.

Mr. Schönheyder stated that formerly he had had some experience with rock drills. In the type of drill with which he was concerned the valve was very short, so that no trouble was caused by its expansion. The advance was automatic, but was effected without a tappet by means of a separate feed cylinder, the admission port of which was opened at every stroke of the drill. It was noticeable in the later forms of drill, as shown in the diagrams accompanying the paper, that the method of securing the tool to the piston rod was very superior to that formerly adopted, his experience being that after a short time the fastening always worked loose. Mr. Schönheyder objected to the meter used, which he said was all right for a rapid flow, but would not give accurate results with a slow flow. If the meter were used for water with a quantity of 20 cubic feet per minute, equal to 125 gallons per minute, or 7,500 gallons per hour, the record would be fairly accurate, but air was subject to compression, and the conditions in that case were different. The fluid acted on the vanes of the meter by impact, and, therefore, the force exerted would be proportional to the mass. Making allowance for compression to 60lb. per square inch, the relative mass of equal volumes of air and water would be as 1 to 164, hence 7,500 gallons of air would be equivalent to only about 46 gallons of water. In his opinion a much smaller meter ought to have been employed. Some form of gasometer for measuring the air would have been better if practicable.

Mr. Tomlinson explained that Mr. Carbutt and Mr. Henry Davey were in no way responsible for the meter adopted. Mr. Schönheyder was quite right in his criticisms, and, as a matter of fact, the quantity of air consumed had in some cases been omitted from the records because they were convinced of the inaccuracy of the meter. All the conditions of the trials had been arranged beforehand by the Crystal Palace officials without consultation with the judges.

Mr. Bright (of Messrs. Tylor & Sons) explained the circumstances under which the meter was supplied, and stated that no idea of the quantity of air to be passed through was given. He was only informed that the supply pipe was 2in. diameter, and was anxious that the meter should be large enough. Air and water were measured with equal accuracy by such meters, but his firm had no means of testing them with air on their premises.

Mr. Collins gave an account of his experiences in Norway with a rock drill similar in construction to the "Rio Tinto." With this machine he had worked on gneiss, which was much harder than granite. Some of the bits used had a chisel edge, others a cross-shaped edge. The position of the cutting edge relatively to the machine was a matter of considerable importance. From careful personal observation, he had found that the time occupied in actual boring formed an extremely small portion of the total working period. Much time was lost in blasting, changing the bit, setting and adjusting the machine, clearing out the bore holes, &c. The tool had to be replaced after a depth of about 4in. had been drilled. Of the total time about one-seventh was spent in actual boring. In order to test the relative merits of hand and machine work, the same "level" had been driven for five months by hand, and for seven months by rock drills working with a pressure of 60lb. to 70lb. per square inch. The dimensions of the level were 6ft. 6in. by 6ft. 6in. clear. Four men (Swedes and Norwegians) were employed on the work, in two shifts of two men each, working about ten hours per shift; although very skilful miners, these men had no previous experience with rock drills. According to the Norwegian method of hand boring the work is performed single-handed, the miner holding the bit in one hand and striking by a mallet with the other. The bits were of ⅞in. steel and the mallets 4lb. in weight. The rock drill used was a 3⅛in. "Cornish" drill, the tool being made of the best drill steel obtainable.

As the heading progressed, there was perhaps a slight change for the worse in the character of the rock, making the conditions somewhat harder for the rock drill than for the hand boring. Dynamite (No. 1) and gelatine dynamite were the explosives used, which were paid for by the men at cost price; no charge was, however, made for compressed air or for sharpening the borers, and the following figures, quoted by the speaker, include no allowance for interest on capital or depreciation:—

	Average Driven per Month. Fathoms.	Average Cost per Fathom of Level.	Cost for Dynamite and other Materials.	Cost for Labour.	Average Wages earned per Day.
Hand boring, average of 5 months	3¼	£5 6 0	£1 11 10	£3 14 2	2s. 8d.
Rock drill, average of 7 months	4fms. 5ft.	5 5 0	2 7 3	2 17 9	3s. 3d.

Mr. Collins pointed out—as shown by the preceding figures—that, while the total cost per fathom was much the same in both cases, the proportion to the whole cost of the amount expended in dynamite and other materials was 30 per cent. for hand boring, while for machine boring it was as much as 45 per cent., the proportions for labour being respectively 70 and 55 per cent. The following further data, the speaker believed, might be of interest:—

	Lbs. of Dynamite used per Fathom of Level.	Lbs. of Steel used per Fathom of Level.	No. of Holes bored per Fathom of Level.	Average Depth of Hole.	Depth bored by each borer without sharpening.	Depth of Holes bored per Shift (1 machine & 2 men).
						ft. in.
Hand boring	20⅛	4¾				
Rock drill...	32½	7⅞	32⅛	43½in.	4½in.	13 10½

All time lost in blasting, &c., was included in the particulars stated. The chief advantage of machine boring, it was evident, consisted in the increased speed, which, of course, was of very great value. The greater quantity of explosive material used in machine work was very noticeable, being nearly twice as great per cubic yard as for hand boring. The extreme hardness of gneiss was strikingly demonstrated by the fact that, while in hard granite the drill would bore 6in., it would only penetrate 1in. in gneiss during the same time. As a very desirable improvement in the construction of rock drills, Mr. Collins offered the suggestion that the turn at each stroke should be varied according to the nature of the rock, instead of fixed, as at present, in ordinary machines. That an alteration of this character was required was shown by the very different character of the *débris* removed from the holes in soft and hard materials. The cost per fathom given for machine driving did not include the extra skill necessary for sharpening the chisels.

Mr. Reginald Bolton said that his experience ranged over a considerable number of different rock drills, and that he had put the first "Eclipse" machine that arrived in this country to work, and was acquainted with all the leading machines, most of which were not described in this paper at all. He had some criticisms to offer upon the drills shown, and, commencing with the question of the rotating motion. He pointed out that it was substantially the same in all the diagrams. The arrangement shown in the illustration of the "Climax" drill was, however, open to considerable objection, as there were far too many points of friction and impact in the sliding of the pawl over the ratchet wheel teeth. It was essential to have not only a pawl engaging the teeth, but a second pawl half engaged, so that in hard rocks, or with shortened strokes, the pawl would catch with a turn of half a tooth. The present stereotyped form of rotating mechanism was a weak feature in all drills, and the teeth were not unfrequently entirely stripped off a ratchet-wheel by the breakage of a chip off one pawl or tooth. The "Cranston" drill, used in the North-Eastern district, had a band rotation, which was a good feature in certain cases. Referring to the valves shown, the speaker commented on the great similarity of those worked by fluid to the "Eclipse," from which they seemed to have been copied, but he considered the "Coles" valve-box too light to stand a miner's usual method of giving vent to his feelings on a rock drill by a blow with a hammer or chunk of rock. The "Climax" valve was also a very old device. The "Daw" drill was not fully described, nor illustrated in the paper, as he hoped it would be, since he wished to become acquainted with the details of every rock drilling machine. With reference to the breakage of the Ingersoll drill, Mr. Bolton expressed the opinion that the bit failed owing to excessive hardness. Makers of rock drills paid too much attention to the design of new valve gears and unimportant details, and gave too little consideration to the essential point of obtaining the greatest force of blow. The speaker advised the use of higher air pressures than those usually adopted, even up to 120lb. per square inch, by which means a greater percentage of work could be obtained out of a given tool in the same time. He himself had tried pressures of from 90lb. to 100lb. The better results achieved in tunnelling in the United States were in great part due to the use of higher pressures and deeper blast holes. He himself, with a 2½in. "Eclipse" drill, working with 90lb. pressure, had succeeded in perforating 12in. of Leicestershire granite with a hole 1⅝in. diameter in one minute. This went to show how much the work done by a drill might vary according to circumstances, favourable or the reverse. Mr. Bolton then proceeded to criticise very severely the manner in which the trials described in the paper had been conducted. The so-called trials, he said, showed nothing and proved nothing, while the results obtained had no value. Even trials under working conditions were not always reliable, as often more depended on the man than on the machine, and he knew of at least one case of a competitive test in which a machine, after being condemned for failure on one day, achieved on the following day a most remarkably superior result, brought about by the judicious expenditure of some of Her Majesty's standard coinage! As a matter of fact, which he knew from his own experience, all such trials were very unreliable, and established nothing except the ability of the man who worked the machine. Reference had been made to the steam trials at the Royal Agricultural Society's shows; but he could tell the meeting that the engines taking part in the competition were often ordinary agricultural engines only in outside appearance, and in their internal details sometimes differed considerably from these. The leading portable engine makers now avoided such contests. A water meter should not have been employed to measure the air. The proper way to do this was by pumping a large reservoir full to a fixed pressure, and from this supplying the drill until the pressure fell to another fixed point. The conditions laid down as to the diameter of the holes bored were absurd. A hole of 1¼in. diameter bore quite a different relation to a 2½in. drill piston and bit to that which a 1¾in. hole bore to a 3½in. drill and bit. The case was very much as though in a steam engine competition the trials were conducted under the following conditions:—All the machines fastened to a loose foundation, the diameters and strokes being different. The number of revolutions unknown. The steam supply measured by, say, a gas-meter. Flywheels all alike, connected by bands to saw-benches. The diameter of saw to be double the diameter of cylinder. All the saws to cut for two minutes in the same block of wood. The cuts to be measured with scientific accuracy, and the result stated as follows—"Wood removed per cubic foot of steam registered in the gas meter." Would any engineer purchase a machine on the strength of the results of such a trial?

Mr. Lockart expressed himself as being much interested in the Norwegian method of hand-working by one man, described by a previous speaker. The question was—

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Could three men working singly in this manner do more than when acting in combination, with one man holding the drill and two striking? His own experience of piecework was that more could be accomplished when the men worked singly than when they were combined. A larger number of holes were bored in less time.

Mr. T. Wilson (representing Mr. McCulloch, the maker of the "Rio Tinto" drill) remarked that Mr. McCulloch's drill could not rightly be classified under either of the heads mentioned in the paper, inasmuch as it was a combination of both tappet and air-worked valve. In some cases the valves of rock drills were actuated by tappets only, and in most of these cases it had been found necessary to employ a spring to keep the valve in its place at the end of its stroke, when the tappet was not in contact with the swelling or enlargement on the piston or rod. Under these circumstances it was generally found either that the spring was too strong, and caused excessive friction, or that it became reduced in strength by wear to such an extent as to be useless for its purpose. In other cases, notably those of the "Climax" and "Ingersoll" drills, the valve was kept in its position by the pressure of the air or other motive fluid acting on the back of it, but this, like the spring, caused excessive wear, not only on the face, but on all the moving parts. The valves of some rock drills were actuated entirely by the working fluid, but in practice this was found to be unreliable, as the valve, when it became worn, was apt to flutter or stick, owing to the leakage of air past it, or was rendered entirely inoperative by the entrance of sand or grit—for instance, rust off the interior of the pipes. In tappet valves such obstructions would be forced away by the blow of the piston. In the "Rio Tinto" drill, as soon as the valve had been moved to the end of its stroke by the tappet, the air pressure acting upon the opposite end prevented any movement while the enlargement on the piston rod was out of contact with the tappet, thus avoiding the friction caused by springs or pressure on the back of the valve.

On the conclusion of the discussion the secretary, at the request of the President, read two letters from members unable to be present at the meeting. The first of these was from Mr. Stevens (who is connected with the "Ingersoll" hand-power drill), in which he characterised the trials as useless. The second letter was written by Mr. David Joy, and referred to some early records in the possession of the writer, of trials of rock drills in the Cleveland district. Mr. Joy stated that the chief difficulty in the way of their introduction at that time arose from the opposition of the workmen.

Mr. Carbutt, in replying to the discussion, stated that he and his colleague were in no way responsible for the conditions under which the trials were carried out, as these had been settled without any reference to their opinion. If any of the competitors were dissatisfied they had only themselves to blame, as all the arrangements were made after consultation with them, and with their full consent. In spite of Mr. Reginald Bolton's strictures, Mr. Carbutt was, he said, convinced that the trials of the Royal Agricultural Society had been beneficial to agricultural engineering.

THE "CLYDE" PISTON RING.

We illustrate herewith a form of piston ring which has been invented by Mr. James Menzies, 52, Mount Street, Glasgow, and which is claimed to be extremely simple, safe, and efficient. We understand that it has been applied in a number of marine engines, under exceptionally severe conditions, and with the best results.

The construction of the ring will be understood from the illustrations, Fig. 1 of which represents a horizontal section, Fig. 2 a plan of the spring and rings, Figs. 3 and 4 represent a modification, and Fig. 5 shows a general view of the complete ring, for which the following advantages are claimed:—When the junk ring is screwed down, the rings and springs are bound together, leaving the packing practically in one piece. By fitting the body of the piston to the parts formed on the inner surface of the rings, the packing is supported under shocks, and the piston under oscillations. The vertical pressure remains constant, the springs and pressing heads not being subject to wear in the slightest degree, while the adjustments are independent and allow either the vertical or lateral pressure to be increased or diminished as desired. The arrangement is said to have all the elasticity and rigidity required to keep the cylinder in good order when the engine is new or the cylinder in fair condition, and when cut in sections and fitted to an unequally worn cylinder results are obtained which give general satisfaction. All the springs in the ring are interchangeable except the one fitted at the saw-cut section. The modification shown in Figs. 3 and 4 is particularly applicable to pistons for new cylinders.

THE "CLYDE" PISTON RING.

CONSTRUCTED BY MR. JAMES MENZIES, GLASGOW.



FIG. 1.

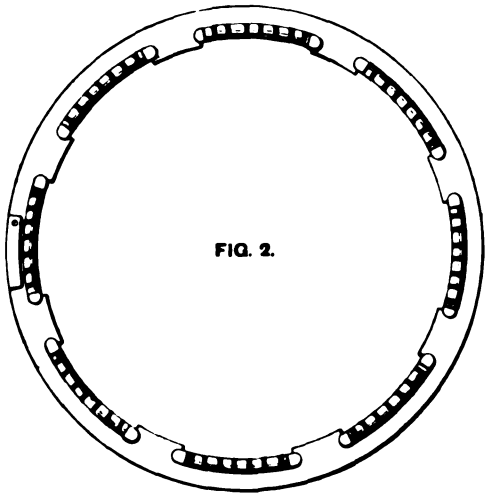


FIG. 2.

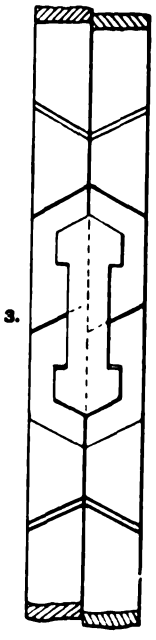


FIG. 3.

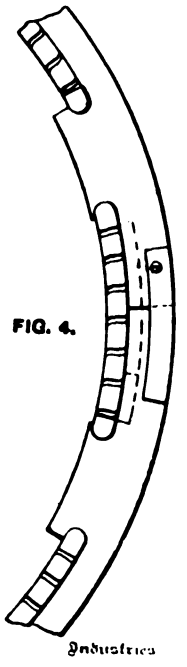


FIG. 4.

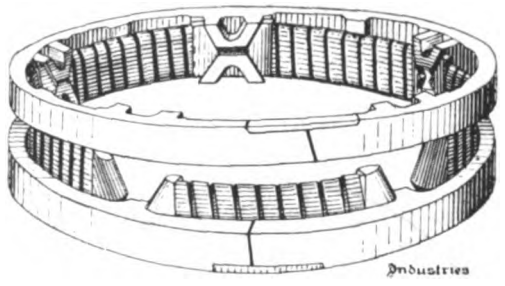


FIG. 5.

THE AGRICULTURAL PROSPECTS OF CANADA.

On the occasion of the visit of the Iron and Steel Institute to America last year some of the members gave glowing accounts of the industrial resources of Canada, and prophesied a great future for it as a manufacturing centre. These opinions were, no doubt, correct to a very large extent, but the Canadian Government has very wisely determined that due attention shall also be paid to the oldest industry—that of agriculture. In August of last year we directed the attention of our readers to the fact that the High Commissioner of Canada, by the instructions of the Minister of Agriculture, had invited representative tenant farmers from different parts of the United Kingdom to proceed to Canada to report upon its agricultural resources, and the advantages the country offers for the settlement of farmers and farm labourers, and of other classes for which there is a demand. The reports of these gentlemen have now been published, and we commend them to the attention of all who may have any idea of settling in Canada or of sending their sons to that country. They have been issued in four parts, the first two of which are by the delegates from England, while the other two are by those from Scotland and Ireland. This plan makes them more convenient for distribution, which is being done very freely by the agents of the Canadian Government throughout the country, and also by the various steamship agents who are to be found in almost every village. The different representatives have, of course, looked at the subject from their own point of view, or rather from the point of view of the suitability of Canada as a place of settlement for people from their own parts of the United Kingdom, and, of course, there is thus a considerable variety of opinion. The Canadian Government has also issued a new edition of its official handbook, and in it will be found a large amount of trustworthy information which should be carefully studied by intending emigrants.

In the preface to the reports of the delegates will be found a synopsis of the land regulations in the different provinces of the Dominion, relating to free grants of land. It also gives the prices of farms which have become vacant from various reasons, and are most suitable for persons possessed of some means, who desire more of the social surroundings than can be obtained in those parts of the various provinces in which Government lands are still available for occupation and settlement.

The importance of Canada, from an agricultural point of view, may be estimated from the fact that the value of its agricultural products alone now reaches nearly $40,000,000 per annum, in addition to the immense quantity required for home consumption. The climate of Canada seems to largely deter many people from thinking of Canada as a place of residence. No doubt the winters in many localities are severe, but, on the whole, it is one of the healthiest of countries, as is shown, not only by the statistical returns, but also by the general healthfulness and physique of the population, which is a subject of remark by all visitors and new settlers. Canada has now a reputation for fruit far beyond its boundaries.

We cannot, of course, enter into details of the various reports, but we may say that they all contain a very large amount of information. The delegates do not hesitate to give candid opinions where these are necessary, on the different points brought under their observation, and have not endeavoured simply to "write up" the country. They give particulars of the climate, soil, methods of agriculture, land regulations, experimental farms, roads, dairy farming, cattle ranching, wages, loans, schools, churches, and taxes, and they do not hesitate to point out some of the defects of the country. In some districts drought causes considerable difficulty, while hail storms, autumn frosts, and occasionally locusts and mosquitoes, give trouble. As to the class of persons principally wanted in Canada, Mr. John Speir, one of the Scotch delegates, points out that they are farmers of all classes, farm servants, domestic servants, and a few artisans; all others are, for the present, unlikely to be any more successful there than at home. The men likely to meet with most success are those who have been in occupation of the smaller class of farms at home, and who, between themselves and their families, can do a good proportion of their own work, for labour is so costly that if much of it has to be hired a considerable part of the profit is thus lost. We cordially commend the whole of the reports to the attention of those of our readers who are interested in Canada.

OIL-FIRED BOILERS FOR SUBMARINE VESSELS.

It is a recognised fact that, if petroleum is to displace the use of coal to any material extent as fuel for generating steam, it must, to compare favourably, be employed in boilers specially designed for its combustion. Messrs. Fraissinet & Co., of Marseilles, whose exhibits of marine boilers at the late Paris Exhibition attracted a considerable amount of attention, seem to have made a special study of the adaptability of oil fuel for boilers employed in submarine navigation. That this study has met with considerable success will be seen from the particulars and illustrations, given herewith, of two boilers of the above class, one of which is designed for

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OIL-FIRED BOILERS FOR SUBMARINE VESSELS.

CONSTRUCTED BY MESSRS. FRAISSINET & CO., ENGINEERS, MARSEILLES.

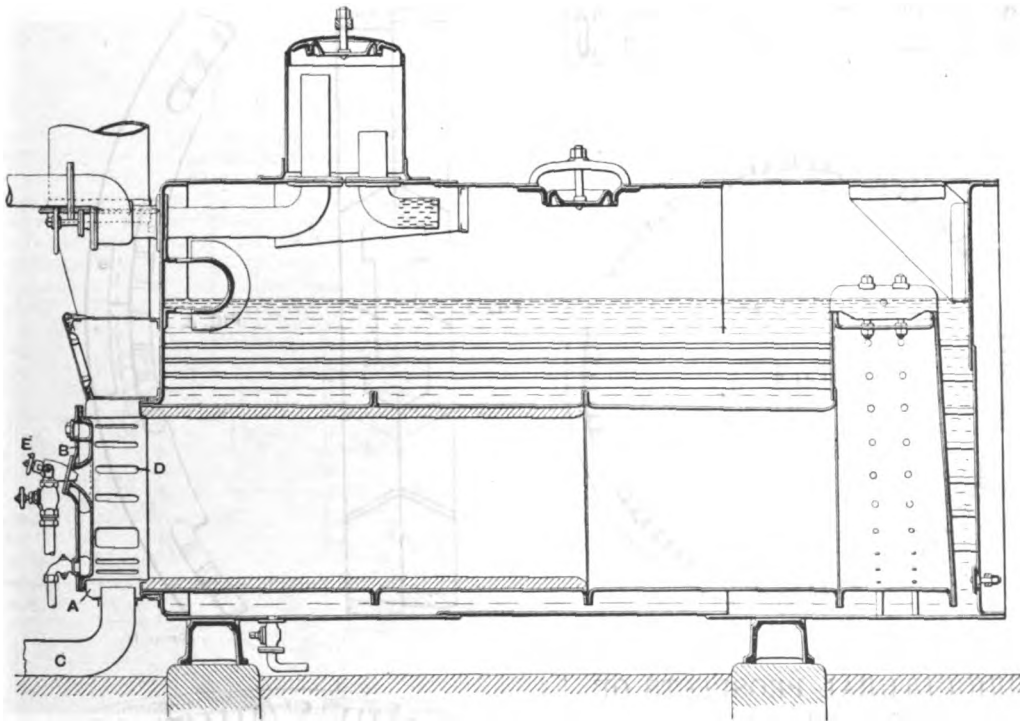


FIG. 1.

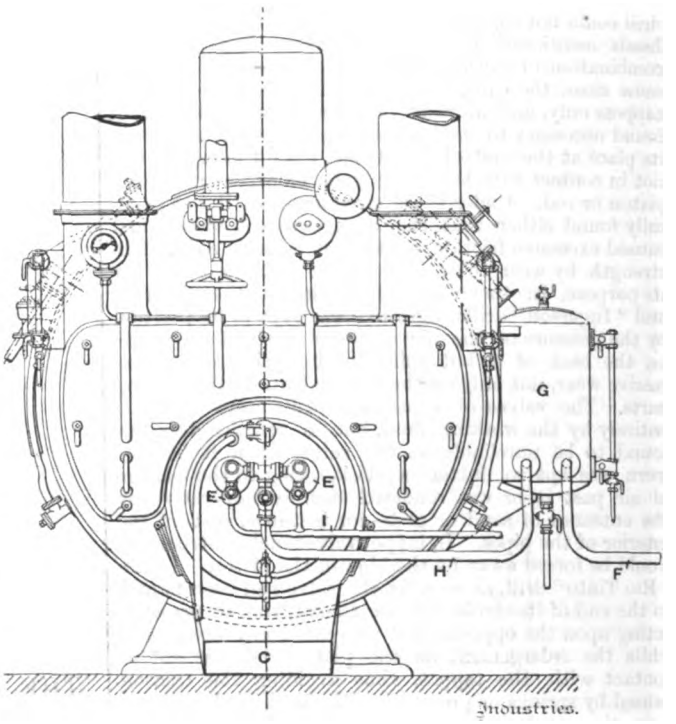


FIG. 2.

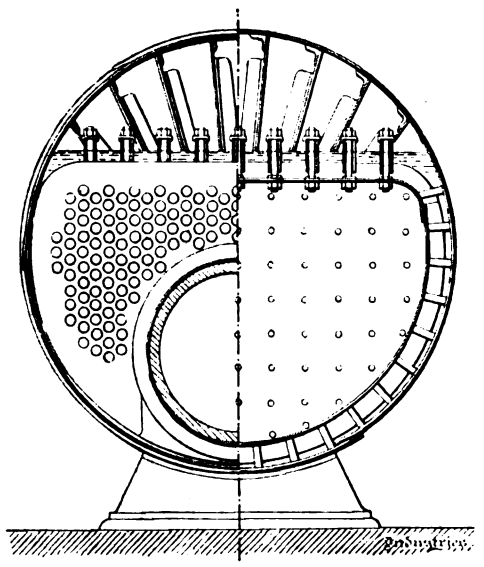


FIG. 3.

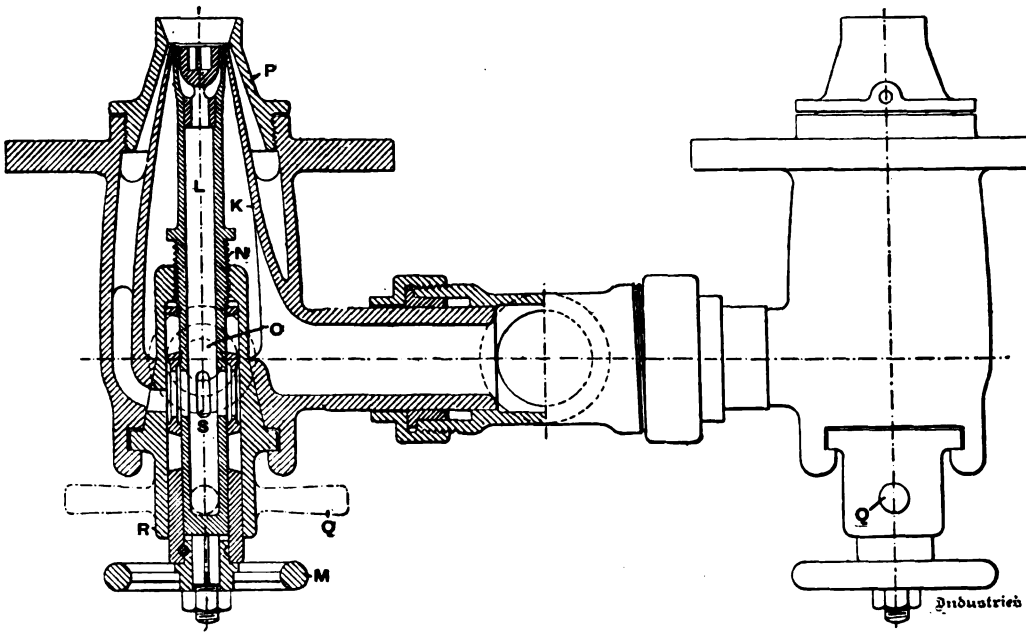


FIG. 4.

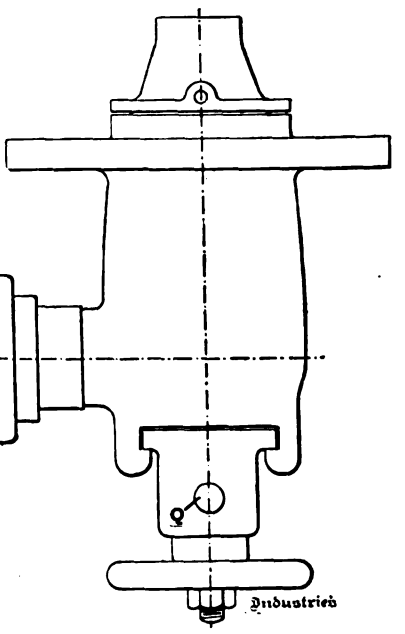


FIG. 5.

working under ordinary draught, while the other is capable of working either under ordinary conditions or under air pressure. In Figs. 1, 2, and 3 we give a longitudinal section, a front elevation, and a transverse section of a boiler of the first-named type.

This boiler has been constructed for a working pressure of 130lb. per square inch. It is 13ft. 9in. in length over all, 12ft. 1in. from the back to the front plate, the length of the tubes being 10ft. The external diameter is 6ft. 6in., and the internal diameter of the furnace about 2ft. 4in. As will be seen, the boiler is of cylindrical form, with an internal furnace, slightly projecting beyond the front of the boiler, lined with fire-bricks for about two-thirds of its length, terminating in a combustion chamber, and, except for its relatively long furnace and the omission of fire-bars, similar to an ordinary return multitubular marine boiler. The extension of the furnace A at the front of the boiler is formed of wrought iron, with a cast-iron front B. The air required for combustion is supplied direct to the furnace by means of a ventilator connected to the pipe C, the air being divided into two currents as it enters the box A, through the orifices D, an air pressure equal to 1in. of a column of water giving good results. It will thus be noticed that instead of the air for combustion passing into the furnace in the same direction as the oil fuel, it enters at right angles to the latter, and this arrangement, it is claimed by the makers, ensures a more complete mixing of the gases and more effective combustion. On the front of the furnace two jets or burners E E for supplying the liquid fuel are placed (see Figs. 1 and 2). The petroleum, being first pumped into storage tanks or bunkers, flows through the piping F into the reservoir G, which is supplied with a glass gauge, so that the engineer can be certain of having an ample supply in the reservoir, from which it passes through the pipe H into the burners E E (Fig. 2), the steam or compressed air necessary for the splitting up of the petroleum being supplied through the pipe I. In Figs. 4 and 5 enlarged views of one of the burners are given. Through an inlet the petroleum passes into the conical receptacle K, which is formed of gun-metal, its escape into the furnace being impeded and regulated by the spindle L, which is manipulated by means of the hand-wheel M being advanced or drawn back on the screw N, the maximum annular opening for the escape of the petroleum being two millimetres. The steam or compressed air supplied through O surrounds the oil space K, and when steam is employed increases the temperature of the petroleum and passes between the cones K and P in a cylindrical spray, enveloping the petroleum and projecting it in the form of spray into the furnace. In this respect this oil injector is similar to others employed by other firms, but this, the J. d'Allest petroleum injector or burner, has also provision for increasing the quantity and the effectiveness of the consumption of oil, this being found necessary where, as in torpedo boats, a maximum power is required. For this purpose the spindle L is made hollow, so that the steam or compressed air can enter into it at S and pass through the centre of the spindle L. By this means the petroleum passes into the furnace surrounded with two currents of steam or compressed air, so that no particle of oil escapes the splitting up action, the operation being similar to an Argand burner. The operation of lighting the furnace is similar to other petroleum furnaces, by means of a torch, and when a sufficient quantity of air is obtained through the ventilator there is complete combustion and an absence of smoke. As already indicated, in the boiler illustrated there are two fuel injectors or burners, and this arrangement considerably facilitates operations and practically obviates the possibility of stoppage in the supply of fuel to the furnace, as well as giving greater control over the generation of steam. Each injector being provided with a stop-cock to the oil supply, either of them can be extinguished and again relighted. If, by any means, the injectors should become choked, the rapid turning of the

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OIL-FIRED BOILERS FOR SUBMARINE VESSELS.

CONSTRUCTED BY MESSRS. FRAISSINET & CO., ENGINEERS, MARSEILLES.

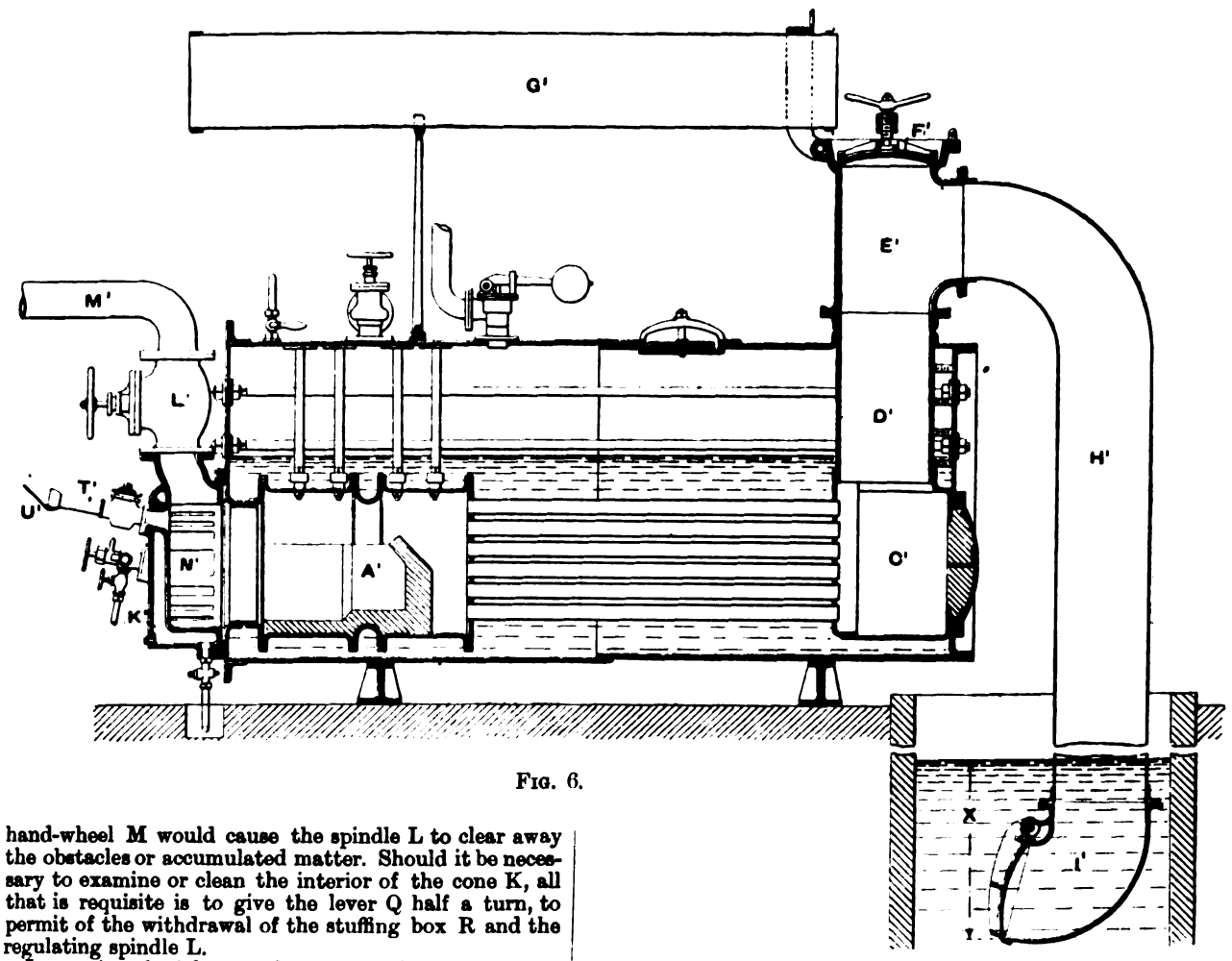


FIG. 6.

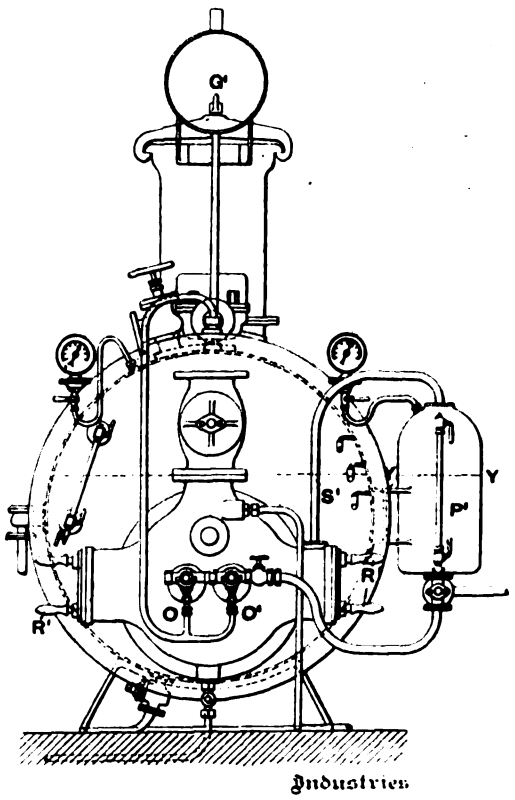


FIG. 7.

hand-wheel M would cause the spindle L to clear away the obstacles or accumulated matter. Should it be necessary to examine or clean the interior of the cone K, all that is requisite is to give the lever Q half a turn, to permit of the withdrawal of the stuffing box R and the regulating spindle L.

In a series of trials carried out with this boiler on land, there has been no difficulty in evaporating 80 litres of water per square metre of heating surface per hour—equivalent to 16·35lb. of water per square foot of heating surface. At this rate of evaporation, a tendency to priming was experienced, but with about 70 litres evaporated per square metre of heating surface the water was ordinarily tranquil. Adopting 70 litres per square metre of heating surface as the normal evaporative capability, this boiler, having 100 square metres of heating surface, will evaporate 7,000 litres of water per hour, and the total weight of the boiler, including water, fire-box, air conduits, and all usual fittings, being 13,108 kilogs., the weight of boiler, water, &c., per kilogramme of steam is 1,872 kilogs., with a fuel consumption of 636 kilogs. of petroleum per hour. The quantity of water evaporated per kilog. of petroleum, under these conditions, is 11·06 litres, or 11lb. of water evaporated per 1lb. of petroleum.

There are, no doubt, important advantages to be derived from the use of liquid fuel in torpedo boats. With boilers of the type above described, using liquid fuel, the closed stokehole is dispensed with. From a naval point of view, the absence of smoke, sparks, &c., when petroleum is used as fuel, is also important, as the destination and whereabouts of the vessel would not be so easily gauged by the enemy. Reference has already been made to the saving of weight in the boiler, &c., owing to the greater evaporative efficiency of petroleum, but such an important feature can scarcely be over-emphasised, as it renders possible greatly increased speed with equal weight of boilers, or decreased weight and equal speed. In the boilers constructed on J. d'Allest's system it is also noteworthy that the evils common to boilers of the locomotive type fitted in torpedo vessels—due to the excessive local heat—are obviated by the adoption of a fire-box and return tubes, 196 tubes of 2in. external diameter being fitted in the boiler illustrated in Figs. 1, 2, and 3.

The above illustrations (see Figs. 6, 7, and 8) represent a marine boiler for burning liquid fuel, specially designed by the same firm for submarine vessels. Fig. 6 shows a longitudinal section, Fig. 7 a front elevation, and Fig. 8 is a transverse section of the boiler, which is 9ft. 3in. in length from back to front plate, and 4ft. in external diameter, with one furnace A^1, having an internal lining of fire-brick on the bottom and sides and a bridge of the same material. The furnace is connected to the combustion chamber C^1 by 58 tubes, 2¼in. external diameter, 4ft. 10in. long, the whole boiler being constructed for a pressure of five atmospheres. On the smoke-box D^1 is placed a casting E^1, which can be closed as shown at its upper part by a water-tight manhole door F^1 when the vessel is to be submerged, the ordinary funnel G^1 being hinged so as to be canted over and rest upon a suitable support. Connected to the casting E^1 is another funnel H^1 leading into the water either under the

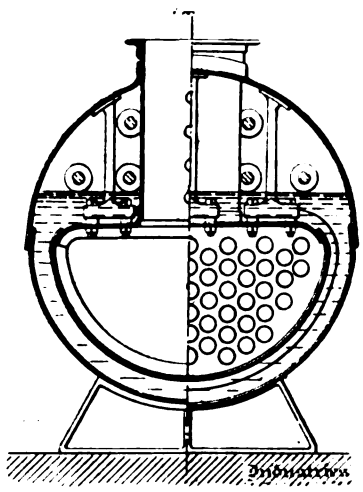


FIG. 8.

bottom, or through the sides of the vessel, having at its extremity a sea valve I^1. The front of the furnace K^1 is of cast iron and fitted perfectly air-tight. air under pressure being supplied to the furnace through the pipe M^1, a stop valve L^1 being placed intermediately to regulate its supply. The air meets the liquid fuel at right angles, as in the previously described return tube boiler, passing through the apertures N^1, the petroleum from the reservoir P^1 being injected through two burners or pulverisers O^1 O^1, shown in Fig. 7, and also upon a larger scale in Figs. 4 and 5, attached to the front of the furnace. It will be apparent that this boiler can be either worked under ordinary draught or under pressure. In the former instance, the manhole door F^1 is removed, the funnel G^1 raised to an upright position, the plugs R^1 (Fig. 7) unscrewed, and then, if the pulverisers are set to work and the furnace lighted, the boiler works in the usual manner, the air necessary for combustion entering through the openings R^1, and the products of combustion escaping by the funnel G^1. Supposing, however, a vessel in which this boiler was fitted was being submerged, the manhole F^1 and openings R^1 would be hermetically closed, compressed air being forced into the furnace through the pipe M^1 (Fig. 6) at a somewhat greater pressure than that represented by a column of water X (Fig. 6), viz., the depth to which the valve I^1 was immersed. Combustion would thus continue to be effected, the unconsumed gases being forced to the valve I^1, by which they would escape, provided the supply of petroleum to the furnace was continuous. This is provided for by connecting the reservoir P^1 with the furnace by a pipe S^1 (see Fig. 7), so that the same air-pressure will exist, in both the furnace at the front of the pulverisers and the portion of the reservoir P^1 above the level Y Y of the petroleum, the weight of the latter causing it to flow to the pulverisers or injectors whatever the pressure of air supplied to the furnace. The difficulty of ascertaining the rate of combustion, in the hermetically closed furnace, has been overcome by providing a tube T^1 (Fig. 6) closed at its external end by a thick glass; as, however, the latter might suddenly break, a small hinged mirror U is provided, so that the observer may see the condition of the fire by reflection and escape the danger of being burnt. For submarine purposes a sufficient quantity of compressed air would have to be stored in the vessel, with reducing valves, so that the air used in the furnace of the boiler might be at a suitable pressure, this being dependent, as already indicated, upon the depth of immersion, readily ascertainable by a hydrostatic pressure gauge. As to how far submarine navigation is practicable with liquid fuel, as compared with stored steam, or electric motors driven from accumulators, is no doubt a question of moment. In any case there are serious drawbacks, but Messrs. Fraissinet & Co. at least deserve credit for their enterprise.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 31st March, 1891.

Iron.—A meeting was recently held at Paris of several of the largest forge-owners in the country, at which it was unanimously agreed to limit the production of iron, and, if necessary, to reduce the number of working days, and also to immediately raise the market price of the metal 8s. per ton. In the face of this co-operation on the part of the producers, nearly all the merchants on the Paris market have issued circulars quoting bars at 136s. 7d., and joists at 144s. 7d. per ton. These prices will be approximately adhered to, except in the case of very important orders, when an allowance of 3 or 4 per cent. may be made. Old iron rails continue to be quoted at 72s. 4d., and there is a good demand for castings at 112s. 6d. per ton. From the provinces the reports are, in general, good, and testify to a steady improvement in the iron trade throughout France. Several important orders have been received in the North from abroad. A strike of puddlers has taken place at Hautmont, where there are altogether 2,000 men idle, and some fear was expressed of the disaffection spreading further. The cause of the men leaving their work in the first instance was a reduction of 5 per cent. in their wages.

Coal.—There is no change in the state of the coal market. The demand is especially strong for the classes of fuel used for manufacturing purposes.

Copper, Tin, Lead, and Zinc.—The copper market remains stationary. Best Chilian bars are quoted at £56 8s., and ordinary Chilian bars at £54 10s. per ton. Tin has fallen 10s. per ton, and the demand for this metal is generally weak. An order for 22 tons of tin has been given by the French Admiralty at £92 16s. 8d. per ton. Lead continues to be quoted at £13 2s. per ton. The zinc market is weaker than it was, all qualities having decreased in value 7s. per ton.

Atlantic-Mediterranean Ship Railway. — Some time ago a proposal was made to construct a ship canal through France to convey vessels from the Atlantic to the Mediterranean without their having to go round by way of Gibraltar. This proposal was, however, given up on account of the great cost. It is now reported by your contemporary, *Annales Industrielles*, that a special committee has been formed at Bordeaux which proposes to replace the ship canal by a ship railway of a length of about 280 miles.

Cable Tramways in Paris.—It has been proposed to facilitate the communication of some of the high-lying parts of Paris with the more central districts by means of the establishment of rope tramways, and with this object a line was constructed last year joining the Belleville quarter with the Place de la République. A preliminary trial of the line was not satisfactory, and its opening was deferred until the necessary modifications had been made. Another series of experiments was afterwards undertaken, when it was found that either the traffic or the frost, or, perhaps, both, had caused the opening of 20 millimetres, which serves as a passage for the grip, to be contracted in places to 11 millimetres. This opening had been left as narrow as possible to obviate the danger of carriage wheels getting into it, but it has now been enlarged throughout to a uniform width of 28 millimetres. The endless rope was then found to have become slack, and it was only recently that the trials could be recommenced. On this occasion the cars worked fairly well, and on their first trips attained the speed of 120 metres per minute, or two-thirds of their proposed normal velocity.

VIENNA, 30th March, 1891.

The Iron Market.—There has been no change in the Austrian iron market during the past week. The market generally is dull, and only materials used for constructive purposes maintain their price. At a recent meeting of the Pilsen Machine and Waggon Works Company, a report was presented to the shareholders, which showed a profit of 13,000fl., and it was resolved that a dividend of 6 per cent. should be paid.—The shares of the Alpine-Montan Company are being much inquired for. It is reported in the money market that this company has made a profit of three million florins during the past year, and will pay a dividend of 6½ per cent. During the previous year the company made a profit of 2·2 million florins, and paid a dividend of 5½ per cent.

The Coal Market.—The opening up of traffic on the Elbe has caused a considerable increase in the coal trade of Bohemia. Since last week large quantities of coal have been despatched daily from Laube and Bodenbach for the export trade.

Cotton and Yarns.—A large number of influential cotton manufacturers in Austria have combined to form a syndicate. The principal cause of the creation of the syndicate is the negotiations which are being carried on between Austria and the German Empire. It is feared that some branches of home industry may be neglected, and the manufacturers have combined in order to make their influence felt.—The Vienna Chamber of Commerce has just received a communication from the Ministry of Commerce with reference to the numbering of yarns. This report states that the Ministry of Commerce has been informed by the Austrian Foreign Office that the marked falling off in the export of English cotton yarns is attributed by the English Foreign Office to the mischievous effect of incorrect descriptions of the goods when they are distributed by Austrian spinners. This view has already been put forward by the Manchester Chamber of Commerce. The English Foreign Office draws attention to the want of some legislation in Austria analogous to that of the Merchandise Act of 1887. The Chamber of Commerce and Trade and other competent authorities in this country have already expressed themselves in favour of the proposal of Mr. von Pacher for uniformity in the description of goods. The Vienna Chamber of Commerce has been requested to consider this subject again, and to make some proposals to the Ministry of Commerce with reference to it. The Ministry of Commerce further points out that it would be impossible to make a regulation similar to that contained in the Merchandise Act, according to which hanks of yarn must be made up in lengths of 840 yards, as the Austrian law of July 23rd, 1871 provides that all measurements must be made on the metric system.

Exhibition at Prague.—An Exhibition is to be held at Prague during the present year in commemoration of the first Trades Exhibition held on the Continent in 1791. The Exhibition, which will be open from May next till the 15th September, will comprise an international section of appliances for the prevention of accidents. This section will be divided into the following groups:—Machinery, chemicals, mining and foundry work, architecture, transport, lighting, ventilation, and fire engines. Full particulars may be obtained by applying to the Executive Committee, at 55, Winzelsplatz, Prague.

Exhibition of Carpets at Vienna.—An Exhibition of all kinds of ancient and modern carpets is to be opened next month in Vienna. The Exhibition will be held in the Imperial Austrian Commercial Museum, and full particulars may be had upon application to the secretary, 1, Börsenstrasse, 3, Vienna.

BRUSSELS, 31st March, 1891.

The Iron Market.—The iron market continues inactive. Business is very slack, and new orders are scarce at unremunerative prices. Constructive works and steel works have a better supply of orders than rolling mills, of which many are limiting their activity. Buyers refuse to deal at any increase of prices as far as concerns the cost of working. As has been already stated, it is intended to form an important society in Belgium in order to favour export trade. The directorate of this society was elected at Brussels on the 25th inst.—Some important contracts have recently been placed by the Belgian Government with home manufacturers.—An order for electric lighting apparatus for railway stations and for carriages has been placed with the Franco-Belgian Electric Lighting Company at Brussels.

The Coal Market.—There is little change in the coal market with the exception of a reduction in the price of *fines demi-grasses*. The demand for fuel, however, increases in the case of most industries, but little business is done at present in the hope that better prices may prevail. The stocks being now at a low ebb, the present output is soon taken off the market, although sugar and other industries have passed their period of greatest activity. The recent strikes at Seraing have caused some apprehension, and will make owners of coal mines inclined to maintain prices.

The Glass Trade.—The syndicate of glass manufacturers has decided to give some advantages to their customers by offering them from 1 to 2½ per cent. on their purchases. This will be the means of retaining their best customers. The proposal to stop some of the works meets with many difficulties, owing to the present conditions of manufacture.

Electric Lighting.—The Municipal Council of Antwerp are discussing a project for an installation of electric lighting, for which the motive power will be supplied by turbines. Different opinions are held as to the success of the scheme. The project for the electric lighting of Brussels makes little progress. It has been decided to construct a small circular electrical railway in the Bois de la Cambre. The scheme has been approved by Baron Jamblenne, who has worked out the technical details of the project.

Goods Traffic on the Belgian Railways. — The following statistics have been given with reference to the number of waggons employed on the Belgian railways from the 15th to the 21st of March during three consecutive years :—

	1889.	1890.	1891.
Coal and coke ...	20,611	22,679	21,223
Other goods	35,419	34,475	35,715
Railway service..	3,057	2,359	2,811
	59,087	59,513	59,749

The Belgian State Railways.—A considerable falling-off in the receipts realised last year by the working of the Belgian State Railways has been noted. The figures for 1890 show a deficit of 5,000,000fr. when compared with those of the two former years. Among the causes, according to the report just presented to the House of Representatives, is the great rise which has taken place in the price of fuel. From the figures given it appears that the average prices from 1887 to 1890 were, in succession, 4fr. 79c., 5fr. 80c., 6fr. 81c., and, lastly, 10fr. 97c. in 1890. Steel rails had also risen greatly in price. The ton of steel rails, which in 1887 cost on an average 108fr., has gone up each year in succession to 115fr. 65c. to 115fr. 52c. and to 132fr. 60c. last year. The last tender for Goliath rails, which are being more and more used on the Belgian lines, was 153fr. The long-distance lines will soon be laid with these rails, weighing 51 kilos., while the average rail formerly used was only 36 kilos. per metre. About 325 kilometres of Goliath rails have already been laid, which took 34,000 tons of steel.

DÜSSELDORF, 31st March, 1891.

The Iron Market.—The condition of the iron and steel market remains unaltered. Business in pig iron is still depressed. The Rhenish-Westphalian Pig Iron Union has been compelled by foreign competition to lower the prices generally from 1 to 4 marks. The following statistics are given with regard to stocks at the blast furnaces :—

	March 1st, 1891.	February 1st, 1891.
Best puddled iron	39,258 tons.	39,552 tons.
Ordinary puddled iron	5,901 „	6,498 „
Bessemer iron.....	9,467 „	12,297 „
Thomas iron	27,840 „	29,721 „
	82,466 „	88,068 „

The stocks of foundry pig iron at the blast furnaces amounted to 21,540 tons at the end of February, 1891, as compared with 23,245 tons at the end of January. The bar iron works continue to be not fully employed, and there is no improvement in the condition of the market for rolled iron. The business in thin sheets is still dull. Wages have been already reduced in the Siegen district. Works which are concerned in the production of railway material are briskly employed in carrying out new contracts. Machine works and iron foundries are generally well employed.

The Coal Market.—The demand for coals becomes more urgent every day. Railways and ironworks are trying to complete their stocks of fuel. The union of owners of gas coal mines has already ordered a rise of 1 mark per ton. It is to be feared that the export of coal will be considerably reduced through the anticipated rise in prices. The demand for coke has also largely increased.

AMSTERDAM, 30th March, 1891.

The Royal Engine Factory at Amsterdam.—The Royal Engine Factory at Amsterdam has been reconstructed as the Dutch Factory of Machinery and Railway Material, with a share capital of 1,280,000 guilders, and a mortgage loan of 920,000 guilders at 4½ per cent. From the prospectus, now issued, we gather that the works of the old company, that went into liquidation in consequence of heavy contract losses, will be taken over for 1½ million guilders, which is considerably under cost price. The new company will acquire a freehold plot of ground extending over 82,500 square metres in a favourable position, together with all buildings erected thereon and the stock they contain, valued at 226,000 guilders. The old mortgage debt will be cancelled by the payment of 100,000 guilders in cash and 480,000 guilders in new shares. Part of the new shares (600,000 guilders) bear a combined guarantee of 4 per cent. by the Holland Railway Company and of the State Railways Company, the essential condition being that the Dutch Factory of Machinery and Railway Material should give up shipbuilding as much as possible, substituting for it chiefly the manufacture of railway plant. Mr. C. H. Strumphler, at present manager at the well-known iron works of Messrs. Stork & Co., at Hengelo, will act as the director of the new undertaking. The result of these subscriptions so far has been that the whole of the guaranteed shares, and half the unguaranteed shares have been taken by the public. It may be noted that Queen Emma has put down her name for a considerable number of shares of both descriptions.

New Postal Law.—The Second Chamber of the States-General has passed the Government Bill for the better regulation of the postal service. Its provisions as to postage are extremely liberal. The cost of transmitting ordinary newspapers up to 40 grammes (say, a little less than 1½oz.) will be, for instance, only half a cent., which is under ½ of an English penny, whilst 150 grammes (say, 5oz.) of newspaper matter may be sent through the post for 1 cent., being under a farthing. The transmission of letters and samples will be proportionally cheap. "Copy" may be sent at "book rate," even if not accompanying any proof, or with a proof of other "copy." The Government opposed this clause, as facilitating fraud, but the amendment embodying it was carried by a large majority. The Bill has still to pass the First Chamber.

STOCKHOLM, 28th March, 1891.

The Gothenburg-Boros Railway.—Great interest is taken in this new railway, and plenty of capital appears to be forthcoming from various sources, the subscriptions having already reached about 2,000,000kr. The line will prove of considerable commercial and industrial value.

"Peat Coal" Manufacture.—When the question of transforming peat into a more convenient form of fuel was first raised it attracted much attention, but doubts as to the practicability of the process were freely expressed. The practical tests now going on at Omberg appear, however, to yield very satisfactory results. Several more manu-

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factories will be started in various parts of the country during the forthcoming summer. It is thought that the production of "peat coal" will be advantageous to other industries.

INSURANCE OF WORKMEN AGAINST ACCIDENTS.—Attention has on previous occasions been drawn to the frequency of the workmen in industrial establishments being collectively insured against accidents in Sweden. The Fylgia Insurance Company has published particulars of 607 collective accidental insurances, which include 25,152 workpeople. Among these—

	Workpeople.
100 saw mills and other timber industries insure	7,150
27 manufacturing engineers and foundries	3,428
27 weaving and spinning mills	1,734
32 railways	1,348
13 lime and cement works	1,194
40 breweries	1,162
16 iron works	1,112
3 sugar works	854

THE SWEDISH ENGINEERING SOCIETY.—This Society recently held its annual general meeting at Stockholm. In the report special stress was laid upon the recent amalgamation of the two Swedish engineering societies. This arrangement is expected to greatly benefit all concerned. The members numbered 1,364 at the beginning of the present year, and during 1890 sixty-eight sectional and two general meetings have been held. The plan for the proposed large Stockholm Exhibition was discussed.

COPENHAGEN, 28TH MARCH, 1891.

THE AOLBORG PORTLAND CEMENT WORKS. — The Aolborg Cement Works will commence work in a few days, and is likely to become an important establishment. The capital is 800,000kr., and the buildings were begun about fifteen months ago. The engineering firm of Messrs. Smith & Co., Copenhagen, have had the contract for the works. The annual capacity is estimated at 125,000 barrels of cement.

LIGHT RAILWAYS ON THE DECAUVILLE SYSTEM.—Mr. Joh. Steenberg has applied to the Danish Government for concession to build and work narrow gauge railways on the Decauville system in various parts of the country. The first series of lines comprises thirty different railways, with an aggregate mileage of over 400 miles, and at a calculated cost of 10,000,000kr. It is intended that a large Danish company shall be formed to construct and work all these lines, with one central board of management.

THE BUTTER INDUSTRY.—The export of butter from Denmark during last year shows again a large increase as compared with that of the previous year, the figures being respectively 89,200,000lb. and 68,800,000lb. The increase in exports is not solely due to an increase in production, but to a decrease in the home consumption, in which margarine and cheaper imported butter have in many cases taken the place of good Danish butter. The import of foreign butter into Denmark during last year amounted to 18,700,000lb., or nearly 5,000,000lb. more than during 1889. Of the imported butter 15,000,000lb. have been used for home consumption, and the balance has been re-exported. Of the exports over 83,000,000lb. have gone to England.

MADRID, 30TH MARCH, 1891.

PATENT FUEL WORKS AT BILBAO.—A factory with the best plant is to be established at Bilbao for the manufacture of patent fuel. The pitch will be obtained from tar produced by the coke furnace of La Niscaya, which uses Carvé's system for the collection of the bye-products.

BILBAO COKE OVENS.—Messrs. Martinez Rivas are starting 90 coke ovens of the Coppée type, which will produce 200 tons per day, and will thus supply sufficient coke for their four blast furnaces. These furnaces, in addition to other bye-products, supply gas capable of raising steam for engines of 280 horse-power.

MERCURY MINES.—Mr. Gomez Hemas, a mining agent, has recently visited the neighbourhood of Llerena, and has acquired the right to purchase the three mines, Marzo, San Miguel, and Coronada, and work them in the meanwhile by paying a royalty. The cinnabar in these mines is visible for about one mile. Samples of the ore from a depth of 7 metres show 60 per cent. of metal on analysis, ore at a lesser depth gives 16 per cent., whilst mere outcroppings give 2 per cent. It is supposed that these mines have been acquired on behalf of a prosperous company, who are already working ores that yield less than 1 per cent. in other districts. In the mines of Almaden the cinnabar is found in sandstone, but at Llerena it is found in limestone.

ROME, 30TH MARCH, 1891.

NEW WAR VESSELS.—Messrs. Fratelli Orlando, of Leghorn, recently launched from their shipbuilding yard a large steel torpedo boat, the "Aretusa." This vessel is similar to the cruiser "Tripoli," and is provided with quick-firing guns. The engines, which were designed by Messrs. Orlando, and were executed at the works in their yard, are of 4,000 h.p. The vessel is to have a speed of 38 kilometres per hour. Two other cruisers of more importance, the "Umbria" and "Etruria," have just been completed at the same yard, and both vessels will be launched on the same day in April.

A NEW SUBMARINE GUN.—A submarine gun has lately been tried on the Lake of Como with success. The gun was submerged in the lake at a depth of 100 metres, and, notwithstanding the great pressure of the water, its charges succeeded in completely capsising a boat. Some further experiments are to be made on a larger scale.

THE RUBBER TRADE IN 1890.—The official Italian returns of the rubber trade in 1890 show a serious decrease in the imports, while there is slight increase as regards the exports, as may be seen from the following tables :—

	Quantity—Quintals.		Value—Lire.	
IMPORTS.	1890.	1889.	1890.	1889.
Rubber and gutta-percha :—				
Raw (solid and liquid)	3,089	3,051	2,471,600	2,135,700
In leaf, &c.	54	101	89,100	151,500
In threads, &c.	313	309	422,550	386,250
Otherwise worked	679	750	441,350	450,000
In tubes with metal	63	69	22,050	20,700
Mixed with tissues	683	650	341,500	292,500
In ribbons, bands, &c.	463	450	648,200	585,000
Electrical wires (covered)	169	219	88,725	120,450
Submarine cables, &c.	1,592	2,365	318,400	473,000
EXPORTS.				
Rubber threads	27	17	36,450	21,250
,, otherwise worked	260	290	169,000	174,000
,, in tubes with metal	17	39	8,500	17,550
,, ribbons, bands, &c.	152	104	212,800	135,200
Electrical wires (covered)	305	3	160,125	1,650

GAS AND ELECTRIC LIGHTING COMPANY.—At the general meeting of the Societá Anglo-Romana per l'Illuminazione di Roma Col Gas e Altri Sistemi, held recently, a dividend of 41 lire per share was declared, the total profits during 1890 amounting to £85,517. The company supplies electric light as well as gas. The electric plant consists of four dynamos driven by engines of 600 horse-power each, two dynamos with engines of 150 horse-power each, and one with an engine of 50 horse-power; three exciters, driven by engines of 40 horse-power each, steam being supplied by fourteen boilers of 164 horse-power each. The whole of this machinery has been erected by Messrs. Ganz & Co., of Budapest. The concentric high-tension cables used are 19,750 metres in length, and at the end of last year there were 143 transformers in use. The total number of lamps installed at the same date amounted to 11,156, of various powers, equal to 16,508 normal 16-candle lamps. There has been an increase of 3,478 lamps of various types, equal to 6,051 normal 16-candle lamps, during the past year. It has been said that this is one of the finest central stations on the alternating current system.

NEW YORK, 21ST MARCH, 1891.

NEW BILLET MILL.—The Ætna Iron and Steel Company, of Bridgeport, has placed an order with the Lloyd-Booth Company, of Youngstown,' for one 24in. three high billet mill of special design, to be used in its new steel plant, and two 22in. sheet trains. The billet mill referred to above was designed by Mr. C. W. Bray, secretary of the Lloyd-Booth Company, and it is claimed that it possesses some advantages not embodied in the present construction of billet mills.

NEW FURNACES.—The new furnace of the Rome Iron Company has been nearly completed. It is situated at New Rome, on the East Tennessee, Virginia, and Georgia Railroad, about two miles south of the city. The Chattanooga, Rome, and Columbus Railroad also runs near the furnace, over which the red ore will be hauled from Dirt Seller Mountain to the furnace. The plant is one of the best in the South, and the furnace will have a capacity of 80 tons per day. It is understood that two more furnaces will shortly be erected.

A COMPOUND LOCOMOTIVE.—A compound locomotive is being tried on the Southern Pacific Railway. It is a twelve-wheel freight engine, which was built as a simple engine at the Schenectady Locomotive Works, Schenectady, N.Y., and was put on the road about two and a half years ago. Under the supervision of Mr. H. J. Small, Superintendent of Motive Power, the engine has been compounded on the two-cylinder system adopted by the Schenectady Locomotive Works, including the intercepting valve designed by Mr. A. J. Pitkin, superintendent of the works. New cylinders have been applied, with the intercepting valve, receivers, &c. The engine has only recently been turned out of the shops. Tests will be made, states the *Engineering News*, as to its efficiency, especially to ascertain what the performance will be on mountain grades. In making the comparison, an engine will be used of the same weight and dimensions, with the exception of the cylinders. The following are the particulars of the compound engine: Cylinders, 20in. by 26in. and 29in. by 26in.; diameter of driving wheels, 51in.; diameter of truck wheels, 26in.; waggon-top boiler, 60in. diameter; firebox, 42¼in. by 104in.; 262 tubes, 2in. diameter and 12ft. 8in. long. Grate area, 30 square feet. Heating surface, 1,884 square feet. Driving wheel base, 13ft. 9in.; total wheel base, 23ft. 6in. Weight on driving wheels, 109,700lb.; weight on truck, 23,300lb.; total weight, 133,000lb. The tender is carried on 33in. truck wheels, and weighs 71,800lb. It carries 3,800 gallons of water and 6 tons of coal. The engine is fitted with the American Brake Company's brake.

ALUMINIUM.—The Pittsburgh Reduction Company has decided to offer pure aluminium at $1 per pound in any quantity. At this rate it is cheaper than nickel or German silver, and can be used commercially for many purposes, being nearly as cheap as copper. Metal below 97 per cent. and over 90 per cent. pure, containing no sulphur or phosphorus, for mixing with iron or steel, will be sold at 90 cents per pound.

THE OLSEN TESTING MACHINE.—Professor James Madison has presented the testing laboratory of Lafayette College, Easton, Pa., with an Olsen autographic automatic testing machine of 50 tons capacity, arranged for tension, compression, and transverse testing; a 1-ton cement testing machine; a full outfit of appliances for testing rock, cement, and mortar; a small machine for testing wire, cord, and cloth, and a Henning elongation meter, with micrometer callipers.

PHILADELPHIA, 20TH MARCH, 1891.

IRON AND STEEL.—The Standard Steel Company, near Chester, Pa., which recently shut down on account of a strike caused by the demands of the Brotherhood of Machine Moulders, has resumed work. The vacancies have been filled with members of the Iron Moulders' Union and non-union men. The Lehigh Iron Company, at Allentown, Pa., has reduced the wages of its employés 10 per cent. The employés of the Chesapeake Nail Works and the Central Works at Harrisburg are on strike because of a reduction in wages. Puddlers employed by the Glasgow Iron Company and the Pottstown Iron Company, at Pottstown, have accepted a reduction of wages from $3·75 to $3·50 per ton. The rolling mill at West Hamburg, operated by the Pottsville Iron and Steel Company, has resumed work. There are 125 men employed. Puddlers receive $4 per ton, although it was announced before shutting down that their wages would be reduced to $3·50.

HARBOUR IMPROVEMENT AT PHILADELPHIA.—In appropriating $300,000 for continuing the harbour improvement, on the 3rd inst., Congress imposed certain restrictions which made it impossible under the rules of the Engineer's Department to make any contract in accordance with specifications, and it was necessary, therefore, to reject all tenders. New specifications are now prepared, and if satisfactory to the War Department the contract will be awarded within thirty days. The harbour improvement will consist not merely in the removal of the Delaware Islands, 17,000,000 cubic yards of earth, but also in the restoration of the original proportions of the river by an advance of both the Pennsylvania and New Jersey shore lines. Of the material thus removed, 7,000,000 cubic yards are to be used to fill up League Island (navy yard), 1,500,000 cubic yards for the Camden (N.J.) shore, and 500,000 cubic yards for the Philadelphia shore.

RAILROADS.—It is announced that there will be a complete change in the management of the Louisville, New Albany, and Chicago Railroads, by which a large amount of traffic will be thrown into the hands of this company. Senator Brice and General Thomas have agreed to furnish a sum of money, for which they will be given control of the road. These gentlemen control the Lake Erie and Western Railroads, and are prominent in the Richmond Terminal, both of which roads will by this arrangement secure an entrance into Chicago.

THE NEW YORK CENTRAL RAILROAD.—The New York Central and Hudson River Railroad has taken possession of the Rome, Watertown, and Ogdensburg Railroad under a perpetual lease, which gives the former 700 more miles entirely in New York State, and an unbroken line from New York City to the St. Lawrence River, besides several important branches.

THE OIL WELL SUPPLY COMPANY.—The purchase of the Elba Iron Works and the Continental Tube Works, which was recently effected by the Oil Well Supply Company, will enable the latter in future to manufacture its own tubing.

NAVAL.—The work of constructing guns for the new war vessels is rapidly progressing at the Washington Navy Yard. There are at present 72 guns in various stages of construction. The two 10in. guns for the armoured cruiser "Maine" are nearly finished, and the two 12in. guns for the coast defence will be finished in three months. There are many guns of 6in. and 8in. bore. The Navy Department has invited proposals for the construction of the protected steel cruiser of 7,300 tons displacement, which is to be made entirely of materials of home manufacture.

ENLARGEMENT OF MESSRS. CRAMP'S SHIPYARD.—The foundry and machine shops of Messrs. J. P. Morris have been purchased by Messrs. Wm. Cramp & Sons, shipbuilders. Hitherto Messrs. Cramp have furnished sufficient work to keep five separate foundry and machine companies constantly employed.

ELECTRIC SUSPENSION RAILWAY.—The Davy Electric Suspension Company has been organised at Springfield, Ill., with a capital stock of $10,000,000, to build and operate a system of suspended carriages for the transportation of passengers and freight.

QUICKER SPEED BETWEEN PHILADELPHIA AND NEW YORK.—By an arrangement of troughs at Plainfield, the trains on the Philadelphia and Reading Railroad between New York and Philadelphia will be enabled to take water without stop or change of engines at Bound Brook, which has heretofore been the practice. These troughs are 1,500ft. in length, and enable the locomotive to scoop water while running at full speed. Steam pipes are provided on both sides of the trough to prevent freezing in cold weather. The distance between New York and Philadelphia is 90 miles, and by this arrangement the Reading Railroad is enabled to effect a saving of five minutes between the two cities.

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THE INSTITUTION OF CIVIL ENGINEERS.

At a meeting on the 24th ult., the President, Sir John Coode, K.C.M.G., being in the chair, a paper was read "On the Reception and Storage of Refined Petroleum in Bulk," by Mr. W. T. H. Carrington, M.Inst.C.E. The author described at length both the appliances necessary for dealing with petroleum in bulk and the methods of using them.

Mains forming the Pipe Lines.—These were usually of wrought iron, and were from 6in. to 8in. in diameter; the length of line seldom exceeded 500 yards. The connection with the steamer was by means of a flexible tube made of canvas and indiarubber, or canvas alone. The pipe line was constructed so that it could be readily cleaned out, and was also fitted with draw-off cocks. The valves used were preferably steam-valves. A "dirt tank" was provided, into which any cloudy oil was pumped, and the impurities allowed to settle. The pipe line entered the storage tanks either at the top or through the side near the bottom—the author preferring the former arrangement. If the latter plan was adopted an internal radial pipe was used, which could also be employed for suction purposes. It was, however, better to keep the delivery and suction pipes independent. The pipe line was tested to a pressure of 60lb. per square inch, the usual pressure when oil was being pumped varying from 20lb. to 40lb. per square inch. The rate of delivery was from 600 to 1,000 barrels per hour.

Tanks.—The size of tank to be used depended greatly on the nature of the work to be done. If the oil was of uniform quality, a number of large tanks of about 15,000 barrels capacity might be provided, and a few small ones; but a depôt dealing with many different classes of petroleum should be fitted with a number of small tanks and a few large ones. The size of the tanks was also governed by the bearing power of the ground. The foundations on rock or shingle needed only to be levelled; but on soft yielding ground many plans had been resorted to, such as—placing the tank directly on the ground, which rendered the bottom plates liable to rust; setting it on a layer of concrete, which must, however, be very thick and heavy to be of any value; making a foundation of chalk and ballast, which was often successful; piling to the underlying hard ground and supporting the tank on a gridiron formed on the top of the piles—this answered well, but was expensive. On rocky ground tanks might be carried on concrete walls, thus giving access to the seams from underneath. The author had also used timber walls resting on a timber platform as a support, where the foundation was soft. Large tanks were always made of a cylindrical section, with a flat bottom, and a domed, conical, or flat top. The diameters varied from 80ft. to 30ft. The author preferred iron as a material. On soft ground precautions must be taken to prevent the collapse of the tanks in the event of their sinking unevenly. This was better done by increasing the thickness of the lower tiers of the circular sides, than by the use of tee-bars or struts. The plates should be as large as possible, so as to lessen the number of rivet holes, which might lead to leakage. Where the roofs were domed or conical, they were of thin material, about No. 12 B.W.G., and were either carried by trussed frames, or by tee-bars, radiating from a central column. In hot climates flat tops were used, and made to carry a depth of about 6in. of water, in order to reduce the internal temperature, and therefore the evaporation of the oil. Either two or four manholes were provided in the roof, both in order to obtain access to the inside, and for ventilating purposes; occasionally others were placed in the sides near the bottom. These were convenient, but, in the author's opinion, should, if possible, be avoided, as they constituted a point of weakness. Tests were applied at two stages of the construction: First, when the bottom and first circular tier were riveted up, at which period the tank should be supported on wood blocks some little distance above the ground. It was then filled to a depth of 2ft. with water, and the bottom, being made perfectly tight, was coated with tar or varnish. The second test was made when the work was finished. It was necessary to clean the inside very carefully before the oil was put in; for this reason it was either painted with white zinc paint, or the whole internal surface was wiped with oily cloths. The petroleum, when delivered into the tanks, had to be measured in order to determine the quantity received. This was done by taking soundings at a number of points through suitable doors and manholes, placed for the purpose in the roof, a steel tape, fitted with a slider of ebony, being used for the purpose. In order to determine the quantity of water sent over with the oil from the discharging ship, a water-searcher, invented by Messrs. Horley & Sedgely, was employed. On being lowered to the tank bottom it brought up a section of the liquid, showing the depth of water and sediment lying there.

Delivering Arrangements.—The withdrawal of the petroleum for delivery from the storage tanks was done either by gravity, where the situation permitted it, or by pumping, and it was delivered into tank-barges and waggons, or into barrels. In the latter case it was pumped into a small tank, about 10ft. above the ground, from which it ran into the flexible pipes carrying the automatic cocks which were arranged so as to cut off the supply when the oil rose to a certain level in the barrel; with them one man could fill upwards of 50 barrels per hour. The usual number delivered daily from a large wharf varied from 1,000 to 1,500 barrels. Before being filled they were carefully examined, and, when necessary, coopered and made sound, and then, in order to make them perfectly oil-tight, about a quart of hot glue was put into each, and the barrel turned about in such a manner as to cause the liquid to cover the whole surface. After being drained they were put into a store to dry, and were then ready for use. The painting was done by boys with large brushes, but in some cases the barrels were dipped bodily into a tank containing a quantity of paint. A brush worked by steam had also been lately introduced, and was said to answer well. The weight of the barrel and the brand of oil it was intended to contain was also stencilled on it. Barrels formed a strong and convenient package, and though their use was becoming less general, owing to the introduction of tank waggons and carts, it would be probably a long time before anything more convenient for retail purposes would be found.

SOME DETAILS IN MARINE ENGINEERING.*

(*Concluded from page* 297.)

The Machining of Crank Shafts.—It is somewhat common to find it stated in specifications of triple-expansion marine engines that the built crank shaft shall have its main bearings turned when all the three sections of the shaft are bolted together. If the only point of accuracy that was worth attaining were the condition of having the axes of all the six main bearings truly in one line, the above would be a very wise condition to impose upon the engine builder in the specification. This, however, is far from being the case. It is just as important that the crank pins should run well as the main bearings, and to this end it is necessary that the axes of the crank pins should be truly parallel with the axis of the body part. Most modern crank shafts are made interchangeable, and many of them reversible as well. If this condition is to be fulfilled in the best possible manner, it is necessary that the faces of the couplings should be truly square with the axis of the body part. And if the simplest method of interchangement be provided for without loss of accuracy in the result, the axis of the couplings should be truly in line with the axis of the body parts, at the same time that both the previous conditions are fulfilled. If any one will give a little thought to this matter, he will find it is not sufficient to bolt three sections of a shaft together, leaving the body parts rough, and turning the whole when thus bolted together.

To fulfil the conditions above mentioned it is necessary that each individual section of the shaft should be true in itself. And it is a much more difficult and costly matter to make three individually accurate shafts, all precisely like one another, and accurately bolt them together so that the body parts are truly in line, than to bolt together three rough shafts and finish the body parts all at once. The method on which the writer proceeds in this matter is to finish the pins before shrinking together and leave the body parts rough turned. Then fix one individual section of the shaft in the lathe on the main body part centres, setting it accurately by the pin; that is to say, the shaft is revolved into four positions—top, bottom, right, and left. In these four positions a spirit level is laid on the finished pin, and the shaft moved in the centres until it will revolve in such a way as to show the axis of the pin is truly parallel with the axis on which the shaft is revolving. The shaft is then completely finished. Its main bearings are turned, the peripheries of its couplings are turned accurately to a dimension, and the faces of its couplings are surfaced down. When the three sections of the shaft have been thus treated they are set together by the peripheries of the couplings in V blocks, the bolt holes are bored and the shafts bolted together. The shaft is then brought as a whole again into the lathe, not, however, to be *turned*, but simply for examination, to prove the accuracy of the work. If the shaft is out of truth, that is, if the whole six main bearings are not running truly on one axis, the fault is obviously in the bolting together. To take a cut off any part would be to make the shafts no longer duplicate, and would undo what so much care had been spent in previously doing. The writer would not have called attention to this matter had it not been now so common to see the other method asked for in specifications, and which in his opinion only secures one good quality in the shaft out of many that are equally desirable.

Piston Packing.—There is, perhaps, no mechanical detail about an engine that has a greater influence on the economical use of steam than a thoroughly satisfactory piston packing. Piston packings have been designed in almost every conceivable form, and the patent specifications relating to the subject are perfectly bewildering. The writer does not propose to weary the meeting with a criticism of the various piston packings in use, and, indeed, such criticism would require a long paper to itself. There can be no doubt, however, that many packings are designed without a proper knowledge of what it is that is required of them when put to work. A packing that will do quite satisfactorily in a low-pressure cylinder may be unsuitable for the medium-pressure cylinder, and a packing that would suit a medium-pressure cylinder might not do at all in a high-pressure cylinder. The converse of this, however, is not necessarily true, for a packing that will be suitable for a high-pressure cylinder is likely also to be suitable for all lower pressures.

The writer has given close attention to this subject during the past ten years, and after many experiments made to discover the simplest possible packing that would answer in high-pressure cylinders, he finally patented, in 1886, the form of packing he now has the pleasure of placing before the Institution, and which, after a very extended trial and use, has more than satisfied his most sanguine expectations. Some engineers having tried various forms of packing in their high-pressure cylinders, with the result that the latter have been bored out perhaps ¼in. larger in diameter on a voyage, or corded in a shocking manner, have finally fallen back in despair upon the ordinary Ramsbottom rings, and as these have certainly the quality of producing a pretty cylinder, they thenceforward swear by them alone. Ramsbottom rings, however, wear at a considerable rate, and, worse than that, they pass steam from one side of the piston to the other and reduce the economy of the engines.

The writer has found considerable misapprehension existing in the minds of many engineers with whom he has come in contact regarding the physical conditions under which piston-packing exists when at work in the cylinder. For instance, many appear to suppose that, if the packing rings and their tongue pieces are so carefully fitted to the piston as to be practically steam-tight, no steam will get past them into the recess in the piston behind the rings. A moment's consideration, however, should show that if we have, for instance, 150lb. pressure on one side of a piston, and say 50lb. on the other side, it will be absolutely impossible for any perfection of fitting to be capable of retaining the space behind the packing rings for days and weeks together at atmospheric pressure. If it were possible to insert a tube into this ring space when the engines were at work and take a diagram, it would represent a sort of horizontal figure 8, and if the rings very freely pass steam, the upper ring of the figure would nearly reach the 150lb., and the lower limb the 50lb. which we have assumed to represent the pressures on the opposite sides of the piston. The more and more perfect the fitting of the rings, the more the figure 8 would flatten towards a straight line; and therefore the best possible condition, with the most perfectly fitted rings, would be a diagram showing a constant pressure of say 100lb. per square inch behind the rings. This really is the beginning of the subject in designing high-pressure packing rings, and it is this pressure of something like 100lb. per square inch on the internal surface of the rings, forcing them against the cylinder walls, that is the main factor to be dealt with. When this fact is recognised, nothing can seem more absurd than the placing of heavy springs behind the rings, forcing them against the wall, and so augmenting this already heavy pressure instead of reducing it. Indeed, in a vertical engine, a piston packing that is not allowed to run so far over the bell mouth at the ends of the cylinder as to receive a blow from the steam on its outer surface sufficient to drive it into the piston recess, requires no springs whatever behind it, and is infinitely better without any, for the very simple reason that when it is free from any connection with the body of the piston it acts as a floating packing, or, in other words, it is laterally independent of the piston, and follows the line of the cylinder walls only, regardless of where the piston may be. This floating quality is of very high importance in view of the cylinder retaining its circular form, as when it is absent the tendency of the piston to put pressure on one side or the other is communicated to the packing rings, and the cylinder is worn out of truth accordingly. The principal office of springs in a piston packing should be either to reduce the pressure on the walls of the cylinder due to the steam pressure behind the rings, or to minimise the effect of this pressure. The latter is perhaps the easier course to adopt, and in the packing under description this is done by making the upper and lower rings of the packing bear upon a wide surface on the junk ring and piston flange, and applying a very heavy vertical pressure against these surfaces proportionate to the steam pressure acting on the inner surfaces of the rings. The breadth of surface adopted is 2in. in all pistons from 18in. diameter up to 80in. As the leading idea in this piston packing is the attempt to secure the greatest universality of form, whilst complying with the varying physical conditions of pistons of all pressures and sizes, we may remark that the first point of universality gained is the breadth of bearing surface on the junk ring and piston flange just alluded to. In the next place, each of the two rings is made the same height as it is in breadth—viz., 2in. by 2in., the vertical height of the ring space, therefore, becoming 4in. This, it will be observed, gives a plain rectangular section of ring, and which has important advantages over any bevelled or otherwise shaped section, inasmuch as its natural tendency is, when opening out to a larger diameter of cylinder, to expand in one plane; whereas other sections, having more breadth at the upper than at the lower edge, are incapable of expanding in one plane, because one edge expands more freely than the other, with the result that the ring curls up, and requires re-bedding as soon as the cylinder begins to wear. That this rectangular section, 2in. by 2in., can be made satisfactory throughout so large a range of diameters as 18in. to 80in., and through so large a range of pressures as obtains between the high-pressure and low-pressure cylinders of a triple or quadruple engine, might at first sight seem surprising, but the explanation is simple—viz., that the higher the pressure the stronger and stiffer the rings require to be, and this variation in stiffness comes naturally with the lessening diameter whilst retaining the same cross section.

To the all-important question of the form and application of the springs much attention was given, with the result that this also was reduced to the most complete universality of size and form for pistons of all sizes and pressures ordinarily in use in triple and quadruple expansion marine engines. A spring of the common helical form 2 3/8in. in length and 1in. in diameter is found capable of meeting every condition where a spring is wanted, or ever likely to be wanted in any piston. To provide the heavy pressure that is necessary between the junk ring and piston flange, holes are bored in the upper surface of the lower ring, and in the under surface of the upper ring, into which these little helical springs are inserted. The distance apart of these springs around the circle can of course be varied, and this variation in distance apart, together with the variation that can be given in

* Paper read by Mr. Thomas Mudd before the Institution of Naval Architects on the 20th ult.

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the amount of compression of the springs, is found sufficient to meet all the differences required between high-pressure pistons and low-pressure pistons. It is, indeed, only by taking advantage of these natural adjustments that it becomes possible to make one form of spring suit every class of piston.

The great pressure used in pressing the packing rings by means of these springs against the junk ring and piston flange, amounting as it does in high-pressure pistons to many tons, and augmented as it is by the steam pressure between the rings, has the effect of preventing the rings being forced unduly against the walls of the cylinder by means of the steam pressure behind them, and thus it is found that new engines fitted with this piston packing can make a voyage round the world without doing more than dress out the tool marks in the cylinder. One of these springs is usually inserted tangentially at the joint of each ring, with just sufficient pressure to hold the ring from sliding down the cylinder with its own weight. The form of the ring fortunately lends itself to an easy provision in case of emergency. That is to say, if from any cause the pressure on the vertical springs was released, the rings would become worn without the engineer in charge being aware what was going on, and he might in such circumstances open the cylinders in a far distant port to find the rings so slack as to be incapable of being forced out to the cylinder wall by means of the tongue spring. Holes are therefore drilled horizontally into the inner side of both the rings, so that the same springs can again be applied in such a way as to press against the body of the piston and force the ring out till it reaches the cylinder. This is intended entirely as an emergency provision, and would only be used to enable the rings to bring the ship home, when a new set of rings would be required, as when thus used they have lost their floating capabilities, and are not what they were intended to be.

It is with this as with all matters connected with engineering—viz., experience alone can decide the practical value of any particular device—and on this subject it is satisfactory to be able to state that out of more than 250 pistons of all pressures that have been fitted with these packing rings there has never yet been one to renew, and there is not one, within the writer's knowledge, that has worn more than ⅛in. open at the joint since it left the shop. The absolute universality of the spring for high-pressure, medium-pressure, and low-pressure cylinders of every size and every pressure, will strike every engineer as being a great point gained, because the spare springs put on board of any individual ship will suit any piston and any position of spring, and, indeed, if any engineer on board of a ship requires springs when he happens to have no spare ones, he is likely to meet in any ordinary port in the world some other ship having the same maker's engines, and which may have on board spare springs that he may borrow. Besides, the spring itself being of the most ordinary and simple form, merely representing a coil of steel wire, can be dealt with or made by any ordinary engineer sufficiently well for any emergency.

There is another view of the case that should not be overlooked. Many piston packings appear to run fairly well so long as there is no steam jacket in operation around the cylinder, and it is very common to hear chief engineers remark that they dare not put steam in their jackets, because the cylinder would immediately become cut by the packing rings. This is a serious loss, and it is one that need not exist. With a sufficiently heavy pressure between junk ring and flange there is no fear at all of the packing rings cutting, and with the pistons under description it is the writer's practice even to run new engines on their trial trips with the high-pressure jacket at full boiler pressure.

Cylinder Construction.—The use of high-pressure steam, with its consequent high temperature, led the writer to adopt the method of placing the high-pressure cylinder of three-crank triple engines in the middle between the other two, with the object of reducing, as far as possible, the loss of heat by radiation from the steam when at its highest temperature. In carrying this policy out still further, he places all the valve chests between the cylinders, thus leaving the forward and after ends of the cylinder structure merely plain semicircles. He further provides the high-pressure cylinder with a steam jacket, and carries the receivers or steam chests of the two lower cylinders round the outside of this jacket so as entirely to enclose it. In this way the high-pressure cylinder and its steam chest nowhere come in contact with the atmosphere, except at top and bottom. The cylinder structure by this method has a very straightforward plain exterior, which is very easily covered all over to a depth of 2½in. with fossil meal non-conducting material, held in place by sheet steel. It will be observed that the jacket, although small in extent, is practically a double jacket, for its inner wall is radiating heat into the cylinder, and its outer wall is equally giving off heat into the receivers. That this jacket in ordinary work is very actively operative is proved by the trials recently made by Professor Kennedy and his scientific staff on board the s.s. "Iona," in connection with the Research Committee on Marine Engine Trials of the Institution of Mechanical Engineers, when this single jacket was found to be condensing about 4·55 per cent. of the total feed-water. Professor Kennedy's report to the Institution of Mechanical Engineers, and which is at the present time under consideration by that Institution, appears to indicate further that the writer's expectations of steam economy arising from this arrangement of cylinders and jackets is to a high degree realised, as on a sixteen hours' trial the engines of the "Iona" were found to be giving one indicated horse-power on 13·35lb. of feed-water per hour. The writer is of opinion that amongst the contributing circumstances leading up to this satisfactory result, there are none of greater importance than the arrangement of the cylinder structure, and the application of the piston packing rings which he has had the honour of describing.

SHIPBUILDING NOTES.

On the 17th ult. the s.s. "Oil-rivers," a handsome steel screw steamer, which has been built by Sir Raylton Dixon & Co., Middlesbrough, to the order of Messrs. Elder, Dempster, & Co., of Liverpool, for the African Steamship Company, took her trial trip from the Tees. The dimensions of the vessel are:—Length over all, 324ft. 9in.; breadth, 39ft.; depth, moulded, 27ft. 5¼in., with a deadweight capacity of about 4,300 tons. Her machinery, which has been fitted by Messrs. T. Richardson & Sons, Hartlepool, with cylinders 23in., 38in., 61in., by 39in. stroke, accomplished 11 knots on trial trip, and gave general satisfaction.

On the 24th ult. the first of the three steam hopper barges for the Corporation of Preston, recently launched from the yard of Messrs. Wm. Simons & Co., of Renfrew, was tried on the Clyde with satisfactory results. The measured mile was run on the Gareloch, where the vessel attained a speed of fully nine miles per hour, which was in excess of that contracted for.

Notices of Meetings.

THIS WEEK.

Institute of Marine Engineers.—Friday, April 3rd, at 7 p.m. Annual general meeting.

Geologists' Association.—Friday, April 3rd, at 8 p.m. Papers to be read: "Notes on the Sections on the New Railway between Nunhead and Shortlands; and on the New Railway from Grays to Upminster," by Mr. T. V. Holmes; "The Eocene and Oligocene Beds of the Paris Basin," by Messrs. G. F. Harris and H. W. Burrows.

NEXT WEEK.

Society of Engineers.—Monday, April 6th, at 7.30 p.m. Paper to be read: "A Trial of a Refrigerating Machine on the Linde System," by Mr. T. B. Lightfoot, M.Inst.C.E.

Society of Chemical Industry.—Monday, April 6th, at 8 p.m. Papers to be read: "The Analysis of Illuminating Gases" and "The Products of Checked Combustion," by Professor Vivian B. Lewes.

Cleveland Institution of Engineers.—Monday, April 6th, at 7.30 p.m. Paper to be read: "Observations on Various Matters of Interest to Engineers in the United States of America," by Mr. J. Head, M.Inst.C.E.

Royal Institute of British Architects.—Monday, April 6th, at 8 p.m. Sessional meeting.

Institution of Civil Engineers.—Tuesday, April 7th, at 8 p.m. Ordinary meeting. Paper to be read: "The Cost of the Generation and Distribution of Electrical Energy," by Mr. R. E. B. Crompton, M.Inst.C.E. Monthly ballot for members and (at 9 p.m.) reception by the President and Council.

Royal Victoria Hall.—Tuesday, April 7th. Lecture on "Minute Things in Nature," by Professor Rupert Jones.

Institution of Electrical Engineers.—Thursday, April 9th, at 8 p.m. Paper to be read: "The Design of Multipolar Dynamos," by Mr. W. B. Esson.

PRICES CURRENT, 1st April, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

METALS.

Spelter: Ordinary	£24	15	0	to	25	0	0
Copper: British Cakes and Ingots	56	10	0	„	57	0	0
„ Chili Bars, G.O.B.'s	53	2	6	„	53	7	6
„ Other sorts, G.M.B.'s (equal to Chili Bars)	53	2	6	„	53	7	6
„ Manufactured (strong)	65	0	0		.....		
Lead: Common Pig	13	10	0	„	13	15	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	90	7	6	„	90	15	0
„ Australian	90	15	0	„	91	5	0
„ English Ingots	94	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues quiet, and without change. Owing to the holidays business has been very limited during the past week, but prices generally are maintained. Chili bars are slightly higher, being quoted to-day £53 2s. 6d. to £53 7s. 6d. cash, with irregular market. Manufactured £65, "strong."

Tin: Firmer, at improving rates.

Lead: Slightly higher, and improving.

Spelter: Firmer, with a good demand for spot parcels.

PIG IRON.

Middlesbro' Warrants, No. 3.	38/3	Cash.
Scotch Warrants, m/n	42/7½	„
Hematite Warrants, m/n	47/1½	„
Stocks in Stores. Scotch	528,529	Tons.
Middlesbro'	122,694	„
Hematite	184,019	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	65/-	.....	58/6	f.o.b.	Glasgow.
Gartsherrie	60/-	.....	56/-	„	„
Summerlee	...	.....	...	„	„
Eglinton ex store	49/6	.....	47/6	„	„
G.M.B. „	43/3	.....	43/-		„

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	65/6	56/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	5¼	to	0	0	6¼
„ „ Liquid	gal.	0	1	0	—	.....		
„ Citric	lb.	0	1	8½	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	15	0	—	.....		
„ Tartaric	lb.	0	1	3½	—	.....		
Alum: Lump (powder 10/- ex.)	ton	5	12	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	23	10	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	11	12	6	—	.....		
„ Liquor	lb.	0	0	3	—	.....		
Antimony	ton	75	0	0	—	.....		
Bleaching Powder	„	6	12	6	—	.....		
Bisulphide of Carbon	„	13	0	0	—	.....		
Borax	„	29	0	0	—	.....		
Benzole (90 %)	gal.	0	4	7	—	.....		
„ (50/90 %)	„	0	3	5	—	.....		
Copper Sulphate	ton	16	10	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	21	10	0	—	.....		
„ White Sugar	„	26	0	0	—	.....		
„ Brown „	„	19	10	0	—	.....		
Potash: Bichromate	lb.	0	0	3½	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	20	10	0	—	.....		
„ Chlorate	lb.	0	0	5½	—	.....		
„ Prussiate (Yellow)	„	0	0	10	—	.....		
„ Sulphate (Basis 90 %)	ton	4	0	0	—	.....		
Precipitate: Red	lb.	0	3	6	—	.....		
„ White	„	0	3	6	—	.....		
Salts: Epsom Bags	ton	3	0	0	—	.....		
Epsom Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	10	10	0	—	.....		
„ Recovered	„	7	0	0	—	.....		
Soda: Ash	deg.	0	0	1¾	—	.....		
„ Caustic (White 70%)	ton	10	17	6	—	.....		
„ „ „ 60%)	„	9	12	6	—	.....		
„ „ (Cream 60%)	„	9	5	0	—	.....		
„ Crystals	„	3	7	6	—	.....		
„ Bicarbonate	„	7	0	0	—	.....		
„ Hyposulphite	„	6	10	0	—	.....		
Solvent Naphtha	gal.	0	1	7	—	.....		
Tartar, Cream of	cwt.	5	7	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: The Easter holidays have interfered with business, and there is nothing of interest to report since our last, the markets being practically unchanged. Sulphur continues in exceedingly strong demand. The articles controlled by the United Alkali Company are all moving off steadily.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	36	0	0
„ Ceylon	„	30	0	0
Cottonseed	„	21	10	0
Cod	„	23	0	0
Lard	„	35	10	0
Linseed	„	22	10	0
Olive, Spanish	„	43	0	0
Palm, Lagos	„	27	0	0
Rapeseed: English	„	29	15	0
Seal: Pale	„	.....		
„ Brown	„	.....		
Sperm	„	48	0	0
Whale	„	21	0	0
Turpentine	per cwt.	1	9	6
Coal	per gal.	.....		
Petroleum (Refined)	„	0	0	5¾
Spirit		0	0	7

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HOME INDUSTRIES.

LONDON, 2nd April, 1891.

The Money Market.—The end of the first quarter of the year, as well as of the official financial year, has, as usual, caused a somewhat sharp demand for money, while the supply has been correspondingly diminished. Call money has consequently been fairly dear this week, commanding in some cases 3 per cent. A good deal of borrowing has taken place at the Bank of England, owing to the deficiency in the supply in the outside markets. In consequence of the recent holidays, business this week has been on a restricted scale, but the markets are showing less absolute dulness than before the holidays, and there has been a welcome movement upward in American and Canadian railway securities, induced largely by the conclusion of a species of traffic alliance between the Vanderbilt interest and the Canadian Pacific. Home railways continue inert, the cold weather during Easter having restricted travelling, and so made little impression on the traffic returns. Foreign bonds have been dull and drooping, financial difficulties in Italy, political events in Bulgaria, and the obstacles encountered by Portugal in the effort to secure a new loan combining to depress values in this department. Argentine issues have declined in consequence of a fresh rise in the gold premium at Buenos Ayres. The market for miscellaneous and industrial securities has been quite idle. Copper shares are neglected, but there is some activity in Indian and the better class of South African gold shares.

The Junior Engineering Society.—At a meeting of this Society held on the 20th ult. a paper was read by Mr. H. Young, Jun., on "Iron from the Ore to the Casting." The author said that cast iron was not known in this country until the fourteenth century. The ironfields were then in Sussex, and the balustrade which surrounds St. Paul's Cathedral was cast in that county at the Lamberhurst furnace, and, according to the account books, cost £11,202 0s. 6d. Recently new railings of similar design had been made by Messrs. H. Young & Co. as an enclosure to the new statue of Queen Anne, and had cost £110, or £1·3 per foot run, as compared with £8·14 per foot run in the case of the balustrade. Considering the increased price of materials and of labour at the present time, it was surprising that the cost of production had so greatly diminished. The author proceeded next to an investigation of the character of the various ores. Roasting, weathering, and the general preparation of ores before entering the blast furnace were fully treated, and the methods adopted for the utilisation of slag and of blast furnace waste gases were discussed. The capillary structure of slag wool was shown by aid of a microscope. The chemical changes taking place in the blast furnace were explained, as were also the chemical and physical properties of the different grades of pig iron and their crystallisation. In illustration of the paper, a very complete collection of specimens, which had been kindly furnished by the Bowling, Carron, Caulder, Tipton Green, and Weardale companies, and by Messrs. F. Jones & Co. and Messrs. D. Anderson & Son, was exhibited. A practical demonstration of founding constituted an interesting feature of the lecture.

The Telephone Service in London.—We are glad to learn that an association of subscribers to the telephone has been started for the purpose of securing a cheaper and more efficient service of telephones in London. Having regard to the expiration of the patents, the charges for the use of the Post Office Telephone Exchanges in the country have been reduced, so that subscribers within a quarter of a mile of the exchange pay £8 a year; within half a mile, £10 a year; three-quarters of a mile, £12 a year; and one mile, £14 a year. No reduction, however, in the charges to London subscribers has been made by the United Telephone Company. The association seeks, in addition to a lowering of the charges, a more effective service. This would be attained by the use of the double-wire system, by which alone the voice can be clearly heard in London.

Emigrants' Information Office.—According to information just issued by the Emigrants' Information Office, 31, Broadway, Westminster, S.W., this is the best month in the year for emigrants to go to Canada, where, besides the usual demand for female servants, there is now a demand for farm hands and for men in the building trades, which is likely to continue during spring and summer. The Canadian Government now offers for the first time bonuses of $15 to the head of a family, and half that amount to his wife and grown-up children, if he settles on land in the North-West or in British Columbia. In Australasia the harvest is now over, but there is still a demand for female servants, miners, navvies, farm hands, dairymen, ploughmen, bushmen, general labourers, and men who understand pruning fruit trees and nursery work. Such men and women will, under certain conditions, get free or reduced passages to Queensland and Western Australia. In South Africa carpenters, masons, bricklayers, and other useful mechanics, navvies, and female servants are in demand, and may, under certain conditions, obtain reduced passages to Cape Colony and Natal. Farmers and fruit growers will find openings in all these colonies, and may obtain reduced passages to Western Australia, and in certain cases free passages to Natal. Emigration is strongly discouraged to South America at the present time. The existing political and social conditions of the Argentine Republic and Chili are very unfavourable to emigrants from Great Britain or from Ireland, while Brazil, to which free passages have lately been advertised, and with regard to which special warnings have lately been issued by the office, is a tropical country, and in almost every respect ill-suited to such emigrants.

The Camera Club.—The fifth annual conference of the Camera Club, at which there will be an exhibition of members' pictures and of lantern slides, is to be held at the rooms of the Society of Arts on the 7th and 8th inst., under the presidency of Captain Abney, F.R.S.

Business Announcement.—The business of Mr. Napier Prentice, electrical engineer, Stowmarket, has been amalgamated with that of Messrs. Easton & Anderson, Limited, of Erith and London. Mr. Prentice has removed his factory and staff to Erith.

Congress of Hygiene.—The Council of the Society of Arts, acting under the provisions of the Benjamin Shaw Trust, have offered two Gold Medals, or two prizes of £20 each, to the Executive Committee of the Congress of Hygiene and Democracy, for any inventions or discoveries of date subsequent to 1885, exhibited at or submitted to the Congress, and coming within the terms of the Trust. Under the conditions laid down by the donor, these prizes are to be offered for new methods of obviating or diminishing risks incidental to industrial occupations.

MANCHESTER, 2nd April, 1891.

The Iron Trade.—The market for iron in this district is very dull, and any sales which are being made are only small. Pig iron is going steadily into consumption, but speculation is entirely at a standstill. Bar iron is very slow of sale, and prices are maintained with difficulty. Some of the brands of marked iron are proportionately worse than the commoner qualities, and generally the outlook in this department is very bad. Steel plates are being steadily taken up, but the whole tone of the market is lifeless.

The Engineering Trades.—Owing to the holidays there is a lull in business, and very little new work is to hand. The general impression is that there is likely to be less demand in the immediate future for machinery of all kinds, a variety of causes contributing to that result. In the meantime work is being actively proceeded with. Most firms have plenty of orders in hand, and, unless the present state of affairs is interfered with by the fifty-three hours question, a fairly good year is probable. Several large engines are being constructed for the new mills in course of erection in this neighbourhood, but there are many signs that the condition of the spinning trade is not very satisfactory. Spinners have had to contend during the year with a bad quality of cotton, and it is not likely that the prosperity enjoyed by them will last in the face of the enormous increase in the number of operative spindles during the past two years. The increase in the number of new mills is therefore likely to receive a check which must react upon engineers. Toolmakers up to the present have little reason for complaint, and their prospects continue to be good. Cotton spinning machinists are fully engaged, and there are still considerable orders being placed. Messrs. John Hetherington & Sons, Limited, have recently purchased a plot of land, containing four acres, adjoining their works, for the purposes of extension, their business having grown rapidly during the past three or four years. The Mills Patent Boiler Company, Limited, have acquired the extensive premises recently owned by Messrs. Barningham & Co., Limited, and are adapting them for the manufacture of this specialty, for which they have a large demand, principally for London and the Continent.

Railway Fares.—The Manchester, Sheffield, and Lincolnshire Railway Company, in pursuance of the policy agreed upon at the last meeting of the shareholders, commenced yesterday to run trains composed only of first and third class carriages. The fares have been revised so as to be similar to those current on the Midland Railway Company. The change, however, does not apply to a number of the local trains, where second-class carriages are extensively used.

Business Announcement.—The works and offices of Messrs. Meldrum Bros., engineers, have been removed from the Cathedral Yard to more commodious premises at the Atlantic Works, City Road.

The Linen and Jute Trades.—There has been little business during the past week. Orders are fairly numerous, considering the season. Cotton towels, which are stocked in the linen departments, have been inquired for largely, and linen descriptions have been taken off the market to a fair extent. Stair cloths are slow, oilcloths having superseded the linen article to a large extent. Union makes (flax and jute) meet with a steady sale. The damask trade is quiet, no feature of special importance being noticeable in connection with this department. The linen dress linings are again meeting with a moderate sale, but they have not, of course, interfered with satteens. There is no appreciable change in quotations, which keep steady all round, both for yarns and cloth. The shipping trade is quiet, except in a few instances. From Canada there has been more inquiry, and hopes are entertained that that market will shortly improve. It is impossible, however, to hold out any hope of a complete revival for some time to come, as the affairs of wholesale houses on the other side of the Atlantic are still greatly disarranged. Trade with South America is extremely slow. For Australia there is more business, and prospects are improving. Yorkshire crashes and other standard makes sell steadily. Yarns are dull here. Linen threads are inquired for to a satisfactory extent, and agents for well-known makes have little ground for complaint as to the condition of the home trade.

Fire Extinguishing Apparatus.—A public trial was made of Noble's patent pumping arrangement, to which reference has been previously made, in the yard attached to the chief fire station in Manchester, on the 24th ult. This apparatus consists of a pump contained in a suitable frame and operated by the foot of the person using it. The stream of water thus obtained is ejected by a hose, and it was shown that a considerable quantity could be thrown for several feet. The appliance is portable, and can be employed as a domestic fire engine, and is also available for washing windows. Generally the trial was considered to be a satisfactory one.

GLASGOW, 2nd April, 1891.

Minerals.—The pig iron market opened on the 31st ult. The price advanced fractionally. Coal shipments are again active. Last week the total shipments amounted to 121,439 tons, an increase of 17,239 tons over the preceding week, and 1,820 tons over the corresponding week last year. The prospects of the foreign coal trade seem fairly good. In spite of the heavy loss of shipments during the strike, the totals of shipments are now so large that much of the loss is likely to be made up.

General Trade.—It is generally felt that we have now entered upon a period of depressed trade. The cause of this seems to be the fact of a large falling off in the effective demand. Some local industries have been injuriously affected by the McKinley Tariff Act. The iron and steel trades, which had been abnormally inflated during the period of activity on foreign and colonial railway construction, are now suffering from temporary slackness. Two years ago also there were several important engineering enterprises going on both at home and abroad, and there is a lull in the promotion of these. This falling off in demand has not yet seriously affected the rate of wages, but it has caused much irregularity of employment.

Scottish Railways.—Although the railway men are dissatisfied with the terms offered by the North British Railway directors, there is a strong impression that they will delay taking any steps until the result of the Select Committee is known. It is generally understood that the Government are practically pledged to legislate on the question, and the men seem to be inclined to wait for the promulgation of the Bill. Besides, the strain upon the staffs of the railways is diminishing from other causes. Traffic returns show a decrease, and the press of work is not nearly so great as it was last year. The men are therefore less severely tasked than they were in the months preceding the strike of December last.

Shipping.—The "City of Rome" will begin sailing from the Firth of Clyde to New York this month. The large vessel will find berth accommodation in the James Watt Dock, Greenock. This dock, which has not been hitherto very successful, will derive much benefit from this new departure of the Anchor Line Company. The State Line steamers, having been purchased by Messrs. J. & A. Allan, of the Allan Line, will begin sailing between Glasgow and New York this month. The price paid by Messrs. Allan for the vessels and the goodwill of the business is said to have been £70,000. Unfortunately the shareholders will receive very little on the completion of the liquidation, if there is not even a deficit. The £5 shares of the State Line were being offered in Glasgow this week at 6d. each. The Gulf Steamship Company is about to start a line of steamships between Glasgow and Australia. The first sailing will take place at the end of April. The freight market is extremely quiet. San Francisco, 40s. for December, and 41s. 3d. for earlier months. The following fixtures are reported:—Cardiff to Venice, 9s.; Calcutta to U.K., 34s. 6d. The unfixed sailing tonnage is put at 7,000 tons.

Shipbuilding.—Though new orders are coming in slowly, there is still a good deal of work in progress in the Clyde yards. At Dumbarton the s.s. "Scott," for the South African Service of the Union Company, is now approaching completion. The vessel is intended to reduce the passage to fourteen days. It is hoped that the speed may reach at least 19 knots at sea. The beam of the vessel is unusually large. The vessel will be ready for sea about the beginning of May. The other work in the yard consists mainly of small vessels and some barges for the Irrawady flotilla, for which Messrs. Denny have supplied all the craft. Messrs. Blackwood & Gordon, Port Glasgow, have just received an order from the Ceylon Steamship Company, through the managers, Messrs. Walker Brothers, Bishopsgate Street, London, for the building and engineering of a steel screw steamer of about 600 tons and 700 i.h.p. for passengers and cargo service round the coast of Ceylon. They have also received an order from Messrs. Hill, Gomes, & Co. for an additional steamer for trading in Brazil, somewhat similar to, but shorter and less speedy than, the twin-screw steamers "Iris" and "Satellite" recently finished by them for this company.

The Future of the North British Railway.—The fall in the stock of this company has been quite phenomenal. In August last the ordinary stock stood at 74⅜; in January, during the strike, it touched 49¼; in February, after the close of the strike, it dropped to 48 5/16; and in March it fell to 41. The uncertainty

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of the effect upon future dividends of the changes which it is now obvious must be effected in the management of the company, combined with the determined "bearing" of the stock, thrust it down. It must be noted, however, that at the prices of last summer the stock was abnormally high, and that only disguise of the real condition of the company kept the stock at its then level. At the present prices of the combined stocks, 111, the stock is much nearer its normal value then it was at 154 during August last. There does not seem any valid ground for pessimism as to the future of the company. It is quite unrivalled in many districts, and has possessed itself of the leading through routes. With more adequate detail administration, and, perhaps, also the investment of some additional capital in land and rolling stock, it will be fully able to take advantage of its really splendid opportunities.

THE GLASGOW TRAMWAYS.—The Glasgow Tramway Company recently procured permission from the Court of Session to alter their articles of association so far as to permit the employment of mechanical power on the tramway lines. The lease of the lines to the company expires in 1894, and it is improbable that it will be renewed on terms similar to those of the present lease, or, indeed, on any terms whatever if the present attitude of the Corporation be maintained. It is unlikely, therefore, that the company will take any steps towards exercising the powers they have obtained.

(From our own Correspondents.)

LIVERPOOL, 1st April, 1891.

ENGINEERING AND SHIPBUILDING.—Most of the shops and yards on both sides of the river have been closed for the Easter holidays; some of them, however, have been compelled not only to work during the holidays, but to work overtime on account of urgent work and repairs. It is satisfactory to note the continued prosperity in the trade, with good prospects for many months to come. During the Easter holidays more than 30,000 passengers crossed the Woodside Ferry, the number last year being 38,689, and in the previous year, 41,390.

LIVERPOOL AND THE RIVAL PORTS.—Although the question of Milford becoming a rival port to Liverpool periodically crops up, and is as regularly ridiculed by many Liverpool men and by the financial papers, many prominent and able men consider that there is real cause for alarm, and that Mr. Greville's scheme is within a measurable distance of being fully realised. They cannot overlook the fact of the splendid natural advantages of Milford, and the circuitous approach to the mouth of the Mersey and the difficulties connected with the bar. Liverpool is undoubtedly more favourably placed as regards the railways, but Milford is nearer London and has many other natural advantages over Liverpool.

LIVERPOOL ENGINEERING SOCIETY.—At a meeting of this society on the 18th ult., under the presidency of Mr. F. Hudleston, an adjourned discussion took place upon Professor Hele Shaw's paper on "The Education of an Engineer." The President urged that the preliminary education of an engineer should be as broad as possible, and valued highly the study of higher mathematics. Mr. G. Farren described the Continental system of training with reference to the Government schools in Holland. Mr. H. H. West advocated the old-fashioned principle of five or seven years' apprenticeship, to be followed, if possible, by two years of college training. Mr. Higginson spoke in favour of six months' work in the shops during the summer, and six months' training in the college during the winter. Mr. Turner thought that the student should first see actual work in the shops and office, and afterwards study the scientific principles which underlie what he has seen practised.

SHEFFIELD, 1st April, 1891.

IRON AND STEEL.—Active operations were suspended at all the iron and steel works in this district on Easter Monday and Tuesday. There are sufficient orders to keep manufacturers fully employed for some time to come. Orders for railway material and rolling stock continue to come in steadily, and manufacturers are well employed. Messrs. Ashbury's Railway Carriage Company have orders for 1,600 carriages and waggons, mostly for the home railways. Makers of ordinary merchant iron are complaining of a falling off in the demand, and find it difficult to maintain prices. Pig iron of all descriptions has declined to unremunerative prices, and all surplus iron is being stocked in the hope of better prices. Steel castings appear to be in less demand than for some time past, and in the smaller castings there is much competition from outside, and even from Germany. In very heavy work, the local houses are fully employed on castings and forgings for general marine and mill work. In boiler and ship plates there is not much business at present. The "Purves" flues, of which Messrs. John Brown & Co. are the sole makers, are coming largely into use, and this firm have in consequence again extended their works.

COAL.—Prices for fuel of all kinds continue high. Mr. G. B. Walker, of the Wharncliffe Silkstone Colliery, who has just returned from a visit to Australia, has recently given some interesting particulars with reference to coal and mining generally in Australia. Mr. Walker is of opinion that some reduction in the cost of winning coal in England must be effected, and suggests the more general use of coal cutting machines.

BARROW-IN-FURNESS, 1st April, 1891.

HEMATITE.—The business done in hematite pig iron during the week has been very small, and makers have not been able to effect any transactions of moment, as they are still undersold by holders of hematite warrants. The latter are being sold as low as 47s. 6d. per ton net cash, and makers cannot possibly sell at less than 50s. per ton for Bessemer iron in mixed numbers net f.o.b. unless they sell at a loss. The make of iron has been further reduced, but the weak market has caused weak holders of stock to sell, and while this has the satisfactory effect of clearing stocks it is also checking makers' sales.

STEEL.—Business in the steel trade is very quiet, although prospects are better, both in the rail and in the steel shipbuilding material department. Orders are fairly numerous, but the mills are not working full time. Some heavy contracts for steel rails are offering, but at low prices, and makers are still firm in quoting £4 12s. 6d. for heavy sections net f.o.b. There is some hope of a brisk future in the steel shipbuilding material trade, as some very good shipbuilding contracts will probably come to Barrow. New and powerful engines are being built by Messrs. Galloway, of Manchester, for the present heavy rail mill of the Barrow Steel Company, and when these are erected and in working order the company intend to roll the heavier and larger class of plates, which are now in brisk demand alike for shipbuilding and boiler purposes. It is confidently expected that when the new light mill is put down great economies will be achieved in the Siemens-Martin steel trade of Barrow, and that an impetus will be given to the manufacture of this class of steel in Furness.

AMERICAN WAGGON BUILDING AT BARROW.—The Tubular Frame Wagon Company have now acquired possession of the Vulcan Steel and Forge Company's works at Barrow, and already have 100 men in their employ. They propose to build bogie trucks, 35ft. long, on the American principle, each to carry 30 tons, and they have selected Barrow as the *locale* of their operations because their trade will be largely on foreign account, and because Barrow offers many advantages for shipping purposes. It is expected by Mr. M. R. Jefferds, the general manager of the company, that they will produce and deliver 20 trucks per day, and it is proposed at once to put down plant for the manufacture of steel tubes, malleable castings, and grey iron castings, so as to concentrate all the work on the premises. The timber required will be directly imported from America. Workmen's dinners are to be provided free by the company, and it is expected in a short time 500 men will be employed, while ultimately the works are to employ 2,000 men. The directors are:—Colonel Church (chairman), Colonel J. T. North, Alderman Fenton (London), and Mr. R. N. Fowler (Leeds). The new industry promises to be of considerable importance to the trade and port of Barrow.

MIDDLESBROUGH, 1st April, 1891.

PIG IRON.—The iron market is still very dull. Scarcely any business is being done, and prices are only nominal. The quotations are no stronger than those given in our last report. For prompt f.o.b. deliveries of No. 3 G.M.B. merchants ask 39s. per ton, but this is more than buyers are prepared to give, and they generally offer 38s. 6d. Cleveland warrants are nominally 38s. 9d. per ton cash sellers and 38s. 6d. cash buyers. Grey forge is quoted at 38s. 3d. per ton, but some has been sold for 38s. There is more available for sale on account of the stoppage of the local forges, and also because Scotland has been taking less. East Coast hematite pig is quoted at 53s. per ton for mixed numbers. It is not expected that stocks will show any decrease this month, as the local forges are working irregularly on account of the holidays. Shipments were a little better last week, and amounted to 16,110 tons. The shipments of pig iron for March amount to 66,435 tons, against 70,499 tons in February and 60,683 in March, 1890. Of the 66,435 tons, 38,876 tons went to various parts of England and Scotland and 27,559 tons went abroad. As compared with the same month last year, the home consumption has increased more than double, and the foreign dwindled down to little more than half.

MANUFACTURED IRON AND STEEL.—There is no change to report in the finished iron and steel industries, and there is little or no demand. Common iron bars can be bought at £5 12s. 6d. per ton, less 2½ per cent. f.o.b. Heavy steel rails are £4 12s. 6d. net.

COKE.—The demand for coke is not so great, owing to the blowing out of several furnaces. The price quoted is from 14s. to 15s. per ton, delivered at the furnaces.

WORK AND WAGES.—The adjourned meeting of the Cleveland ironmasters' and the blast furnacemen's representatives was held yesterday. It will be remembered that at the previous meeting the masters gave the men the option of accepting 12½ per cent. reduction or reviving the sliding scale which regulated their wages up to the end of June last. The men's representatives were only prepared to accept 5 per cent. reduction, but afterwards stated that they would accept the sliding scale subject to certain alterations. The employers were not prepared to entertain these suggested alterations, and the meeting was adjourned until the 8th inst., in order that the delegates might consult the men. In order to protect the masters' interests, the men will receive a fortnight's notice to quit their work.

SUNDERLAND, 1st April, 1891.

THE SHIPPING AND COAL TRADE.—The freight market continues depressed, but there is an improved prospect in the local coal trade, as the prolonged Silksworth Colliery dispute has been settled. Imports fluctuate considerably, six cargoes being received last week, as against twenty-three cargoes in the previous week. Coal shipments amounted to 69,984 tons during the past week, an increase of 8,045 tons, about two-thirds of the total being for coastwise orders. Other shipments were barely up to the average.

SHIPBUILDING.—No additional contracts are being booked, and inquiries are not so numerous. During the past month six steamers of 10,417 gross register tons have been launched, making a total for the first quarter of the current year of seventeen vessels of 35,563 tons. A steamer of 4,000 tons, which has been built at Mr. James Laing's Deptford Yard, has been sold to the local Neptune Steam Shipping Company, Limited.

NEWCASTLE, 1st April, 1891

THE IRON TRADE.—Some of the local rolling mills are kept going steadily on orders received last year, but little is being done in the placing of new contracts, and the outlook is consequently not very promising. The workmen at the Walker blast furnaces have received notices to terminate their engagements early this month, and it is thought probable that a temporary stoppage may take place. It has not transpired, however, that the blowing out of the furnaces has been decided upon, and as further supplies of ore are said to be expected shortly, the contingency spoken of may not be so near as the issuing of discharge notices to the workmen would seem to indicate.

THE COAL TRADE.—In connection with this industry very little is being done this week, either at the pits or at the shipping staiths. A conference of coal owners and miners' representatives has taken place at Newcastle, to discuss the question of boys' working hours in coal mines. After an exchange of views, it was settled that 10 hours per day should in future be the maximum, excepting in certain cases where the nature of the employment makes it necessary that this limit should be occasionally exceeded.

THE ELSWICK ORDNANCE WORKS.—At this great establishment the orders in hand are being rapidly worked off, and as no new contracts of importance have lately been secured the advent of a slack period appears to be inevitable. Workmen are being paid off from all the shops, and in one of the leading departments the ordinary working staff has been reduced by fully one-fourth. There is also a distinct falling off of briskness in the steel foundry connected with the works, and the state of business in the boiler-yard, forges, and engineering shops is now beginning to be adversely affected.

LEATHER AND INDIARUBBER TRADES.—In these industries business is fairly active, and such leading establishments as the works of Messrs. E. & J. Richardson & Co. (Elswick Leather Works), and Messrs. Geo. Angus & Co. (St. John's Leather Works) are briskly employed. The last-named firm continue to do a large business in specialties for engineering purposes.

APPOINTMENT OF A PROFESSOR OF ENGINEERING.—At the invitation of the Durham College of Science in 1887 the Council of the North-East Coast Institution of Engineers and Shipbuilders appointed a committee to draw up a scheme for a department of mechanical and marine engineering and naval architecture. The nomination of the professor was placed in the hands of the Council of the Institution, and it was arranged that the department should be managed by a committee of specialists, on which the Council of the Institution should be largely represented. The Council of the Institution nominated Mr. R. L. Weighton, M.A., who has within the last few days formally accepted the chair. For seven years Mr. Weighton has held the appointment of chief draughtsman at Messrs. R. & W. Hawthorn, Leslie, & Co.'s works at St. Peter's, and is the author of important papers on "The Compound Engine, viewed in its Economical Aspect," and on "The Normal Indicated Horse-Power of Marine Engines and Boilers."

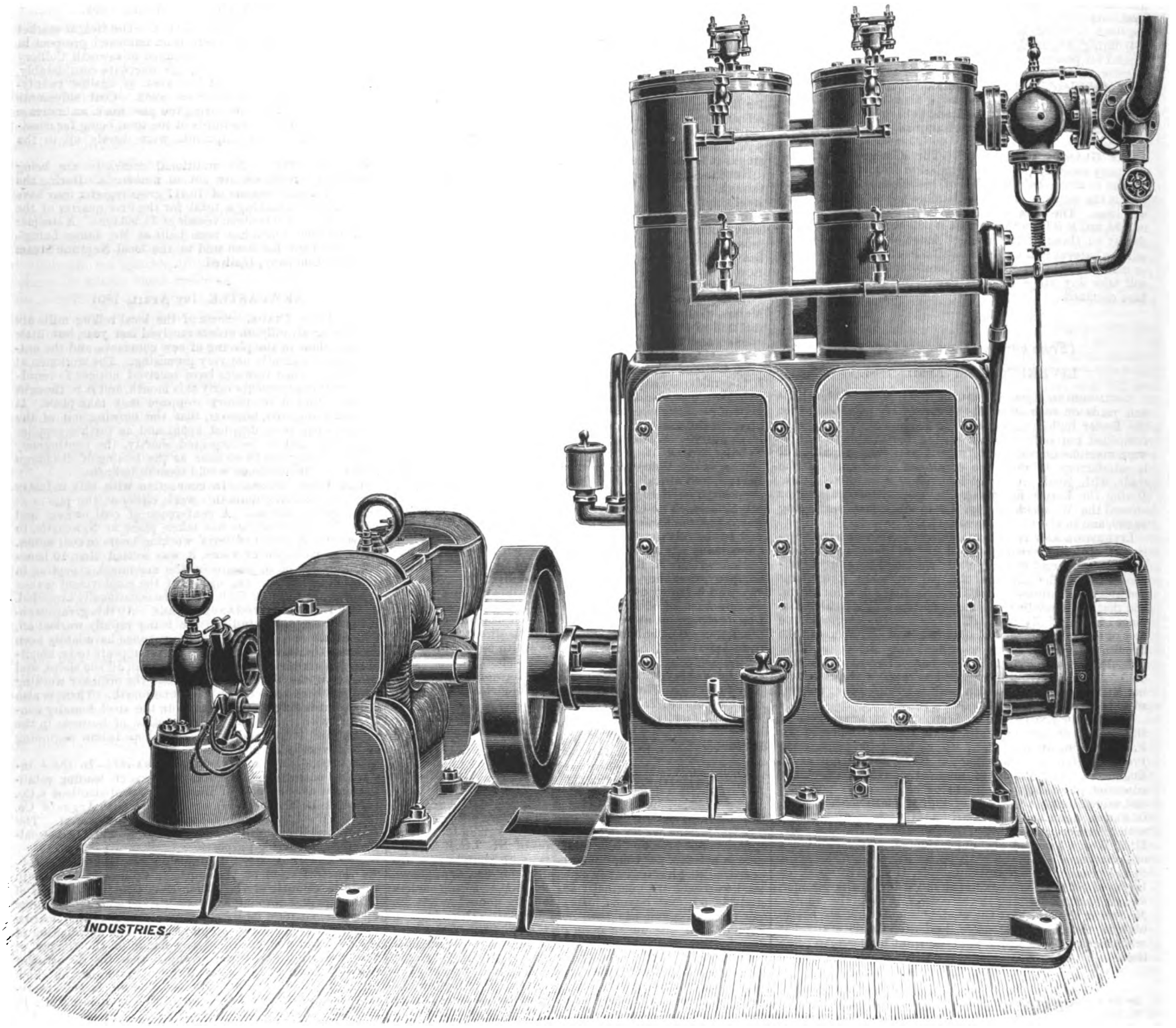
DUNDEE, 1st April, 1891.

PRICE OF COAL GAS.—A committee of the Dundee Gas Commission, which has been giving some attention to the most economical mode of purchasing coal for the manufacture of gas, has come to the conclusion that the purchase of the higher-priced cannels is much more expensive than the judicious use of lower-priced coal. The value of richer kinds of coal as gas producers was found to be very much overstated, and in one case to the extent of £1 2s. 10d. per ton.

DUNDEE SUBURBAN RAILWAY.—It is reported that a contract has been made with Messrs. Best & Son, Edinburgh, for the construction of the suburban railway, at a cost of over £300,000. The railway will be about four miles and a half in length. The deepest cutting will be 40ft. There will be one viaduct, 50ft. high and 100 yards in length, and twenty-two bridges.

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THE CROMPTON-CHANDLER STEAM DYNAMO.



General View.

THE CROMPTON-CHANDLER STEAM DYNAMO.

The rapid growth of central station work is developing the manufacture of quick-running engines and large direct-coupled dynamos. The above illustration shows a double-crank compound engine of the Chandler type driving a Crompton direct current dynamo. The engine can indicate 6½ horse-power, and run at 500 revolutions per minute. The dynamo has a ring armature of the type which Messrs. Crompton have used so successfully. It is 15½in. diameter and 5in. axially, the radial depth of the discs being 3in. The armature is built up of thin discs on a cast spider. This not only makes a good mechanical armature, but allows thorough ventilation. The maximum rise of temperature after six hours' run is only 30° Fahr. The output is 55 volts and 100 amperes. The particular steam dynamo we now illustrate is one of several sets being sent to Australia. The total weight of engine, dynamo, and bed-plate complete is 22 cwt. This type is being largely introduced for shiplighting, several having been fixed on Messrs. Cook & Sons' Nile steamers and elsewhere, where they have done very well.

THE SIBERIAN RAILWAY.

It seems that the long-talked-of Siberian Railway is at last about to be commenced, as an Imperial ukase has been published directing the expropriation of the owners of the land required for the construction of the Vladivostock-Grafsraja section, and it is stated that the engineer and the workmen by whom the line is to be constructed have left Odessa for Vladivostock, where the works are to be begun. This section of the line is to be pushed on as quickly as possible, probably as much with a view to military contingencies as for any other object. We are informed that the Chinese authorities are considerably alarmed at the prospect of the railway being completed in that district, and that probably one effect will be the making of another line by the Chinese in order to facilitate the transport of troops in case of need. Siberia embraces a great variety of climates, and has great mineral and agricultural resources. The total length of the line will be 4,810 miles, and the cost about 32 millions sterling. If permanent bridges are built across the great rivers the cost will be much greater. When completed the railway will have most important commercial results by opening up the immense resources of Southern Siberia. A large portion of it will run through millions of acres of the finest virgin soil, and through countries abounding in mineral and vegetable wealth. Moreover, it will enable Russia to compete more successfully for the Japanese and Chinese carrying and import trade, and goods which are now sent by sea to Europe will be carried overland. Probably, however, it will not much affect the sea traffic, as the development of trade will be so great that there will be enough for both routes.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 3RD APRIL, 1891.

MR. GOSCHEN'S CURRENCY PROPOSALS.

THE chief interest in the public finance of the year is centred in the proposals of Mr. Goschen as somewhat vaguely indicated in his recent speech at Leeds. The speech is a very interesting and important economic deliverance, but much additional information is necessary ere adequate materials are available for forming a judgment upon it. The leading point which Mr. Goschen made was that in his view the recent Baring crisis brought the country within measurable distance of serious and widespread commercial disaster, and that not so much because of the magnitude of the commitments of the house of Baring as because of the slenderness of the stock of gold available for prompt use in the discharge of international obligations. It happens that foreign Governments make London bankers their depositories for large sums, and in this way they acquire a control over the money market of an occasionally embarrassing nature. Mr. Bagehot pointed out long ago the difficulty in which the very existence of such deposits placed us. The German Government, for example, has invariably a large sum standing at its credit in the books of one of the London joint stock banks. This sum must, along with the other deposits of the bank, be employed, otherwise the bank could not exist. The money, as a matter of fact, becomes merged in the general funds of the bank, and the amount available for the prompt liquidation of the liabilities of the bank is, as is customary, lodged in the Bank of England. The balances of the joint stock banks are as a rule maintained at a high figure in the books of the Bank of England, but money represented by these balances again finds its way into the market through the discounts of the Bank. Thus, under normal conditions, the regulation of the rate of discount operates as an efficient check against the diminution of the balances in the Bank of England. An abnormal strain, however, such as a demand from Germany or from Russia for the prompt payment of £1,000,000 to £2,000,000 in gold, comes first upon the bank with whom the money had been deposited, but finally upon the bankers' bank—viz., the Bank of England—and unless the demand has been anticipated that Bank suddenly finds its stock of gold depleted, and is compelled to restrict its discounts in order to encourage the inflow of gold again. The requirements of our own Government can be ascertained with almost mathematical exactness, but those of foreign Governments depend upon circumstances, which are not always so accurately known, and although, as a matter of fact, the power wielded by Russia and Germany over our money market is seldom exercised in a sinister fashion, it is possible at times for either of these Powers, even unwittingly, to cause the greatest financial disturbance. Without exaggerating in any way the importance of having a large stock of gold in the country, it is quite clear that unless we have very ample gold reserves the ordinary course of banking business may be characterised by serious crises, which speedily affect circles beyond the financial circle immediately concerned, and indirectly, but still potently, affect commercial and industrial circles generally.

Mr. Goschen is thus really acting in the interests of the whole community in putting his shoulder to the wheel in order to effect some means of rendering financial crises less frequent in occurrence, and to provide some automatic method of meeting them when they actually occur. Although there is a large class of people who live upon the fluctuations of the money market, and to whom even a crisis brings profit, the interest of manufacturing business is always in the direction of certainty in prices, and therefore in the reduction of monetary fluctuations within the narrowest possible limits. There can be no doubt that the existence of an ample reserve of gold in the Bank of England gives, reasonably or unreasonably, a feeling of confidence to the money market, and through it a feeling of steadiness to the whole commercial and industrial organisation of the country. On the other hand, a small gold reserve and heavy liabilities produce a feeling of uneasiness which is contagious, and which speedily affects almost every one in some degree. The primary object of Mr. Goschen's proposals is, then, so to increase the gold reserves at the Bank of England as to afford against panic a security of a permanent character. The question is—Can this be done? Mr. Goschen's idea is that there is a quantity of gold circulating in the pockets of the people, and therefore unavailable in quantities on an emergency, which might be replaced by bank-notes, so far as the pockets of the people are concerned, and that the gold coin so displaced would then find its way to the Bank of England, there to form a second gold reserve, and so constitute a security against panic. The method which Mr. Goschen proposed has indeed been pressed upon the attention of bankers for years by an eminent Scottish banker, Mr. Charles Gairdner, manager of the Union Bank of Scotland. A few months ago that gentleman read a paper at Edinburgh to the Institute of Bankers in Scotland, in which he employed substantially the same phrases as Mr. Goschen used at Leeds to describe the danger of the existing inadequate reserve, and proposed substantially the same remedy. The position is briefly this. We hold a smaller quantity of gold absolutely than the United States, or Germany, or France, and a vastly smaller quantity relatively to our internal or external trade as compared with those countries. The United States hold over £60,000,000 of bullion under central control and about £82,000,000 in the national banks, a large part of this amount being by law incapable of depletion. The Bank of Germany holds about £40,000,000 in gold and silver; the Bank of France holds about £95,000,000. Against these figures London, the banking centre of the world, the pivot upon which the whole structure of credit turns, possesses a central reserve of only £24,000,000. Even if there be added to this the gold in the provincial banks of England, Scotland, and Ireland, amounting to under £20,000,000, we have only £44,000,000, of which only about £20,000,000 in gold is really available as a national reserve. There is a very obvious advantage in the possession of an ample reserve. It contributes to the stability of public confidence, and consequently to the avoidance of panic and to the prevention of great extremes of fluctuation. Although there are other causes for the steadiness of the Bank

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rate in France as compared with the Bank rate in England, besides the retention of a large metallic reserve, it is very remarkable that during the past seven years there have been only seven changes of the French Bank rate, between the limits of 2½ and 4½ per cent., while during the same period there have been sixty-two changes of the English Bank rate, between the limits of 2 and 6 per cent. In order to increase the reserve, not temporarily, but permanently, Mr. Goschen proposes to issue £20,000,000 or £30,000,000 in £1 and 10s. notes, and to keep as a special national reserve the metallic money it represents at present in the pockets and tills of the public. Mr. Goschen is indubitably right in saying that if the gold so withdrawn from circulation and replaced by paper were simply added to the existing reserve it would speedily disappear. It would be driven out of the country by the irresistible operation of Gresham's Law, which has defeated the efforts of so many currency reformers. Although Mr. Goschen recognises this danger, he has so far promulgated no definite proposal for providing against it. For unless some provision be made for the permanent retention of this gold in the coffers of the Bank of England, there would be no additional reserve; on the contrary, it is conceivable that it might even be smaller than before. Again, if the gold be permanently locked up in the Bank of England, incapable of being employed save in the case of war, as is the German military treasure in the fortress of Spandau, of what avail would it be in an ordinary financial crisis? It must, however, be admitted that, so unreasoning is the commercial mind during financial crises, that the mere knowledge of the existence of a store of gold, even though the store were unavailable save by exceptional action of the Government, might suffice to impart a feeling of confidence. The important points, after all, are that in a time of financial strain, solvent houses should be enabled to borrow upon substantial security, and that thus the area influenced by the strain should be restricted as much as possible. The obvious danger is that the formation of this national reserve might encourage risky finance among large houses. At present, with the grave warning of the recent crisis before their eyes and the serious consequences which the crisis entailed still apparent, the largest houses have a natural fear of the results of injudicious speculation. It would be a great misfortune if, in seeking to protect the public against financial panics, the course of action which leads to these were in any way encouraged. Apart from the question of the formation of a second reserve, the issue of 10s. and £1 notes can hardly fail to be a distinct advantage, although there is much to be urged against the former being issued in place of silver while this metal is so greatly depreciated. The obvious result of the withdrawal of, say, £10,000,000 in half-sovereigns, and the issue of 10s. notes against a nominal amount of £10,000,000 in silver, would be a large profit to the Government, and a corresponding nominal loss to the public. This issue might, indeed, result in much practical inconvenience unless these notes were made legal tender up to any amount instead of being made legal tender only to the amount of 40s. It is, however, rather premature to criticise Mr. Goschen's proposals until their details are more fully disclosed.

WORKMEN'S HOURS OF LABOUR.

A Parliamentary Return has just been issued by the Board of Trade which is of peculiar interest at the present time, as it shows the average number of hours, excluding overtime, worked as a week's work in the principal skilled and unskilled trades of the United Kingdom in the years 1850, 1860, 1870, 1880, and 1890. The Board of Trade sent out 1,448 circulars to employers, and got 962 replies; to trades unions they sent 292, and received 159 replies. The report is confined to a statement of facts, and readers are left to form their own conclusions. One point which is clearly shown, as might have been expected, is that the hours of labour in most of the industries throughout the country have diminished considerably during the last forty years. In one group, however—that of agricultural and dock labourers—the reduction of hours seems to be very slight. Of course, there is some difference of hours in the same industries in different parts of the country. "Dock gatemen" head the list with 105 hours per week in winter, even at the present day. Bakers, except in Birmingham, where, according to their trade union, they still work for 90 hours per week, in some cases show an average of about 9 hours per day. In the building and textile trades the trades unions and the Factory Acts have reduced the average from 10 or more hours thirty or forty years ago to 9 hours or less per day at the present time. Nine hours is also about the average in the principal mechanical trades, such as carpenters, painters, plasterers, coachmakers, engineers, fitters, smiths, &c. Among the sedentary trades there is considerable diversity, and some rather puzzling discrepancies. The hours for miners deserve special attention. There need be little wonder that the Northumberland and Durham miners are not at all anxious for the passing of the Eight Hours Bill, for at present many of them only seem to work from 38 to 44 hours per week. The hours of the surfacemen and firemen are, however, much longer, and vary from 66 to 84 hours per week. In Lancashire, Cheshire, the Midland Counties, Somersetshire, and Yorkshire miners seem to work about 48 hours per week, instead of from 60 to 70 forty years ago. In Wales the average is about 54 hours per week. The returns by employers and trades unions show considerable discrepancies in many cases, while in others the range mentioned is so wide that little information is got from the figures. For instance, a trade union reports that the hours of railway servants generally in Great Britain and Ireland range between 48 and 100 per week. Signalmen's hours usually range from 48 per week to 72, but in some few cases to 84. One of the most minute returns is that given by the Miners' Federation of the details of a collier's day, excluding Durham and Northumberland. The English and Welsh miners are at the coal face from 7½ hours per day, except in the Yorkshire districts, where they work 10½ hours per day. These returns will no doubt be carefully examined and criticised by all who are specially interested in the questions involved, and we commend them to the attention of our readers.

THE SUEZ CANAL.

In the accompanying table is given a return, year by year, of the shipping and tonnage that passed through the Suez Canal from its opening in 1869 to the year 1889 inclusive, a period of over twenty years, which table also shows the progressive increase of the tonnage and of the transit receipts. It will be noted that in 1869 there were 10 vessels, with a net tonnage of 6,576, and the receipts were 54,460fr.; in 1879 the number of vessels transiting the Suez Canal was 1,477, the net tonnage was 2,263,332, and the traffic receipts were 29,686,060fr.; and in 1889 the number of vessels was 3,425, the net tonnage was 6,783,187, and the traffic receipts were 66,167,579fr. In 1890 there were 3,389 ships, the net tonnage was 6,890,014, and the traffic receipts were 67,010,914fr. Notwithstanding this decrease in the number of vessels the total tonnage for 1890 was 6,890,014, as compared with 6,783,338 tons in 1889, or 36 ships less, and 106,676 tons more in 1890.

Year.	No. of Vessels.	Gross Tonnage.	Net Tonnage.	Transit Receipts. Fr.	c.
1869	10	10,557·61	6,576·00	54,460	80
1870	486	654,915·02	436,609·37	5,159,327	22
1871	765	1,142,200·46	761,467·05	8,993,732	87
1872	1,082	1,744,181·32	1,160,743·54	16,407,591	42
1873	1,173	2,085,072·61	1,367,767·82	22,897,319	18
1874	1,264	2,423,672·22	1,631,650·14	24,859,383	00
1875	1,494	2,910,708·45	2,009,981·09	28,886,302	27
1876	1,457	3,072,107·01	2,096,771·61	29,974,998	74
1877	1,663	3,418,949·72	2,355,447·69	32,774,344	22
1878	1,593	3,291,535·38	2,269,678·31	31,098,229	18
1879	1,477	3,236,942·32	2,263,332·19	29,686,060	81
1880	2,026	4,344,519·89	3,057,421·88	39,840,487	64
1881	2,727	5,794,491·19	4,136,779·77	51,274,352	95
1882	3,198	7,122,125·68	5,074,808·88	60,545,882	08
1883	3,307	8,051,307·30	5,775,861·79	65,847,812	16
1884	3,284	8,319,967·36	5,871,500·92	62,378,115	54
1885	3,624	8,985,411·80	6,335,752·98	62,207,439	21
1886	3,100	8,183,313·15	5,767,655·84	56,527,390	58
1887	3,137	8,430,043·20	5,903,024·09	57,862,370	71
1888	3,440	9,437,957·32	6,640,834·44	64,832,273	20
1889	3,425	9,605,745·48	6,783,187·12	66,167,579	14

British vessels transiting the canal in 1890 amounted to 2,522 out of the total number of 3,389, as compared with 2,612 British ships out of a total of 3,425 in 1889, and 2,619 out of a total of 3,440 in 1888. The net tonnage of 2,522 British ships transiting the canal in 1890 was 5,331,533 tons, as compared with a net tonnage of 5,358,072 for 2,612 British vessels in 1889, or a decrease of 90 ships for 1890, and only a decrease in net tonnage of about 26,500, so that the mean net tonnage per ship has increased. The number of French vessels transiting the canal was 171, as compared with 168 in 1889 and 187 in 1888; the net tonnage of these 171 ships was 366,262 tons. After the British, with 2,522 ships, the next in numerical order are Germany, with 275; France, with 171; Holland, with 144; Italy, with 87; Austria, with 55; Norway and Sweden, with 43; and Spain, with 32.

In 1890 the average time of transit was considerably shortened, and only took 24 hours 6 minutes; whereas in 1889 it was 25 hours 50 minutes; in 1888 it was 31 hours 15 minutes; in 1887 as long as 33 hours 58 minutes; and in 1886 not less than 36 hours.

The following table shows the number of ships that navigated the Suez Canal with the electric light, month by month, during the years 1887 to 1890 inclusive, and in this latter year the number amounted to as many as 2,836 with electric light out of a total of 3,389 vessels transiting the canal.

Months.	1887.	1888.	1889.	1890.
January	13	86	207	242
February	12	99	186	232
March	15	110	221	237
April	19	128	240	249
May	19	139	190	245
June	25	116	193	214
July	27	135	216	242
August	35	140	186	209
September	45	140	185	219
October	49	167	208	243
November	63	173	203	228
December	73	178	210	276
Total	395	1,611	2,445	2,836

In the year 1889 the average time for the transit of vessels travelling at night with electric light was 22 hours 30 minutes, or 4 minutes more than the mean time in 1888, and in 1890 reached the short and quick passage of 22 hours 9 minutes.

The following table will show more clearly the progress that has been made in shortening the time, and gives an average of the number of hours taken in the transit of the Suez Canal:—

	1887. H. M.	1888. H. M.	1889. H. M.	1890. H. M.
Average time of transit	33 58	31 15	25 50	24 6
Average time with electric light	—	22 26	22 30	22 9
Shortest time	14 65	14 55	14 45	14 15

THE SPEED TRIALS OF FAST SHIPS.

In connection with the experiments which are being conducted under the auspices of the Institution of Mechanical Engineers, we have recommended that the Committee should issue regulations for conducting trial trips, as at present the results which are published cannot be depended on, the methods of observation and experiment being so varied. This is true as regards coal consumption, and also speed. On the latter we find a paper in the Journal of the American Society of Naval Engineers by Messrs. Norton & McFarlane, assistant engineers in the United States Navy, in which four methods of measuring the speed of a vessel upon a trial trip are discussed. These are—(1) By readings of patent logs; (2) by successive runs in opposite directions over a measured distance; (3) by a continuous run at sea, the speed being based on the number of revolutions of the propeller found necessary to give a knot in smooth water; (4) by a continuous run at sea past a series of buoys, or stations on shore.

Although the first has the great advantage of simplicity, it is found to be entirely untrustworthy, and is therefore condemned, and the authors back up their condemnation by evidence which cannot be disputed. They recommend for the second method of measurement a course of 1 knot, instead of one of 10 knots, which has been proposed, as in the latter case the intervals would be so long that the change in velocity of the tide would introduce a very appreciable error. When the third method is chosen, it is necessary to determine the number of revolutions per minute and per mile for various speeds in smooth water, by runs in opposite directions over a measured knot. Large vessels should have a depth of water of not less than 19 fathoms. Several sets of runs should be made at different speeds; at least four, and, if possible, six runs at each speed. The revolutions should be counted with the greatest accuracy, and curves plotted on a large scale, showing revolutions per minute and per mile, with the speeds for abscissæ, so that speeds to the hundredth of a knot may be determined. On the continuous trial, which should be of four hours' duration, readings from two counters attached to each shaft should be taken every ten minutes. The total number of revolutions made in the four hours being determined, the average revolutions per minute can be obtained, and from them

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the number per mile and the speed of the vessel. The fourth method is troublesome and expensive, and involves a large number of observations, so that on the whole the authors favour the third method. They think that by using a chronograph which will read accurately to the tenth of a second, and revolution counters of which the error will be less than one revolution, sufficient accuracy may be obtained.

Letters to the Editor.

THE FRICTION OF BEARINGS.

To the Editor of "Industries."

Sir,—I have to thank you for the honour you have done me in reproducing the remarks which I made at the meeting of the Institution of Mechanical Engineers on the 19th inst., but I regret that, by the omission of the reference which I made to the results of certain of the experiments which were then under discussion, the purpose of the suggestion which I submitted for the consideration of the meeting is lost, and the introduction of the viscosities of sperm oil and of lard oil is rendered meaningless and superfluous.

What I had in my mind and desired to bring before the meeting was the fact that increase in temperature, whether caused by augmentation of pressure or of speed, is accompanied by a reduction in the coefficient of friction.

It has been demonstrated by the elaborate experiments of the Eastern Railway Company of France—

(*a*) That, with constant speed and uniform conditions of cooling the journal, *augmentation of pressure* produces increase in temperature and diminution of the coefficient of friction.

(*b*) That, with constant pressure and uniform conditions of cooling the journal, *increase of speed* causes an increase in temperature and corresponding diminution of the coefficient of friction.

(*c*) That, when equality of temperature is maintained, the coefficient of friction increases with the speed.

These deductions appear to be wholly consistent, as far as it is possible to compare them, with the results of the extensive series of experiments which have been planned and carried out under the auspices of the Institution of Mechanical Engineers, from which, if I correctly apprehend them, the following additional deduction is to be made—viz., that, temperature and speed being constant, the coefficient of friction diminishes with increase of pressure.

These rules are not wholly unrestricted in their application—*i.e.*, the diminution of the coefficient of friction which results from increase in pressure, speed, and temperature is only observed within certain limits—but I understand that these limits are such as engineers accept as being imposed upon them by other considerations and as being practically coextensive with their requirements.

I may add that the results of both of these series of experiments confirm in the fullest manner the conclusions which I had arrived at from various series of frictional and other experiments in which I have taken part at different times.

As, therefore, it appears to be established that temperature increases and the coefficient of friction diminishes with augmentation of pressure and (or) speed, I infer that this diminution of coefficient of friction is due to reduction in the viscosity of the lubricant accompanying evolution of heat. Hence I referred to lard oil and to sperm oil in order to suggest that, as lard oil (Table IX. of 1st Report) at a speed of 100 revolutions per minute, and with a load of 100lb. per square inch, gave a coefficient of friction = 0·0024 at 120° Fahr., while sperm oil, under the same conditions of speed and pressure (Table IV. of 1st Report), gave a coefficient of friction = 0·0025 at 90° Fahr., it is probable that the viscosity of lard oil at 120 Fahr. and of sperm oil at 90° Fahr. are almost identical.

I think that it used to be held that the temperature of a bearing was an indication of the power required to drive it, and of the anti-frictional value of the oil or other material employed to lubricate it, and not a few testing machines for lubricants have been designed and constructed on this theory, but, if the facts now stated are as trustworthy as they appear to be consistent, it is evident that all readings from such machines must be taken subject to several very important qualifications, and it may be asked whether, within moderate and safe limits, it is not better and more economical to run machinery at a temperature somewhat over, rather than expend energy in attempting to keep bearings at or near, normal atmospheric temperatures.

If any practical guidance in the selection of lubricants is to be gained from these experiments it is, I think, unmistakably and unquestionably that, instead of choosing thick oils as likely, on account of their "body," to stick to the journals, preference ought to be given to the thinnest oils which may be used consistently with the weight of the machinery, bearing also in mind the fact that a thin oil will find its way where a thick oil will fail to do so. In the case of heavy planing machines, thin oil will leave a film when and where a thick oil would be entirely scraped or rubbed off.

I regret that this doctrine is not generally accepted by engineers, to the majority of whom "great body" in an oil seems to be the first and the final desideratum. It may be that the use of a thinner oil calls for more care in the selection and adjustment of the apparatus by which the lubricant is to be applied, and for closer attention on the part of the man in charge to see that bearings are regularly and properly lubricated, while thicker oils may, perhaps, dispense with such close attention, but I am strongly of opinion that "hot bearings," both in land and in marine engines, are more frequently due to excess rather than to deficiency of "body," and are to be got rid of by the intelligent and careful use of oils of moderate "body" rather than by the use of the oils of excessive viscosity which have been introduced within the last few years.

Yours, &c.,
J. Veitch Wilson.

Belmont Works, Battersea, S.W.,
28th March, 1891.

MR. KAPP'S CANTOR LECTURES.

To the Editor of "Industries."

Sir,—From the report on Mr. Kapp's lecture in your issue of March 6th it appears that Mr. Kapp has stated that "there is another method of alternate current transmission, known as the three-phase current system."

A system, which may be called so, has been described by me in patents of 1888. In this system the generator has three circuits with a common joint, and the three free ends are connected to the terminals of a similarly constructed motor. This system has been used and thoroughly tested by me in many modifications. I do not agree with Mr. Kapp that its plant efficiency (if Mr. Kapp means this system) is "much greater than with the Tesla system." Its advantage is that the e.m.f. on all circuits is equal, but it has many disadvantages as compared with the two-circuit three-wire system under ordinary conditions. As it is, however, desirable to use one or the other plan, I have pointed out the advantage of making a motor with a number of poles which is a multiple of two and three.

Mr. Kapp seems to make a distinction between the "Ferraris two-wire system," the "Tesla three-wire system," and the "three-phase current system." I do not need to point out that my invention is not a two-wire or three-wire system, nor a two-phase or three-phase system. What my invention is Mr. Kapp may see if he will take the trouble to peruse my patents.

I infer from other papers that Mr. Kapp has stated that I have "worked in the line indicated by Professor Ferraris." I may call his attention to the fact that the date of filing of my application for the American patent anticipates the Ferraris publication in Italy by something like six months; I therefore cannot have worked in the direction indicated by Professor Ferraris.

The statements of Mr. Kapp would appear to imply that I am an imitator. I need not say that I am not an imitator. My aim is to produce original work or none at all.

Yours, &c.,
Nikola Tesla.

New York, 17th March, 1891.

THE SHIPS AND ENGINES OF THE NAVY.

To the Editor of "Industries."

Sir,—The Parliamentary Return on the "Engines in the Navy," to which you alluded in your last issue, shows that the Admiralty are beginning to break through the policy of secrecy which has characterised almost all their transactions. I hope they will be induced or compelled to go further. In connection with the science of shipbuilding, there is a great mass of information regarding experiments carried out by the late Mr. Froude, by his son, and others, which should be made available to the whole of the profession. There may be some points on which public policy makes it necessary to put the seal of secrecy, but things of purely scientific interest, which are being worked out by a public department, should be public property. Moreover, I think the time of the officers in Her Majesty's Navy should be utilised to a much greater extent than it is at present, by asking them to collect information and make experiments regarding their ships and engines. Life on board a man of war is not of a very intellectual nature, and such employment would add much to the enjoyment of life, and to the information of the profession and of the public. They might make observations regarding speed under varying conditions, stability, rolling, resistance, &c., of ships, and the efficiency of engines both as regards the steam, the mechanism, and the boilers. A little has been done regarding the latter by the Institution of Mechanical Engineers, but a great deal still requires to be done, and there are no reasons why the services of public officers should not be utilised to collect information which would be of the greatest advantage.

Yours, &c,
Marine Engineer.

Glasgow, 28th March, 1891.

THE INSTITUTION OF NAVAL ARCHITECTS.

To the Editor of "Industries."

Sir,—The recent meeting of the Institution of Naval Architects was very successful, both as regards the quality of the papers read and the attendance of members, but still it was felt that some of the criticisms which have been passed on the methods of conducting the work of the Institution were more than ever required. Although I have said the papers were of good average quality, and some of them of a very high standard, still I am of opinion that the programme might have been better, certainly more representative of the various departments of naval architecture and marine engineering, and of the practice in different parts of the country. It certainly looks strange that not a single paper came from the Clyde district. I have no doubt it will be said that that was the fault of the Clyde engineers and shipbuilders, and to a very considerable extent that is true, but the feeling seems to be that the Institution is essentially a London institution, and that its management and the preparation of papers for it may largely be left to the members in and around London.

The greatest objection to the present system of management is that too much is attempted in a short time, and for the rest of the year the Institution is practically defunct. It is rather difficult to justify the maintenance of a staff for three days' public work, for no one can doubt but that the editorial work could be done in the leisure time of a competent man. It has been hinted more than once that if some inquisitive M.P. examined the accounts, and discovered that the Admiralty made a grant of £250 a year, he might ask some rather difficult questions as to the return the country got for this money, and, in fact, might dispute the necessity for any such payment to an Institution having so many rich members.

I am glad to learn that the Council propose in future to hold two meetings every year. I would suggest that they go even further, and hold three—one in London, one in Newcastle and Liverpool in alternate years, and one in Glasgow. This arrangement would include the chief shipbuilding districts, and would arouse a local interest in the affairs of the Institution. The meetings need not extend over more than two days at each place, and everything should be done in the simplest and least expensive manner possible. I believe that hitherto the provincial meetings have always involved far too great an expenditure of money, not on the part of the Institution, but of the local members and their friends. A large guarantee fund has always been got up, and rather expensive entertainments provided, all of which, in my opinion, are unnecessary. The Institution would have no difficulty in obtaining the use of a hall free of charge, and there are no reasons why members should not pay for any dinners, luncheons, or other entertainments they attend. These have hitherto been far too important parts of the programme; in fact, so much so that the reading of papers has sometimes seemed a subsidiary function.

I think, moreover, that the value of the Transactions would be very much improved if the plan of the Institution of Civil Engineers were adopted, and correspondence invited from well-known authorities on the subjects of the different papers, and if digests of papers which have been read before other institutions were incorporated. In looking over my set of the Transactions of the Institution of Naval Architects, I have been struck with the fact that they have not developed from year to year, either as regards quantity or quality, in the way that the Transactions of other institutions have done. I am sure that if the suggestions I have made were adopted, we would soon soon see a very great improvement.

Yours, &c.,
M.I.N.A.

Glasgow, 28th March, 1891.

THE CHEMICAL SOCIETY'S ANNUAL GENERAL MEETING.

To the Editor of "Industries."

Sir,—In contrast to the amity and fertility that distinguished its recent jubilee meeting, the business gathering of the Chemical Society, which took place on the 25th ult., was characterised by the clash of opposing parties with fiercest war of words. Quite in accordance with recognised usage was the presidential address, handsomely admitting the need of some reform being begun, cautiously deprecating any alteration of a decisive kind, and amiably endeavouring to pour oil on very troubled spirits

Starting with a proposition of Euclidian sententiousness, that because most good chemists are "Fellows," therefore it has been erroneously supposed that most Fellows are good chemists, Dr. Russell reminded his hearers that the agitation for importing greater stringency into the regulations for the admission of Fellows, which is now a burning question, was in no way new. In 1867 a similar movement had existed; the propositions put forward were referred to a committee, which, in the manner of committees, recommended some kind of verbal compromise, and then had been conveniently stifled. Then, as now, two sets of views were current. One was held by those who considered the Fellowship in some sort a qualification implying professional proficiency, and therefore wished to exclude the incompetent. The other, by a party of diametrically opposite views, who looked upon the Chemical Society in the light of a chemical club open to all socially unobjectionable, and having a real interest in chemistry, whether as amateurs or professionally.

The growing need of some body to hall-mark professional chemists, which was at the root of this agitation, had led to the formation of the Institute of Chemistry in 1877, to act mainly as a qualifying body. Although this Society, as you have recently shown, now exists, yet its existence did not remove the onus of exercising some discretion by the Chemical Society "as to who (*sic*) we may desire to be admitted." Inasmuch as a certain distinction attached to the letters "F.C.S." it was necessary "to exclude unsuitable persons," an aim which had hitherto been attended "with imperfect sucess." In spite of this, however, the Chemical Society had grown both in numbers and standing during the last fourteen years, and on the adoption of the alterations in the procedure for the election of Fellows, which would be submitted to the meeting, all but a few objectionable persons would be excluded, and these might be left to work out their own destruction, while "any Fellow acting dishonourable (*sic*) or wrongly' could be adequately dealt with.

This, Sir, was the penultimate clause of an address which, if not remarkable for grammatical precision or elegance of diction, was a straightforward attempt to mitigate, without altogether nullifying, the effects that would have been produced by the adoption of the proposals of the more rabid reformers.

The most useful and interesting announcement made throughout the evening was, however, reserved for the last. Those unprincipled persons who were accustomed to assume and trade upon titles falsely indicating that they belonged to such bodies as the Chemical Society would, it was hoped, soon be summarily dealt with. A Bill had been drafted jointly by the Royal Society, the Royal Astronomical Society, the Chemical Society, the Society of Antiquaries, the Geological Society, and the Linnean Society, making it penal for unauthorised persons to assume the titles respectively conferred by them.

After the President had thanked the officers of the Society for their co-operation, in the execution of which function it was refreshing to see one of the Secretaries following the example of the immortal Mr. Jingle, and vigorously applauding himself, the usual laudatory motions re the address were made, Mr. Carteighe particularly distinguishing himself by his flowery imagery, alleging that the "address breathed a spirit, gentlemen, which is I think a sound spirit," but opportunity of judgment in this particular is, I am sorry to say, wanting, no samples being to hand.

Facts and figures from Professor Thorpe, the Treasurer, gave satisfaction to the statistically disposed, and led Dr. Stevenson to complain that too little was spent on the library, a complaint which all who use it will endorse. Another useful suggestion was made by Professor Ramsay, who wanted some assistance and apparatus to be available for the use of Fellows about to read papers to be illustrated by experiments before the Society. The election of new officers and members of Council went off without a hitch, Mr. Crum Brown being next year's President.

So far it had been fairly smooth sailing, but now there came that expectant hush premonitory of conflict. Goaded by the

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persistency of the reforming "movement," the Council had prepared some proposed alterations in the bye-laws relating to the election of Fellows. Many exhausted members having retired for refreshment, Mr. C. E. Cassal, undoubtedly the participator in the "movement" having the greatest weight, proposed ringing the bell used on such occasions and summoning the laggards to the fray. This done, Mr. Lloyd, one of the secretaries of the "movement," arose, and with appalling prolixity inquired whether a motion could be brought forward at the meeting of which notice had not been given. The President ruled that it could not, to the consternation of the leaders of the "movement." This brought Mr. Lloyd once more on his legs and gave him some reason for evolving a stream of words more or less limpid.

Great interest and curiosity were displayed by the meeting as to the number of persons composing the "committee" responsible for the "movement," but Mr. Lloyd declined to gratify this laudable desire, asserting, with Delphic obscurity, that "number's nothing," leaving it to be divined whether he wished to indicate his scorn for mere multitude, or to assert the non-existence of the committee itself. He then wished to move that the whole of the amendments proposed by the Council should be postponed to the next annual meeting, but this was ruled out of order by the Chairman. The heavy artillery of the "movement." in the shape of Mr. Cassal, then opened fire, and inquired on what authority that ruling was made.

When at length the momentous question as to the acceptance of the Council's proposed amendments came to the vote, the opposition "movement" mustered as many as five hands! Thus ended a storm in a teacup. Who shall say after all that passed at this meeting that chemists are not capable of self-government?

Yours, &c.,
CHEMIST.

London, 28th March, 1891.

THE USE AND ABUSE OF MATHEMATICS.

To the Editor of "Industries."

SIR,—As you have recently published a very interesting correspondence on the question, "Is the Study of Thermodynamics of Use to Engineers?" I am induced to send you some ideas upon a subject of kindred importance.

There always has been, and probably always will be, a sort of feud between the so-called theorist and the practical man. The conventional theorist is not really a theorist at all, he is assumed to have only an imperfect and one-sided knowledge of his subject; similarly the conventional practical man is anything but a practical man, as he is supposed to have nothing more than a rule-of-thumb knowledge, a kind of knowledge which defies analysis. The true theorist and practical man should be one and the same individual. He will have studied the thermodynamics of his steam or gas engine, and he will also know what kind of cylinder oil to use, and the price of it.

I do not wish to discuss the relative merits of theory and practice in this narrow sense, but only to say a little about the use of mathematics. There is often an outcry against mathematics, and the engineer who says he does not believe in them is quite common. I remember one who stated in print that he did not believe in heavy integrals, whatever that may mean. On the other hand, the mathematician declares that mathematics is the essence of sense, and the people who revile mathematics are those who do not know any. There is here no common ground, and such discussions are futile; but though no one can deny that considerable mathematical knowledge is absolutely necessary to an engineer, there does seem to be much reason in the outcry so often made against the so-called mathematicians. In the first place, mathematics is not highly developed reasoning; such a definition is too large. The higher branches of reasoning are inductive; mathematics is simply concentrated deductive reasoning about quantity.

There is a vulgar quality in the human mind which makes us reverence anything we do not understand. This is shown most strongly in savages, but the same weakness exists in civilised men. Many a reputatation in literature, art, and music is due wholly to the great man's knowledge of this little failing. If a man who knows a little chemistry comes across a paper on a chemical subject which he cannot understand he feels that he merely has to look it up to know all about it. But if he comes across a mathematical paper beyond his reach, he finds symbols and characters which convey no meaning to him, and he falls prostrate and worships. This being so, it is scarcely in human nature for a mathematical man not to flourish his mathematical knowledge in the face of the world at every opportunity. If people realised that mathematics is not really a very high intellectual exercise, but requires little more than close attention and concentration of thought, it might be better.

The admission of women to the Cambridge examinations is calculated to do great good. It will not have the effect of opening the eyes of men to any unsuspected intellect in women; it will merely let them see that the passing of University examinations is not, after all, such a very difficult matter, and that even higher mathematics is not a study requiring any transcendent abilities; that, in fact, many an ordinary person might have been Senior Wrangler if he could have had a few years free from care, work, or anxiety, with the stimulus of others around him, and tutors to help him to do nothing whatever but read mathematics in a systematic and regular way.

The chief real complaint against mathematicians is that they are apt to over-rate the value of mathematical work, and to forget that they are only employing deductive reasoning. Nothing is commoner than to find a simple law assumed, and then followed by pages of calculations which would be useful if the assumed law were true, but are really valueless. This vice is especially common in electrical literature. When electrical engineering began, few engineers were well enough up in electricity to be independent of the advice and fuller knowledge of the various science teachers. The result is that electrical engineering has ever since remained a sort of 'Tom Tiddler's ground," and it will be long before the profession settles down into a state corresponding with other branches of engineering.

The feud between the practical man and theorist, in the narrow and incorrect sense of the terms, has therefore raged very bitterly in that profession. The study of dynamos was retarded for years while pages and pages were written showing how dynamos would behave if the pressure were this function or that function of the excitation. Each equation contained some coefficients, so that each writer could make his law fit roughly. To this day reams and reams of calculations about transformers are published in which harmonic functions are assumed.

Not long ago a scientific paper published an account of a chemical balance which was rendered dead-beat by two air dash-pots. This was a very good idea. The description was followed by a whole series of calculations, showing the "damping" in terms of the dimensions of the dash-pots, and assuming certain laws of air friction to hold good. But this is playing at science. Anyone would naturally make the piston fit as closely as possible without touching, and, if the balance was then too sluggish, would make it looser.

Cambridge sets the fashion in mathematics. No one but a Cambridge man is supposed to be capable of anything in mathematics. A few Dublin men have had a glimmering of knowledge, but an Oxford graduate is in outer darkness, and an unfortunate who has read by himself and never been to any University at all is doomed to eternal ignorance. In spite of this we hope that someone may write a book on practical mathematics which contains just those subjects which are necessary for engineers, and nothing more. We do not mean a book of simplified explanations. They are delusive. Such explanations as Clifford's are very striking to those who understand the matter beforehand, but probably no one ever learnt anything for the first time from them. For practical work graphical methods should be much more developed than they are. The Cambridge man looks upon a graphical solution of a problem as a kind of foul play, and would as soon think of solving an equation by trial, or by omission of an unimportant term, or in any other reasonable way.

Perhaps the chief cause of the differences between "college men" and commercial engineers lies in the former's ignorance of actual requirements and cost of making. Recently a ploughing engine was severely criticised on account of its absurd proportions. Its shaft was large enough, said the writer, to transmit some hundreds of horse-power; and it was assumed that the makers did not know the laws of the torsion of shafts. The critic really did not know the requirements of a steam plough. Such an engine must not only plough, but it must stand the roughest usage in steeplechasing across country. It is no easy matter to calculate the proportions of an engine that will damage nothing but a bridge in falling through it.

Take, for example, a marine engine. Theoretically it is all to be carefully designed on the principle of Wendell Holmes' "Deacon's Masterpiece." In practice nothing of the sort can be done. The head draughtsman looks out the drawings of a former engine of about the same size. He has them traced with a few of the dimensions altered. He works in as many existing patterns as possible, and the details are all designed by eye, keeping as nearly as possible to the dimensions of some engine already made. No other course would pay.

What is really needed is a combination of theoretical and practical knowledge. It is very doubtful if our training is best for engineers. A boy leaves school early and serves an apprenticeship which is entirely practical. Before there can be effective combination between the so-called theorist and practical man, the mathematician must realise that he knows little or nothing about engineering, but that what he does know would be useful in the hands of commercial engineers; and engineers must understand that though the mathematician, or theorist, or college man could not design an engine that would work, some of his knowledge would be very useful. In fact, a little more modesty on the part of the "college man" would be of the greatest advantage to all.

If any of your readers have "something on their mind" similar to the above I hope you will allow them to disburden themselves.

Yours, &c,
ELECTRICIAN.

Leeds, 28th March, 1891.

NOTES ON PATENT LAW.

I.

THE number is legion of treatises on the subject of Patent Law, which have even within the past few months been issued from the press in the form either of original works or new editions. But these are almost without exception intended as text-books for lawyers, and aim at dealing in its entirety with this somewhat large branch of law. They are, consequently, both too large and fragmentary to be of any great service to the general reader. They are voluminous books, which only a student of the subject can afford the time to read systematically, and the authors confine themselves so strictly in their utterances to the language of decided cases that it is generally very difficult to obtain from them any general proposition that covers a particular point of difficulty. It thus happens that, in spite of their excellence as manuals, they are by no means serviceable as books of reference to the general reader, and it is believed that the series of articles of which this is the first will supply a felt want in the way of exhibiting, stripped of technicalities, so far as that is possible, the main outlines of the British Patent Law in those of its aspects which are of distinctively general interest.

There are two classes of persons, excluding the patent lawyers, who are specially interested in patent law—they are (1) inventors and (2) investors in patents. The inventor and the investor are for many purposes antagonists, and every one has heard some touching story of a clever but simple-minded inventor robbed of the fruits of his ingenuity by the wiles of a crafty investor, who has bought the inventor's right for some trifling or illusory consideration, and exploited them to his own immense advantage, without so much as entertaining a passing thought of making the original source of his profits a sharer in their advantages. But although such cases of hardship have undoubtedly occurred in the past, and will occur again in the future, they will affect only a very small part of what we have to put forward. The more common, though much less generally recognised case, is that the inventor and the investor co-operate loyally and to their mutual advantage; and, again, cases are frequent where the inventor is able, without any external assistance, to put his own invention on the market, and thus to combine the two characters in himself. We shall first, then, consider those points which affect them both in the same way—in respect, that is, of their common interest. The consideration of working agreements between co-adventurers will form a separate topic for after consideration.

This plan leads naturally to the discussion in the first place of the patentee's rights, since they lie at the foundation of any advantage which can be secured either by himself or by those who share in his undertaking. These rights are derived from two sources—certain Acts of Parliament and the Royal Grant; and for their full definition both must be consulted. The principal Act under which all existing patents have been created is, curiously enough, an Act directed *against* monopolies, and primarily intended for their suppression. The right of granting trading monopolies claimed by the Tudor sovereigns and by James I. was so enormous and oppressive that Parliament put in the very forefront of its demand for reforms when its dispute with the House of Stuart waxed vehement a demand that they should be abolished. Hence resulted, after a great deal of royal evasion, the celebrated Statute of Monopolies, in the year 1623, by which it is declared that "all monopolies, and all commissions, grants, licenses, charters, and letters patents heretofore made or granted or hereafter to be made or granted to any person or persons bodies politic or corporate whatsoever of or for the sole buying selling making working or using of anything within this Realm or the Dominion of Wales . . . . and all proclamations, inhibitions, restraints, warrants of assistance, and all other matters and things whatsoever any way tending to the instituting, erecting, strengthening, furthering, or countenancing of the same or any of them, are altogether contrary to the laws of this Realm and so are and shall be utterly void and of none effect, and in no wise to be put in use or execution." From this very sweeping denunciation an exception was allowed, which is provided for in the following terms:—"Provided also and be it declared and enacted, that any declaration before mentioned shall not extend to any letters patents and grants of privilege for the term of fourteen years or under hereafter to be made of the sole working or making of any manner of new manufactures within this Realm to the true and first inventor and inventors of such manufactures which others at the time of making such letters patents and grants shall not use, so as also they be not contrary to the law, nor mischievous to the State by raising prices of commodities at home or hurt of trade or generally inconvenient."

Upon this exception has been engrafted the entire patent law, for although it must be admitted that subsequent legislation, and still more the modifications introduced by the judges in their interpretation of the clause, have caused its effect to vary from time to time, in the end, and in spite of the jealousy of monopoly which breathes through the whole Statute, and has at various times found expression from the judicial bench, inventors have received a very large measure of privilege. Thus the grantee of a patent may, while the grant lasts, attack the maker, vendor, or user of his patented invention, and if he makes good his claim, may enforce his right by requiring that the objectionable "manufacture" should be either delivered up to himself or destroyed, besides recovering pecuniary damages against the person who is shown to have committed the infringement of his rights. But this is not the whole measure of a patentee's rights. The letters patent under which he acquires them confer on him and on his personal representative or assignee the power of making use of his invention "by himself, his agents, or licensees." Thus he is able, not only to monopolise the use of his invention in his own hands, but to become a source of similar privilege in other persons, so that he can not only make over his rights by a sale of the patent itself, but, if he so prefer, he can, while retaining the paramount right in his own hands, concede to others the subordinate right of manufacturing under his licence, and on any terms as to the payment of royalties or sharing of profits, to which he and they can agree. It is this power of sharing his privileges which gives to the position of a patentee its great commercial value and advantage, and for our present purposes it is, therefore, all-important. Before passing to that point, however, we must pause to consider the statutory limits of the patentee's rights as above defined, a subject which will afford material for our next article.

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THE "HARLOW" SIGHT-FEED LUBRICATOR.

The accompanying illustrations represent in Fig. 1 a general view of the above lubricator, and in Fig. 2 a sectional elevation of the oil cup. The lubricator is made by Messrs. Green & Boulding, of 21, Featherstone Street, City Road, London. The apparatus is automatic in action, and has a positive feed. As will be seen from the sectional view, the oil is fed from the cup by means of a plunger actuated by means of a rack C in which gears a pinion B caused to revolve by means of a lever and rod connected to any suitable moving part of the engine. The feed can be regulated by means of the wheel valve A, and is further controlled by means of a spring valve D. The lubricant, previous to passing out of the cup, is strained through a strainer F, so as to prevent any foreign material which may be suspended in it from passing to the bearing. The whole is nicely finished in brass or nickel, and the wearing parts are reduced as far as practicable.

THE INSTITUTION OF NAVAL ARCHITECTS.

(*Continued from page* 293.)

The first paper, on Friday, the 20th ult., was read by the Secretary. It was by M. J. Barba, late engineer in the French Navy, and now chief engineer of the Creusot Works, on

Recent Improvements in Armour Plates for Ships.

A historical sketch of the manufacture and trials of armour plates was followed by a discussion of the formulæ for penetration. The effects produced by impact on the projectiles, and the secondary effects of impact upon the plates, were dealt with, and the author concluded with a statement which may be summarised as follows:—The Schneider plates have kept out the projectiles better than any others, in the opinion of the various Governments. Armour should stop any projectiles and limit the damage to the hull of the ship. Cracks do not exercise any influence on the perforation. A laminated structure, assisted by the introduction of nickel, will reduce cracking, but cracking must always appear to a certain extent. In ships, where it is unlikely that two projectiles will strike in the same place, the first thing to do is to keep out the first projectile. For this purpose the metal must be hard throughout its whole mass. Nickel seems to increase notably the degree of hardening, especially with large masses. With a similar composition to all-steel plates, the Schneider plate allows greater hardness, and the easier breaking of chrome steel projectiles when they are not of the best quality; perhaps also of the best ones when they are of large diameter. From this fact the penetration will be less. A laminated structure and the diminution of cracks resulting from it may be an advantage, but it is not to be put on an equal footing with the former. Numerous points of attachment are necessary.

A long discussion followed the reading of M. Barba's paper, which was extensively criticised by several of our largest manufacturers of armour and others.

Mr. Alexander Wilson, of Workington, said he did not see much to discuss in the paper, as so much was omitted from it. There was but little in it to prove that solid steel was better than compound armour. For his own part, he still made a great deal of the latter, and thought it was much the best. Compound armour resists the old cast-iron shells, and also resists solid forged steel shells as a rule, but the solid steel is penetrated. Explosive shells are extremely dangerous if they penetrate, and they are best kept out by compound armour. When speaking of lamination the author seemed, in fact, to prove that compound armour was the best. His firm had made many experiments with a view of reducing penetration, and at the latest Ushant trials compound armour had behaved admirably.

Mr. Ellis regretted that his father was not present to represent Messrs. John Brown & Co., of Sheffield. Several points in the paper did not seem to have sound foundation. Lamination in compound plates was a necessity of manufacture, but it was not easy to see what caused it in solid steel armour. The author candidly admitted that the resistance of solid steel to common shell was less, and this was a vital point, as, for every forged steel shell that will strike the armour, there will be from fifty to a hundred common shell. The bulk of the shot must be kept out, and this gave a superiority to compound armour. In this kind of armour the hard face will give a much greater resistance to obliquely striking shots, of which there will be a large number in actual warfare. His firm were now making plates up to 32 tons in weight.

THE "HARLOW" SIGHT-FEED LUBRICATOR.

Constructed by Messrs. Green & Boulding, Engineers, London.

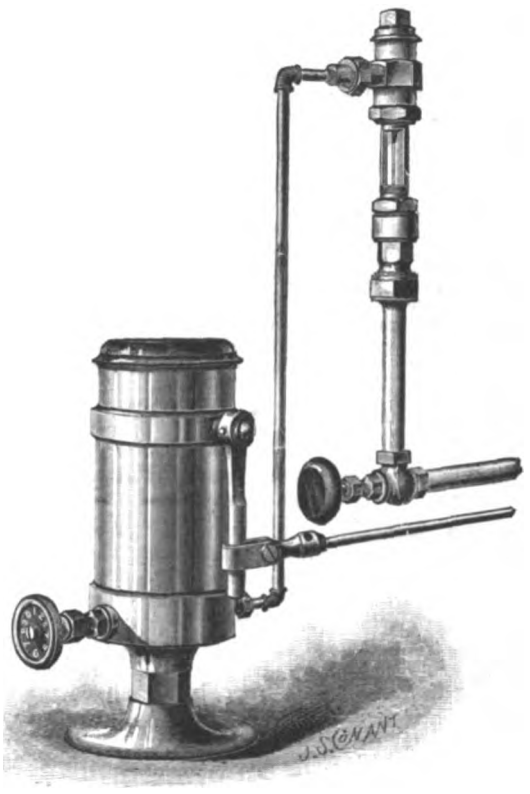


Fig. 1.

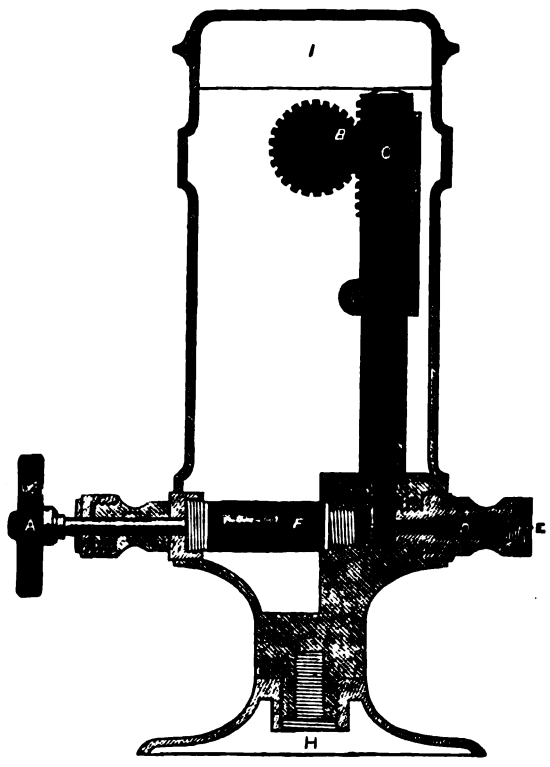


Fig. 2.

Mr. T. E. Vickers thought that it would have been better if the paper had been more scientific, and less of a trade puff. The statement with regard to armour trials in Russia was not borne out by the Russian official report. He quite agreed that the question was one of toughness and resistance. As a manufacturer, he tried to get the maximum of ductility and hardness together, so as to follow a medium line. At Annapolis the nickel-steel was tough, and was penetrated, but did not crack, so that it was considered the best; but the Russians had not taken that opinion. He could not understand how nickel or any metal could cause a laminated structure in solid steel plates. In large plates there is often a fracture parallel to the face, but it could not be supposed that this was caused by lamination existing prior to the plate being struck by the projectile. There must necessarily be toughness to prevent cracking.

Mr. J. F. Hall, of Messrs. Jessop & Sons, and of the English Nickel-Steel Syndicate, stated that one of his nickel-steel plates was tried before the Annapolis tests. He referred to Mr. James Riley's paper, read before the Iron and Steel Institute in 1889, as containing much valuable information. The difficulties with the nickel supply were mentioned by the speaker, who also stated that a small works for the production of ferro-nickel was being carried on, and that nickel-steel plates were being manufactured in this country.

Mr. Vickers (the brother of the manufacturer) said he was present in Russia at the time of the St. Petersburg trials, and so was able to give a full account of them. There were five shots fired at each plate, two shots of the softer metal and three of harder steel. The first two shots stuck in the compound plate, whilst the others went right through it. The Schneider plate cracked very badly. The Russian compound plate was also pierced. The Vickers solid steel plate kept out every shell; most of them stuck in, but none went right through. Pieces were broken from the back, but the face remained good. If the toughness was to be considered the best feature exhibited at Annapolis, the same should be done in the Russian trials.

Captain Tresidder had not heard that the first two shells fired at each plate were too soft. These two shots were fired with a velocity of 1,900ft. per second, and the three last shots with a velocity of about 2,100ft. per second. This velocity was excessive, and would never be attained in war, besides which the shots always were fired to strike the plates normally.

Mr. Beardmore, of Glasgow, said he was learning by experience how to make armour. His first plate was too hard, his next too soft, but the medium was the point to aim for.

Sir Nathaniel Barnaby thought that the paper was most disappointing, as he had hoped for elucidation of principles instead of a display of feeling. Schneider was the originator of hard armour, and that caused the use of the hardest forged and expensive projectiles. It was difficult to ascertain what the navy wanted, whether cracking was to be absolutely avoided or not. Was it to be allowed by the use of numerous bolts on the same principle that Whitworth proposed a large number of small plates, each with its own bolts. There appeared to have been some discussion with Messrs. Schneider & Co. as to the terms on which they should supply us with trial plates.

Mr. Biles thought that the plates should not be tested before they were sent for trial, or an unfair sample was likely to be put up. He would like to see some good summaries of the results of trials.

Mr. W. H. White wished to publicly thank steel manufacturers for the confidence they reposed in him. In 1886, the Admiralty determined on a series of trials supplementary to those of 1877, to determine the relative merits of compound and other armour. The plates were to be 8ft. by 6ft., and 10½in. thick. Many firms, including two in Sheffield, who had been devoted to compound armour, sent in samples of solid steel plates which were compared with compound plates as a standard. The results were not published, but each firm was informed how its own plate had behaved, so that improvements might be made. At the present time steel is being largely used for thin armour, and an order for belt armour of solid steel had been given to Messrs. Vickers. The speaker had seen many plates tried, and trials are constantly being made, but it was perfectly impossible to give any hard-and-fast standard, as both cracks and perforation must be taken into account. He wished to remind Mr. Biles that the preliminary tests were chemical and mechanical, and that inspectors were always present when the plates were made. A very important point with regard to cracking was the difference between armour for land defence and armour for ships. The former was likely to be struck several times in the same place, and so must resist cracking to a greater degree. With regard to nickel-steel, the Admiralty had not been idle. They began to look into the matter some two years ago, and they had tested a 4in. plate as early as April last year. Since then many samples of this material had been received and tested, and had showed a very great advance over the first plate obtained. He hoped

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that he had shown that there were very slight grounds for the reproaches showered on them by the newspapers for their supposed backwardness. He stated that Whitworth's system of small armour plates was untenable, as they could not determine the number of points of attachment satisfactorily. The supports for the plates must be strong. The whole question was simply a battle of armour *versus* projectiles; first one is improved, then the other. The latest development in projectiles was the use of hard shells containing high explosives. The armour must have a hard face to keep them outside. Again, the amount of armour was most important; a vessel might be disabled without the armour being once struck.

The President regretted that M. Barba was not present to answer the objections taken to his paper. He thought that the frank and important statement from the Admiralty would remove much misapprehension. One thing was to be clearly seen, and that was that they must have the best material, whatever the expense might be.

The next paper read was by Mr. Thomas Phillips, and was

On the Alterations in the Form of Steel Vessels Due to Different Conditions of Loading.

The author gave the results of a series of experiments that had been carried out during the past three years, and which, in the first instance, were undertaken at the request of the Committee of Lloyd's Register, who had instructed him to carefully note any changes that might take place in the sheer of a certain steel screw steamer of the well-decked type during the process of loading; it having been reported to the Committee that a sister vessel in every respect, and built in the same yard, had sagged when fully laden to an extent whereby the guaranteed deadweight carrying capacity on a fixed draught was not realised. As the subject of the strength of vessels to resist vertical deflections had not been treated in any paper, except from a purely theoretical consideration of the question, he trusted the information obtained by experimental researches would prove of interest. It has been customary, in the case of her Majesty's ships, to take sights of their sheers before and after launching. In iron vessels the break in the sheer was practically nil, and in the case of wood vessels the break of sheer was from 1in. to 2in. In the particular instance of the wood line-of-battle ship "Cæsar," which stopped on the launching ways, with a large portion of the after end of the vessel unsupported, the alteration in sheer was given to be as much as 18in. The author then proceeded to give full particulars of observations on the deflection of three types of vessels under various conditions of loading, but the details given are not suitable for abstraction. Finally, the writer expressed the hope that these investigations would tend to remove any doubts that have arisen as to the sufficiency of longitudinal strength in steel vessels built to the rules of Lloyd's Register Society to resist alteration of form when fully laden. Tabulated statements of the results were given, and diagrams of the vessels and curves, showing the displacement, sheering stresses, and bending moment, were also appended.

The discussion on this paper was opened by the Secretary reading a communication from Mr. Archibald Denny, who supplemented the observations given in the paper by others taken by his firm of the hogging and sagging of several vessels during launching, and when they were sea-borne. He thought, however, that the strains when the vessel was in a sea-way were much greater than during launching.

Professor Jenkins also cited some observations, and had supposed that the deflection in wooden ships was as much as 10in. to 12in. Though the author stated it as 1in. to 2in., yet other authorities put it at a higher figure. In spite of large deflection, however, there is not any considerable stress, as there is always some "give" owing to the rivets and other connections not being perfectly tight. The same occurs in iron vessels. He thought that some anomalies might be explained by the sights being set up on the deck and being interfered with by lateral as well as longitudinal movement. He did not think that an iron deck affected the deformation. The theoretical deductions from the observations should have been given. More important stresses must take place at sea than during the launch, but there are no data regarding them; the effect might be very great if the periods of oscillation of the vessel and the period of the waves agreed. Too much importance could not be attached to the necessity of straight keels and supporting blocks. No account of the variations in temperature appeared to have been taken in these experiments.

Mr. Martell stated that the sagging of vessels was often complained of, as it meant that as much as 100 tons less of cargo was carried or otherwise the Plimsoll mark went below water. He agreed that the keel must be kept straight, but did not see how lateral deflection was to be measured. Nor did he agree with Professor Jenkins' idea that the iron deck did not affect the question, since it prevented racking strains in the vessel. The paper was of value to the shipbuilding community.

Mr. Walter Phillips was able to give a continuation of the history of the first vessel measured by the author, as he had observed it during loading and unloading. The results, which he gave, were not satisfactory, and the vessel had to be strengthened. He knew that his figures would be criticised, but it was an undoubted fact that vessels often carried much less cargo than they ought to on account of sagging.

Mr. Ellis, of the Admiralty, said that the Admiralty built vessels on a concrete foundation, but in private shipyards it was often very difficult to keep the keel straight. He gave an example of shipbuilding in a Clyde shipyard, where they raised the after end of the keel half-an-inch to allow for settlement of the foundations.

Mr. Thompson said he arranged his sights on battens founded on the keel so that they were not affected by deck deformation. An iron deck prevented the sides of the vessel from coming in. The lateral deflection had been measured and found to be very small. His firm had hogged vessels when heavy boilers were to be put in.

In reply to the discussion, Mr. Phillips stated that the observed deflection of wooden ships in the Pembroke docks was never more than 2½in. His experiments had been performed during average weather. He did not at all agree with what had been stated by Mr. Walter Phillips.

The third paper read on Friday was by Mr. J. A. Yates, on

The Internal Stresses in Steel Plating due to Water Pressure.

This was essentially a mathematical paper, and dealt with a proposed method of calculating the stresses in the scantlings of the framing and the plating. The stresses due to water pressure are the most intense in the flattest parts of the plating exposed, and the calculations were confined therefore to such portions of the plating as are practically straight in both directions. A fore and aft strip of plating may be considered as a beam fixed at both ends, or as a suspension chain or parabolic arch uniformly loaded. Comparison of the formulæ for these two methods showed that if the deflection under pressure was less than one-sixth of the thickness of the plating, the strip considered would be bent under the conditions of a beam fixed at the ends; and if the deflection is greater than one-sixth of the thickness of plating, the strip would be bent as a suspension chain or parabolic arch. The question of side tension on the strips due to the connection with adjacent strips was very difficult to deal with. Further, the straining of the ship in a sea-way would seriously affect the stresses due to the simple water pressure. The author thought that the maximum deflection under pressure should be limited to about 0·05in. per foot of length for outside plating or ballast tank plating. Anything more than that might lead to possible damage of caulking and cracking of the cement. For bulkheads a somewhat greater deflection might, perhaps, be allowed without inconvenience; say, 0·1in. per foot. The stress allowed for local pressure straining should in the cases of the outer and inner bottom be limited to from 2 to 3 tons per square inch; but in the cases of bulkheads and water-tight flats, about 7 tons per square inch might probably be allowed with safety. From these facts and arguments it would appear that the course which should be followed in stiffening bulkheads was to fit substantial rigid stiffening frames at comparatively wide intervals, and only work such light angles between as were necessary for making a fair job of the bulkhead.

In the discussion which ensued, Mr. Smith said that he disbelieved in these theoretical calculations, as the results could not be proved unless the vessel broke down, or by examining her after long and arduous voyages. The only value in them was that they directed attention to what might be expected. Though steel makers were constantly producing stronger material, yet it was not safe to reduce the scantlings or plates in anything like proportion, as was seen when steel was used to replace iron. To prove that the author had overstated the stresses he cited the "Iris," a vessel of 20ft. draught. In that vessel the scantlings were 4ft. apart, but there was no question as to her strength.

Mr. Bryan, of Cambridge, had roughly calculated the form of the strip under pressure, and found that it was neither the catenary nor that of the ordinary beam, but an intermediate form. The true form might be ascertained by exact measurement, but the alternating thrusts and pulls that the plating had to sustain in practice would alter it considerably.

Professor Jenkins thought that the author had meant that the intermediate form should be inferred and that the practical results should be taken as a mean of the two forms given. The cumulation stresses due to the motion of the vessel in a sea-way were important, and would affect the water pressure stresses to a considerable degree.

Mr. Ellis considered each plate as a beam supported in two directions, by the scantlings and by the overlap of the adjoining plates. This gave a comparatively simple formula including the fourth power of the dimensions. From this he deduced the fact that the author's results were twice the proper value.

In replying to the discusssion, Mr. Yates said that he intended to take the mean of the results given in his tables. The bottom of the "Iris" was probably rounder than in the cases he had dealt with. In reply to Mr. Ellis, he said that the lap of the plates only gave partial support, and, moreover, transmitted the stress from one plate to the next.

At the Friday evening meeting Mr. Thomas Mudd read a paper, entitled

Some Details in Marine Engineering.

These, as will be seen from the paper which we conclude on page 320, related to the experience of the author in connection with the construction of boilers, the boring of stern frames, the machining of crank shafts, and the packing of pistons.

Mr. Fothergill said he had seven boilers built by Mr. Mudd's firm, working in ships under his supervision at 160lb. pressure, and they were most satisfactory. Annealing after working was very essential. One advantage of Mr. Mudd's construction was that, with a boiler low down in a ship and corroding at the bottom joints, the rivets were easily removed and replaced, whereas, with the usual radial rivets, it was only possible to get in screwed bolts. His experience of the pistons described was also satisfactory; they were noteworthy as giving no clicking noise, owing to the springs between the rings.

Mr. Milton could not see any great advantage in the boiler construction suggested. He said that 99 per cent. of boiler makers did not adopt it, and there must be some reason for this. The method necessitated annealing, while the ordinary way did not, and everyone knew the great difficulty of uniformly heating large plates. No flanging that he knew gave true surfaces, and there would be puckers in the boilers described as in others, while there were still three of the butt joints—which were so much condemned—left untouched. Another objection was the necessity of a larger space between the furnace and shell, and thus of a larger shell for the same heating surface and accessibility. The most difficult task in fitting crank shafts was in making the holes interchangeable. At Messrs. Hawthorn's they were bored from a standard block, and it had not infrequently happened that the lead of a crank could be changed by simply turning the shaft round one hole, without any other alteration being required.

Mr. Roundthwaite asked if the author's statement that there was always steam behind the piston rings was based on experiment or on reasoning. He thought there was probably always a film of steam between the rings and the cylinder walls, to which was due the smooth wearing of good cylinders. Experiments on rubbing surfaces had shown that cutting and grooving was only avoided when there was a cushion of oily matter between the surfaces, and a piston and cylinder would appear to be much in the same condition.

Mr. Mudd, in replying, pointed out that, although puckers did occur in his flanges, yet the method of fixing the ends was the best possible way of getting rid of them. He hoped some day to be able to turn the flange faces before riveting. His boiler required to be about 2in. larger in diameter for the same heating surfaces. This, he said, gave a larger water space, but that was a good fault. The butt joints left untouched were not in an important position, and were otherwise protected by inside straps. His statement as to steam behind the piston rings was based on reasoning only, but he thought it was sound.

Mr. David Joy afterwards read a paper on

An Assistant Cylinder for Marine Engines.

It described the experience of the author and his assistants in arranging an apparatus, which, while working automatically, should by its action assist the movement of the main slide valves, the object being to relieve the valve gear of the strains caused by the weight of the valve and the resistance due to its contact with the valve face, thus reducing the valve gear to a mere controlling mechanism. Diagrams and models of the apparatus were displayed, showing its progression from a complicated machine, as first designed in 1889, to a much simpler form, as at present fitted. Messrs. Laird, of Birkenhead, first gave orders for its attachment to engines for torpedo gunboats, and it has since been further adopted by them and by other firms. The fittings consist of a small cylinder fixed to the top of the main steam chest in place of the ordinary balance cylinder, and surrounding a piston attached to the prolongation of the valve rod. By the peculiar arrangement of the piston with its contained ports, and of other ports in the assistant cylinder, steam is made to act upon the piston in such a way that the main valve is

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lifted, cushioned, moved down and cushioned again, precisely as best suits its desired motion. Diagrams were given showing the distribution of steam in the "assistant cylinder," and analysed to show the amount of "lifting" and "cushioning" effect. The construction is not more bulky than an ordinary balance piston.

Mr. Cobb opened the discussion, and described the construction and working of his own arrangement of balance cylinder, and its supposed merits over that shown by the author. His piston imprisoned a certain volume of steam as the valve descended, thus producing an effective cushion, while the expansion of this same steam produced an upward force lifting the valve. At the top side there was a similar but less powerful action. He pointed out that his arrangement used the same steam continually and required but little fresh supply, whereas that of Mr. Joy used a large amount of steam, and was thus expensive in working. A combination of the two forms of construction would be most likely to give a much better result.

Mr. Joy, Jun., had been on the trials of engines where this assistant cylinder was fitted, and could speak from practical experience as to its merits. Without the arrangement in use a distinct hard clacking was heard as the valve reversed its motion, but as soon as the assistant cylinder came into action this was succeeded by a soft sound as of the squeezing of a spongy washer. It was impossible not to notice the improvement it produced.

Mr. Joy, in a brief reply, pointed out that Mr. Cobb's arrangement would be found in an old patent specification of his own. They had met with no difficulty in getting rid of water from the cylinder.

There was another paper entered in the programme for reading and discussion, in the name of Mr. Haswell, of New York, on the

Construction of Crank and other Shafts for Marine Engines, and their Liability to Fracture,

but in the absence of the author a proposal was made by Mr. MacFarlane Grey that the paper be taken as read. This was ultimately agreed to, but not without some discussion, and a vigorous protest by several members against this being done without the addition of a note to the effect that the Institution did not therefore concur in the opinions therein expressed. It seemed to be the general opinion of members that the ideas embodied in the paper were not likely to receive approval. The remarks made suggested that the paper advocated methods of construction of very questionable value, all long since abandoned in this country.

THE PHYSICAL SOCIETY.

At a meeting of this Society, on the 20th ult., Professor W. E. Ayrton, F.R.S., President, being in the chair, Professor S. U. Pickering, F.R.S., read a paper on "The Theory of Dissociation into Ions and its Consequences." According to this theory, electrolytes are entirely dissociated into their ions in weak solutions. This dissociation was held by Arrhenius to absorb heat, and although heat is evolved by the dissolution of hydrochloric acid, &c., it is not maintained that dissolution evolves heat, but that the heat absorbed by the decomposition of the molecule into its atoms is more than counterbalanced by the heat supposed to be evolved by the combination of the atoms with their electric charges. These actions the author considered improbable, and thought that before being accepted, the theory must give satisfactory answers to the following questions:—How can matter combine with an affection of matter to produce heat? Whence do the electric charges originate? Why does not the opposite electrification of the different atoms make them cling more firmly together instead of dissolving the union between them? and Why should an atom which possesses a strong attraction for a negative charge (such as chlorine) go to the positive electrode during electrolysis?

When a dilute solution, which is supposed to contain some gaseous molecules, is further diluted, then, according to the theory, some of the molecules are dissociated, and, if heat is absorbed, it follows that the dissociation, and therefore dissolution, of the gas must absorb heat; yet, he said, it can be shown that in some of these cases the dissolution of a gas evolves a large amount of heat. The antagonism between the present, and the old electro-chemical theory, according to which the atomic charges are identical with the free energy of an atom, and are the cause of combination, not decomposition, was commented on, as well as the disagreement between the present theory and Clausius' view that there are a few ions or atoms present in a liquid owing to accidental superheating of some of the molecules. Reasons, however, were adduced for believing the presence of even a few atoms in a solution to be improbable.

A communication on "Some Points in Electrolysis" was then made by Mr. J. Swinburne. Considering a reversible single fluid cell, the author, by a process of reasoning based on Carnot's principle and the conservation of energy, arrives at Helmholtz equation $E = E_c + \theta \frac{dE}{d\theta}$, where E is the electromotive force, E_c the part due to chemical action, and θ the absolute temperature. Writing the equation in full, using suffixes n and p to denote the negative and positive plates, it becomes

$$E_n + E_p = E_{nc} + E_{pc} + \theta \frac{dE_n}{d\theta} + \theta \frac{dE_p}{d\theta}.$$

He then showed that by having the two plates in different vessels, and heating them to different temperatures, the Peltier effects, represented by $\theta \frac{dE_n}{d\theta}$ and $\theta \frac{dE_p}{d\theta}$, can be determined separately. Similarly those of a two-fluid battery might be found by arranging the junction of the fluids in a third vessel.

After pointing out the desirability that the conditions under which all thermo-chemical data have been obtained should be clearly stated, he proceeded to show that any cell in which secondary actions occur (as, for example, if zinc oxide primarily formed by electrolysis were to dissolve in sulphuric acid) must necessarily be non-reversible. He also contended that in a secondary battery, the formation of lead sulphate on both plates is the essence of the cell action, and that there is no intermediate formation of PbO. On the subject of so-called "nascent" hydrogen or oxygen, he said that reasoning from the conservation of energy showed that neither could exist. Taking the case of persulphate of iron in dilute sulphuric acid, which is said to be reduced to protosulphate by the "nascent hydrogen" liberated on putting a piece of metal (say magnesium) into the liquid, he said a better explanation of the phenomena would be that the metal dissolves if it either reduces the metal or evolves hydrogen, and as the former requires less energy, the reduction takes place, and, when no reducible salt is available, hydrogen is evolved. Evolution of hydrogen and reduction of the per salt are thus *alternative* and *not consecutive* actions. Examining Dr. Lodge's views on the contact e.m.f. between metals, he remarked that if the tendency of a metal (such as zinc) to oxidise can produce an electric stress or difference of potential which prevents further combination, actual combination must charge the metal, if it be insulated. A piece of sodium, however, oxidises continuously, and therefore should become charged to an enormous potential. As this effect is not known to occur, the author suggested that the volta effect may be due to films of water, and in support of this view adduced the fact that metals, when perfectly dry, do not combine with chlorine, and that even sodium is not attacked by dry chlorine.

In the discussion on the two papers, Professor Pickering said the idea of nascent elements had, to a large extent, been given up by chemists, and pointed out that the fact of one reaction taking place rather than another was not merely a question of heat energy, but that a kind of chemical selection was involved.

Professor S. P. Thompson recalled attention to the fact that the products of electrolysis depend on the e.m.f. employed in producing it, and thought the e.m.f. required to produce the various products might be taken as a measure of their affinities. He did not agree with Mr. Swinburne's method of finding the e.m.f. of a secondary battery from thermo-chemical data, for he failed to see how two similar actions going on at the two plates of a cell could add anything whatever to the e.m.f. of the cell.

The President said the question whether the potential difference between two dissimilar substances was due to oxidation or to mere contact could only be decided by direct experiments made in a vacuum from which all traces of moisture and oxygen had been removed. Without agreeing with Dr. Lodge's view on the subject, he pointed out that the continuous oxidation of a piece of insulated sodium need not necessarily produce a great potential difference, for the combination might produce heat.

After Professor Pickering and Mr. Swinburne had replied to the points raised, Mr. Walter Bailey took the chair, and Professor Perry read a note on "The Variation of Surface-Tension with Temperature," by Professor A. L. Selby, M.A. Considering unit mass of liquid at constant volume, but variable surface (S) and temperature (t), the author expresses the gain of intrinsic energy due to changes of the variables by $dH + dW = k dt + (l + T) dS$, where dH is the heat absorbed, dW the work done on the film, k the specific heat at constant volume, l the latent heat of extension, and T the surface-tension. This being a perfect differential, it is shown that $T = c - b t$, and $l = b t$, c and b being constants. Supposing c and b to be independent of the specific volume of the liquid, it is shown that at the critical temperature $t = c/b$, hence this temperature may be determined by finding the surface-tension at two very different temperatures. Since also $l = b t$, the latent heat of extension is proportional to the absolute temperature. Reasons for supposing b to be independent of the specific volume are given in the paper.

Mr. Blakesley described an effect of temperature on surface-tension which he had observed in sensitive spirit levels. By warming one end of the tube, even by the hand, the bubble immediately moves towards that end. This effect, which might produce considerable error in engineering operations, was, so far as he was aware, not mentioned in the text-books.

Professor Perry remarked that, although the volume, temperature, and surface of the liquid had been referred to in the paper, pressure was not mentioned, and on this point he inquired whether the results arrived at were true, quite independent of the pressure.

Professor S. P. Thompson, D.Sc., afterwards read a paper on "Magnetic Proof Pieces and Proof Planes." The distribution of magnetism over magnets has been examined in various ways by different observers, but mostly by observing the force of detachment of either rods, ellipsoids or spheres, used as proof pieces. In all these cases it was, the author said, difficult to see exactly what was measured, for the presence of the proof pieces altered the thing to be tested. The pull exerted must also depend on the permeability of the piece used, as well as on its shape and disposition with respect to the magnetic circuit. He had, therefore, investigated the subject by finding the actual distributions by means of a flat exploring coil and ballistic galvanometer, both with and without the presence of proof pieces of various shapes and sizes. The results show that the perturbations produced by the proof pieces are always large; in some cases the perturbed field about a point being four to six times the unperturbed field. In most cases, however, the ratio of the perturbed to the unperturbed field was constant, so long as the former did not exceed 6,000 G.G.S. units. The amount of perturbation was also found to depend on the saturation of the magnet, and on whether it was a permanent or an electromagnet. The numbers obtained in various experiments, and curves plotted from such results, were shown. In conclusion, the author said that, in using proof pieces, much depended on the accuracy of the contact, but in any case the results obtained were not very reliable. The flat exploring coil, or magnetic proof plane, however, furnished a satisfactory method of examining magnetic distributions.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

(*Continued from page* 307.)

II.

The Manufacture of Soap.—The soaps commonly made in this country may be roughly classified as follows:—(1) Household soaps, comprising curd, yellow, brown, and mottled; (2) soft soap; (3) manufacturer's soap; (4) toilet and medicated soaps; (5) soap powders.

These various kinds are manufactured mainly by one of three processes, viz.:—(*a*) By the action of free fatty acids on caustic alkalies, or the carbonates of the alkali metals; (*b*) by acting on neutral oils or fats with the exact quantity of caustic alkali necessary for their complete saponification (as in the so-called "cold process"), the product retaining the glycerine resulting from the decomposition of the oils; (*c*) the ordinary and most commonly used process of boiling the fats or glycerides with caustic soda or potash in open pans, the indefinite amount of alkali used being left entirely to the experience and judgment of the soap-boiler. By this process are manufactured both soaps which retain the glycerine, as, for example, soft soap and marine soap, and those, like the ordinary hard yellow varieties, from which the glycerine is eliminated and subsequently recovered.

By far the largest quantity of soap made in this country is manufactured by the process last mentioned, which essentially consists in boiling the fats with solutions of caustic soda or potash of such strength as is found by experience to be the most efficient, until combination takes place, and in the case of soda soaps, the separation of the glycerine, superfluous water, &c., by the addition of brine. In order, however, to effect complete saponification, and to obtain the soap in a condition suitable for the market, it is necessary for it to pass through several processes or stages of manufacture, each having a definite object, and, as a rule, occupying several hours in working.

The oils or fats intended for the operation are first steamed out of the casks or hogsheads into partially covered iron tanks, from which the melted fat is pumped up into the soap pan. It is the practice at some works to sink these tanks or wells into the ground, until their upper edges are only slightly above the level of the floor of the melting-out shed. The full casks are rolled along inclined shores until they are brought directly over the opening in the top of the tank, when a steam pipe is inserted and the fat blown out of them. Before passing into the well, however, this fat should be strained through a piece of metal gauze placed underneath the cask or fixed over the opening in the tank. The method of sinking the tanks is, however, open to serious objection,

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because it is almost impossible to prevent dirt from being brought into the shed by the workmen and finding its way into the oil wells during bad weather, and also on account of the danger of such a tank leaking to a considerable extent without any cognisance of the fact. Some time ago it became necessary, at one of the soaperies in the North of England, to remove a tank which had been thus sunk in the ground for some years, when it was discovered, for the first time, that there had

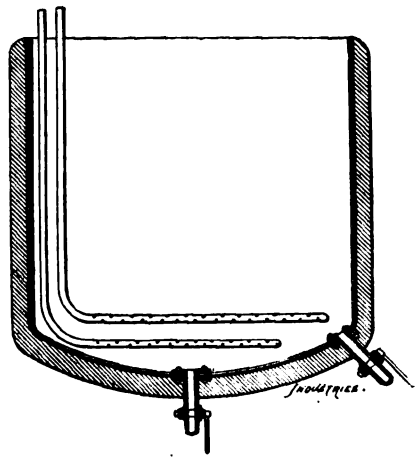


Fig. 1.—Sectional Elevation.

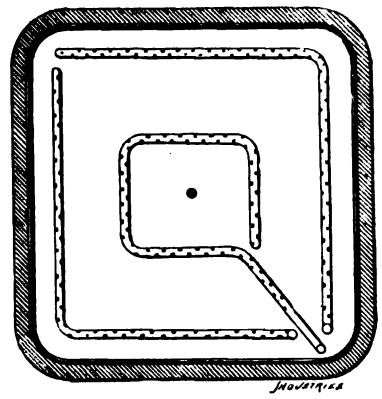


Fig. 2.—Plan.

been a leak, and the ground for a considerable distance round the tank was found to be saturated with oil. A far better plan is to have the whole of the melting-out tanks above ground, the working platform of the shed being from 6ft. to 8ft. above the floor level. The casks can be raised to this platform either by rolling them up an inclined plane or by means of a crane or other mechanism. Messrs. Lever Bros., of Port Sunlight, employ two or three special steam platform lifts with long cylinders for this purpose. The height of the melting stage is 7ft. above the floor level, and the platform of the lift, when carrying a full cask, is raised to this height by a single stroke of the piston. These lifts answer every requirement, and a large number of barrels can be raised by one of them in a very short space of time.

The method of preparing the caustic soda lye, by the double decomposition of soda ash and quicklime, has practically become obsolete, and the alkali is now obtained in a more convenient form as solid caustic soda, generally of 60 or 70 per cent., in iron drums holding about 5 cwt. each. To facilitate solution the solid block of caustic is broken to pieces, while still in the drum, by striking it all over with a heavy hammer. The drum is then placed over or near to the lye tank, cut open, and the broken-up contents thrown into the well, which contains water kept boiling by means of steam coils. The strong solution of caustic thus prepared is next diluted to a definite strength and pumped into storage tanks, placed at a higher level than the soap pans, into which it can be run, as required, by gravity. As a rule, the caustic lye is prepared as required, and is consequently used before it has deteriorated to any extent by absorbing carbon dioxide from the air, but in case of necessity it may be stored, without loss of strength, for a considerable time, if a quantity of paraffin wax be thrown into it while hot. The melted wax forms a protecting crust on the surface of the solution, and effectually prevents the absorption of carbonic acid.

The boiling pans, in which the combination of the alkali with the fatty matter is brought about, may be either round or square, but the latter is the shape now almost universally employed in modern factories. These are rectangular iron vessels with rounded corners and dished bottoms, 12ft. or 14ft. square, and about the same in depth (see Figs. 1 and 2). Each pan is provided at the bottom with perforated steam coils, one of which passes along two sides of the pan at a short distance therefrom, a second runs along the remaining two sides, whilst a third is placed in the centre of the pan. Each of these coils is provided with a separate steam cock, which should also have below it a tap for the egress of condensed water and possible leakage of steam when the main cocks are closed. The pans are covered on the outside with a thick layer of some non-conducting material, to prevent, as far as possible, the radiation of heat, and, both on this account and for convenience in working, are preferably placed together in rows, either in the centre or along the sides of the boiling house, which forms the top floor of a soapery. Over the pans run pipes for the conveyance of the melted fat or oil, with taps for delivering these substances into any particular pan, and there are also pipes for water and for the caustic lye.

(*To be continued.*)

Notes.

DEVELOPMENT OF THE TELEGRAPH SYSTEM.

From a Parliamentary paper recently issued we may see the marvellous increase in our inland telegraph system. In the year 1870, when the telegraphs were taken over by the Government, the total revenue was £612,301. Five years later it had risen to £1,533,982; in 1880 it was £1,469,795; in 1885, £1,820,764; and last year it was £2,364,098.

COAL IN NEW MEXICO.

The extent of the coalfields of New Mexico is not generally known, and consist of the Raton fields, an extension of the Colorado fields, and embrace about 600,000 acres of the best bituminous coal, of good coking quality. The mines have now a capacity of 500 tons per day. There are also other coalfields, besides deposits of gold, silver, and copper ore. The hills are full of undeveloped mines of iron, with coal enough to work them.

THE ELECTRIC LIGHT IN CALCUTTA.

It is stated that the Howrah Bridge is shortly to be lighted by electricity, which will be a very great improvement upon the present system of lighting. At present, indeed, the bridge is very badly lighted, there being no lights at all upon the moveable section, which is 200ft. long. The remainder of the bridge and the boat opening below, are also very indifferently lighted. It is now proposed, states the *Indian Engineer*, however, to place thirteen arc lights on the roadway of the bridge, each of 2,000 candle-power; and four similar arc lights for the boat openings, with eighteen strong incandescent lights for the signal stations, watch-house, and engine-house. The aggregate lighting will be equal to 34,384 candles, and to prevent the possibility of failure, the plant will include a spare engine, boiler, and dynamo. The contractors are Messrs. Laing, Wharton, & Down, of London, who have been selected to supply the electric lighting plant for the Kidderpore Docks. The cost of the Howrah Bridge plant is to be Rs.42,050.

THE NEW NAVAL DOCK AT BANGKOK.

One of the largest public works as yet undertaken by the Government of Siam is the new Naval Dock at Rong Lau, Bangkok, which was opened recently in the presence of the King of Siam. The new dock is 300ft. long, and has its entrance from the river. It is closed by a caisson, which fits into a groove in the masonry. The bottom of the dock is below low water, and a steam engine and pumps on shore, with a well and water channel leading to it, are used for emptying it. The engine is stationary, placed in a shed convenient to the dock, and the two pumps have been supplied by Messrs. J. & H. Gwynne. They are of the now well-known centrifugal kind, and it is claimed that the efficiency is as high as 70 per cent. According to the *Indian Engineer* the dock is emptied by means of these pumps in from five to six hours. The outside embankment is constructed with piling from 32ft. to 38ft. in length, and secured with iron stays fastened on a double row of anchorage piles. All the outside framework is metal-plated to the height of immersion, for protection against the *Teredo Navalis*. The floor of the dock is nearly level. As Siam is so rich in wood, the sides of the dock have been made of strong teak in the form of four steps, and the length and breadth are such that in an emergency the dock can hold two vessels at one time, though in that case they would not be placed in the centre line, but obliquely, so as to give more available length. The contractors for the new dock were Messrs. Grassi Bros. & Co. The total cost of the dock alone is about $40,000.

TELEPHONES IN CALCUTTA.

We learn from the report of the Bengal Telephone Company, Limited, for the year ending 31st December, 1890, that, on that date, 437 exchange and private lines were at work, yielding a revenue of Rs.76,400. The improvement of the telephone service is a matter on which great attention has been bestowed, and in Howrah, and to the south of the Exchange in Calcutta, faults on the line are now rare. There is still room for improvement in the centre and north of Calcutta. As extensive repairs and alterations had to be made to the building of the Central Exchange, the opportunity was taken of entirely reconstructing the switching arrangements. A new derrick, states the *Indian Engineer*, has also been erected on the roof, and the Exchange is now capable of receiving 800 wires. These measures are not yet complete; but, though costly, it is believed they will be real and permanent improvements. In the last report reference was made to an attempt at opening up business in Cawnpore, but the efforts of the company to induce the Government to allow the police stations to be connected, as is the case in Calcutta, Bombay, and Rangoon, have not been successful, and the balance of the Cawnpore account has been written off, as there is now no hope of opening an exchange.

ALUMINIUM FOR INCANDESCENT LAMPS.

Various substitutes for platinum for leading-in wires for incandescent lamps have been proposed from time to time. Iron was proposed by Mr. Ward some eight years ago, but never came into use. Iron and nickel both stand the blowpipe fairly well if enamel is used, but they give off so much gas in the form of minute bubbles that it is impossible to seal them in properly. Copper has been proposed, and Mr. Crookes proposed copper coated with gold. The fusing point of copper is low, however, and this makes its use difficult. The latest proposal comes from Cincinnati. Mr. McGregor, of that city, is reported to have succeeded with aluminium. This metal is generally used for electrodes for vacuum tubes, but platinum is adopted to make the connections through the glass. Anyone trying to seal aluminium into glass will find that a skin forms on its surface, and the glass cracks on cooling. The low melting point of the aluminium also gives rise to difficulties. Aluminium has not only a strong affinity for oxygen and other acid radicles, but the metal itself absorbs silicon with avidity. No doubt it thus attacks the glass, and forms a skin of silicate of alumina, while the metal itself absorbs silicon. We are, therefore, a little sceptical as to the use of aluminium for leading-in wires.

EXHIBITION AT DUNKIRK.

An Exhibition is to be held at Dunkirk during the present year. The Exhibition, which will be opened for a period of five months from May 1st to September 30th, has for its object the extension of commerce and industry in the Nord and Pas du Calais Departments of France, and will be devoted to the following subjects:—Industry, Agriculture, Commerce, Shipping, Science, and Fine Arts. These subjects will be divided into the following ten groups, one of which, it will be noticed, is an international one:—

Group 1. Food Stuffs.
2. Educational Instruction and Professional Teaching.
3. Furniture and its Accessories.
4. Textile Industries and Clothing.
5. Industrial and Agricultural Products.
6. Agricultural and other Machinery, Tools.
7. Architecture, Hygiene, &c.
8. Horticulture.
9. Fine Arts.
10. International Section.

The various French railway companies are offering facilities for the conveyance of exhibits, which will also be extended to exhibits for the international section. During the period that the Exhibition will be open various competitions will be held, and also several special *fêtes* are being organised to make the Exhibition as attractive as possible and to ensure its success. Full particulars regarding the Exhibition can be obtained by applying to M. Alexander Meyer, Commissaire-Général-Adjoint, 11, Rue de Rocroy, Paris.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

16th March, 1891.

4624. Pickles & Pickles ..... Looms.
4637. Hall & Morel ..... Grinding mills.
4644. Arnold, J. O..... Manufacture of steel ingots and apparatus therefor.
4655. Brownhill, W..... Manufacture of metal tubes and machinery therefor.
4661. Mills, W..... Manufacture of alkali and apparatus therefor.
4668. Taylor, G. (of Taylor, Cooper, & Bednell, Ld.) ..... Machinery for making metal balls or spheres.
4674. Brownell, G. L. ..... Twisting machines.
4676. Bowker & Williams ... Looms for weaving.
4685. Riley & Burke ..... Apparatus for bending or curving cold iron plates.
4690. Pickard, A..... Square hole drilling machinery.
4694. Boult, A. J. ..... Wheel driving mechanism (*Zieger*).
4695. Baldwin, W. A..... Process and apparatus for alloying metals.
4697. Yates, J. ..... Safety devices for lifts, hoists, &c.
4699. Angove & Watkins..... Boat suspension and detaching gear.
4702. Griffiths, W. ..... Magazine firearms.
4705. Craven, P. P..... Spinning frames.

17th March, 1891.

4716. Longsdon, A..... Self-acting brakes for field gun carriages (*Krupp*).
4724. Wright & Hill ..... Apparatus for casting multiple ingots in steel or other metals.
4728. Brown, A. G..... Metal founding machines (*Tabor*).
4730. Marriott, C. ..... Apparatus used in the manufacture of sulphate of ammonia.
4732. Pickup, J. ..... Shuttle guard for looms.
4733. Waddington, J..... Tongue rests for loom shuttles.
4734. Morton, J. ..... Machinery for making pipes, retorts, and other goods from clay.
4755. Card, W. L. ..... Concentrators.
4761. Lake, H. H..... Machines for cutting tinplate or other sheets into blanks (*Hodgson*).
4765. Simonson, F. ..... Machinery for handling logs in saw mills.
4771. Cooper, E. W. ..... Gas and vapour engines.
4776. Morgan, F. F. ..... Fire alarms.
4795. Vavasseur, J..... Gun mountings.
4796. Gollings, E. H. ..... Rotary pumps and engines.
4798. Boult, A. J. ..... Gas generators for motor engines (*Compagnie des Fonderies et Forges de l'Horme & Lencauchez*).

18th March, 1891.

4806. Dunlop, J. ..... Compound locomotive steam engines.
4809. Leeder, F. G..... Apparatus for making moulds for castings.
4822. Barnett, D. ..... Apparatus for combing fibres.
4823. Cooke, W. ..... Steam boilers.
4830. Garrett, L. P. ..... Gas engines.
4843. Tresidder, T. J. ..... Dividing apparatus for lathes.
4849. Franke, E. ..... Lubricators.
4851. Stone, R. ..... Machinery for crushing, grinding, pressing, rolling, smelting, and burning purposes.
4862. Lindemann, O. ..... Gas and petroleum engines.
4863. Lake, H. H..... Harness depressing devices for looms (*Stafford*).

19th March, 1891.

4887. Willey, D. H. ..... Engaging and disengaging apparatus for ships' boats.
4892. Lamb, J. ..... Jacquard looms.
4896. Biddles, G. H. ..... Mechanical firebars for destructor or other furnaces and a feed hopper for charging same.
4897. Fletcher, Fletcher, & Fletcher ..... Reverberatory furnaces.
4903. Higginson, A..... Steam winch.
4907. Wright, W. ..... Steam boilers.
4920. Howden, J. ..... Compound steam engines.
4921. Howden, J. ..... Apparatus for supplying air to the furnaces of marine boilers
4924. Johnson, J. W. ..... Scouring machines.
4928. Young & Crippin..... Apparatus for dyeing and bleaching cotton, wool, &c.
4934. Fox, F. W. ..... Spinning and twisting machines.
4936. Storm, J. ..... Lubricators.
4939. Boult, A. J. ..... Railway carriage brakes (*Milburn*).

20th March, 1891.

4965. Lord, Mills, & Newall Opening, scutching, and carding machines.
4966. Perry, J..... Steam engine indicator.
4987. Cory, Reynolds, & Catford ..... Mortising machines.
4991. Powell, D. T. ..... Cylinder printing machines.
4993. Royle, J. J. ..... Valves.
5001. Wenham, F. H. ..... Cocks or valves.
5008. Gardner, G. H..... Machinery for the manufacture of chains (*Brown & Cady*).
5018. Oates, S. ..... Steam boiler furnaces.
5030. Fraser, J. H. ..... Securing tubes in plates of boilers.
5035. Utting, J. A. ..... Fog-signalling apparatus.
5042. Dunaway & Dunaway... Engine governors.
5046. Von Skoda, E. R. ..... Quick-firing guns.

21st March, 1891.

5050. Johnson, T..... Printing machines.
5054. Borchardt, O. ..... Boiler tube scrapers.
5063. Joy, D. ..... Valves of steam engines.
5072. Lanchester, F. W. ..... Gas engines.
5073. Hedley & Jones ..... Balanced slide valves.
5074. Parsons, C. A. ..... Steam turbines.
5083. Munns, W. H. ..... Brakes for railway cars (*Englis & Schierman*).
5084. Munns, W. H..... Car coupling (*Lankford & Langford*).
5085. Munns, W. H..... Rotary engine (*Everest & Betterman*).
5116. Charpentier, E. ..... Wire working machines.
5121. Patten, W. ..... Machine for straightening and bending angle and tee iron.

ELECTRICITY.

16th March, 1891.

4669. Hirbec, V. ..... Apparatus for utilising heat as a source of electricity.
4678. Pilkin, J..... Terminals for electrical purposes.
4682. De Ferranti, S. Z. ..... Arrangement for electrical systems.
4689. Challis, C. E. ..... Switches.

17th March, 1891.

4715. Amstutz, N. S. ..... Process of and apparatus for electrically reproducing uneven and irregular surfaces.
4740. Attree, G. F..... Electric railway signals.
4751. Imray, O..... Electrical transportation systems (*Wheeler & Bradley*).
4757. Willson, T. L. ..... Electric reduction of aluminium and other metals and the production of alloys thereof.
4758. Clark, A. M. ..... Electric railways (*The Waddell-Entz Electric Company*).
4781. Engledue, W. J. ..... Solution for galvanic batteries.
4794. Kingsbury, J. E. ..... Signalling and telephonic systems (*The Western Electric Company*).

18th March, 1891.

4812. Millar, H. A..... Incandescent lamps.
4831. McGeoch, Jun., & McGeoch..... Holders for incandescent lamps.
4838. Bailey & Warner ..... Incandescent lamps.
4860. Howard, H..... Apparatus for heating and welding by the electric arc.
4869. Lake, H. H..... Primary and secondary batteries and the manufacture of electrodes therefor (*Desruelles*).
4881. Clark, A. M. ..... Electric railways (*S. Schuckert & Co.*).
4882. Duck, F. J. ..... Electric indicators.

19th March, 1891.

4949. Johnson, J. Y. ..... Galvanic batteries (*Tardy*).

20th March, 1891.

4988. Thompson, W. ..... Printing telegraphic instruments.
5003. Johnson, J. Y. ..... Holders for incandescent lamps (*Mace*).
5021. Lake, H. H. ..... Accumulators (*Gandini*).
5043. Money & Nash ..... Arc lamps.

CHEMISTRY.

16th March, 1891.

4696. Butterfield, J. C. ..... Treatment of tinned iron for the recovery of the tin and other products.

18th March, 1891.

4820. Beilby, G. T. ..... Process and apparatus for the manufacture of cyanides.
4871. Willcox, B. ..... Colouring matters derived from anthra - quinone (*Farbenfabriken vormals Friedrich Bayer & Co.*).
4878. MacDonald, J. M. ..... Method of liquefying carbonic acid gas and storing same.

20th March, 1891.

5027. Von Brauk, E. ..... Explosive compositions.

21st March, 1891.

5103. Read Holliday & Sons, Ld., Holliday, & Seidler ..... Manufacture of a sulpho acid of alphanaphthol and of colouring matters therefrom.
5104. Read Holliday & Sons, Ld., Holliday, & Seidler ..... Azocolouring matters.
5122. Willcox, B. ..... Production of ortho-oxydiphenyl-carbon acid (*Von Heyden*).

MISCELLANEOUS.

16th March, 1891.

4626. Burghes, J. McL. ..... Joint for drain pipes.
4630. Fraser, N. ..... Brackets for belt guiding pulleys.
4638. Cooper, A. ..... Propellers.
4656. Merington, C. ..... Shells or other projectiles.
4658. Pickles & Pickles ..... Mode of manufacturing healds for weaving.
4663. Ware, T..... Wrench (*Rogers*).
4681. Downing, D. F..... Packing piston rods and the like.
4709. Westaway, J. ..... Fire escapes.

17th March, 1891.

4713. Reusch & Peru ..... Casting of hard metal or chilled rolls.
4793. Middleton, W. B..... Treatment of steel.

18th March, 1891.

4859. Isaac, P. L..... Supplying air to the furnaces of marine boilers.

19th March, 1891.

4947. Maughan, B. W. ..... Propellers.

21st March, 1891.

5080. Munns, W. H..... Railway sleeper (*Jeffers & Girin*).
5082. Munns, W. H..... Nut lock (*Harvey*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

4328. Scott & Thornton.
4356. Wilkinson.
4461. Hornsby & Smith.
4653. Davies.
4740. White.
4824. Nebel.
5567. Shaw & Rollason.
5771. Cawdery.
5903. Healey.
5970. Ashley.
6075. Maynard.
6134. Farrow.
6333. Lyte.
6422. Jones & Jones.
6650. Leigh (*Jeansaume*).
6716. Chambers.
6817. Aish.
6883. Clarke.
6952. Kellner.
7070. Heaton & Holden.
7082. Fowler.
7142. Stern.
7218. Hirst.
7289. Weller.
7343. Willoughby.
7406. West.
7531. Van Ham.
7629. Billington.
7707. Bostel.
7717. Read.
7759. Macnaughten.
7765. Walton.
7778. Hillier.
7782. Boulther.
7793. Smith.
7796. Moul.
7813. Goude, Goude, & Goude.
7826. Locher.
7883. Bessemer & Fletcher.
7894. Walker & Walker.
7902. Lea.
7908. Frankish.
7978. Bates.
8001. Henderson.
8044. Bayly (*Caye*).
8096. Carr & Green.
8178. Adam.
8259. Vosper.
8321. Stratton & Perry.
8369. Popp.
8512. Leslie.
8809. Wise (*Messrs. Favre & Braun*).
9199. Bowing.
9425. McAllister.
9500. Laidlaw.
9617. Guest.
9920. Foley.
4338. Waters & Woodman.
4432. Field.
4650. Palmer.
4716. Punch.
4762. Williams.
5449. Tasker & Hargreaves.
5649. Hodgkin & Hodgkin.
5853. Beechey.
5923. Sleeman.
6021. Newton (*Nobel*).
6129. Smith & Tregoning.
6250. Glover & San Garde.
6418. Harbidge.
6455. Kershaw.
6660. Brophy.
6732. Marsden.
6865. Hartmann.
6899. Walker.
7066. Tweedy.
7078. Davis & Brown.
7084. Johnson & Wilkinson.
7187. Church.
7274. Rivret & Honoré-Colson.
7367. Turner.
7480. Darwin.
7550. Fairburn.
7632. Wolseley & Craven.
7708. Kay & Young.
7746. Mason & Ellis.
7764. Playfair.
7777. Neuman.
7779. Hillier.
7790. Warby.
7797. Gould.
7801. Poupon.
7818. Brough.
7822. Cliff.
7874. Lindley & Bott.
7893. Waldram.
7895. Showell.
7906. Wootton.
7967. Weir & Weir.
7979. Imray (*Rotten*).
8042. Woolham.
8046. Bayly (*Shanklin*).
8105. Cooke.
8180. De la Roche.
8277. Crawley.
8325. Poncia (*Kingsford*).
8386. Jameson (*Tuckfield*).
8770. Phillips & Wrightson.
9048. George William Chinnery, Luther George Chinnery, Swartz Martyn Chinnery, Samuel Bostock, & Cardross Grant.

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10542. George & Dykes.
11872. Blyth.
11950. Hamilton.
12669. Miller.
18438. Bronk.
18463. Moseley.
14370. Dannenberg.
14832. Stringfellow.
14940. Cox.
17103. Edmonds.
17342. Tettweiler.
17607. Wenner. (12th July, 1890.)
18192. Lucht.
18667. Heiland & Kaufmann.
19180. Bayles.
19690. Rumfitt.
20040. Harrison.
20353. McBride.
20727. Still.
21125. McCormack. (19th July, 1890.)

1891.

99. Foster.
262. Carey.
286. Chapman, Petrie, Petrie, Gilbert, & Jones. (16th July, 1890.)
513. Ware.
898. Barton.
960. Thompson (*Green*).
1087. Dunstan (*Phillips*).
1375. Barnes & Barnes. (7th October, 1890.)
1521. Lake (*Knight*).
1960. Lake (*Killinger*).
1985. Roy.
2181. Gardner.
2182. Crooker.
2271. Munns (*Carten*).
2348. Barton.
2372. Bell.
2427. Thompson (*Tayler*).
2450. Carpenter.
2531. Moy.
2590. Steen (*Macky*).
2702. Fellowes.
2783. Pratt.
2808. Barton.
2858. De Pass (*Imbs*).
2874. Burdon.
2893. Huntley.
2959. Robinson.
3040. Bray.
3079. Wallwork.
3126. Henckels.
3157. Cameron.
10642. Vogelsang & Hille.
11891. Clarke.
12639. Schimper.
12755. Macfarlane & Macfarlane.
13752. Wadley.
14631. Lucas, Lucas, & Marshall.
15746. Closz.
17211. Stuart.
17520. Hall (*Moreo, partly*).
17845. Ramsbottom & Smethurst.
18351. Moss, Moss, & Lownds.
19370. Scholes & Scholes.
19442. Turner.
19942. Thompson (*Marx*).
20076. Newton (*Christophersen & Schumann*).
20986. Lake (*Lemp*).
21253. Lindner & Turner.

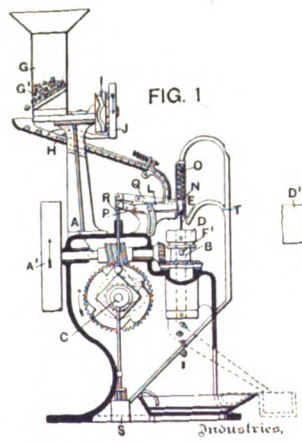
133. Clarke.
272. Skirving & Berger.
367. Turner.
470. Glover, Glover, & Critchley.
641. Hammer.
650. Lake (*Mott*).
908. Ross.
961. Thompson (*Pyle*).
1117. Mannock.
1502. Sutton.
1509. Lake (*Knight*).
1704. Warrington.
1961. Meneely.
2021. MacCallum (*Reissig & Landen*).
2214. Shead.
2345. Cook.
2360. Cheswright.
2411. Carter.
2447. Dunlap.
2456. Speller.
2533. Thies & Cleff.
2683. Bowles.
2711. Browne.
2807. White (*Tye*).
2830. Keeler.
2865. Williams.
2882. Arnold.
2901. Winn.
3037. Dralle, Dralle, & Dralle.
3112. Dowson & Taylor.
3147. Meyer.

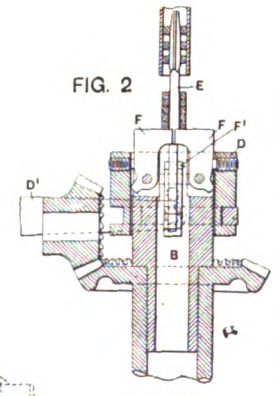
(14th August, 1890.)

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Machinery for Tapping Nuts.—*W. P. Thompson, London.* (*F. S. Cook, Springfield, Ohio, U.S.A.*)—The machine for the above purpose is shown in sectional elevation in Fig. 1, Figs. 2 and 3 being enlarged details thereof. The main shaft A driven from A^1 drives by suitable gearing the tool chuck B and by worm





gearing the shaft C. This tool chuck has on it a revolving sleeve D in a groove in which fits a yoke of a pivoted lever D^1 actuated by a cam on the shaft C, so giving D an intermittent vertical reciprocating motion. The tap E is held between two pairs of jaws F F^1 (Fig. 2), which are alternately allowed to release the tap as the sleeve D rises and falls by the ends of suitable set screws in the latter acting on the heels on said jaws. In this manner the nuts which have been passed over the tap are allowed to escape. The nut blanks are fed from the hopper G, which has an inclined bottom, through an orifice G^1 in the lower part thereof into an inclined trough H. The hopper G is given a slight horizontal reciprocating motion, so as to feed the nut blanks regularly into H, by means of a rack lever, teeth on one end of which engage teeth on the lower part of G and a stud on the other end of which projects into a cam groove on the periphery of the wheel I driven from J. The blanks one by one are fed from the inclined trough H into the horizontal channel K (Fig. 3), and are then forced forward by a plunger L, and by means of a tongue L^1 tilted over on to their faces, and are so forced into the vertical channel M beneath the plunger N. This plunger is then caused to descend, and a spring O forces the nut blank upon the tap. In the meantime the plunger L has been carried backwards, and at the same time N rises and the action is repeated. The plunger L is operated by a radial slot in a lever P engaging a pin thereon, the lever P as well as the lever Q operating the plunger N being actuated through a rod R from a cam on C. The lubrication of the

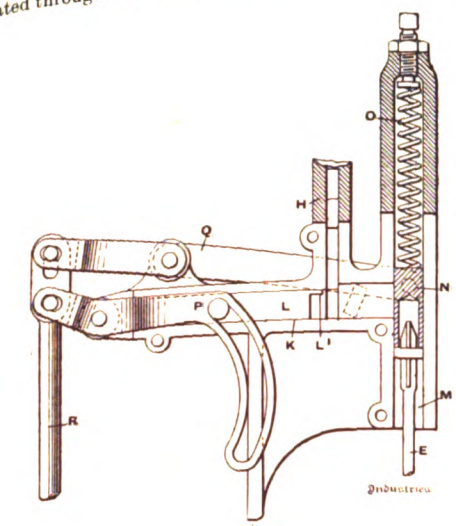
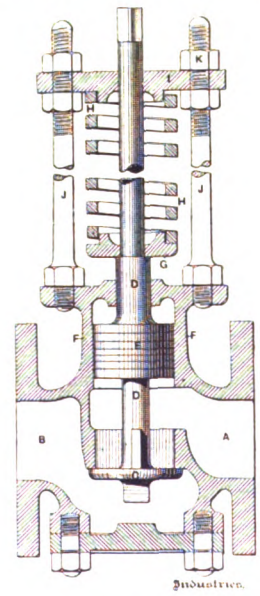


FIG. 3.

various parts is effected by means of a pump S operated from the main shaft and pipes T. The inventor describes several modifications of the tool chuck. Claims: (1) A nut tapping machine having in combination a feed hopper for the blanks, a counterbalanced feed conduit adapted to receive the blanks one by one from said hopper and to convey them all in the same position towards the tap, and means whereby an excess of blanks over a given amount in the conduit will tilt the same and automatically check the feed of blanks from the hopper; (2) in a nut tapping machine, a continuously revolving upright chuck or pair of chucks having two sets of jaws for gripping the tap at two points in its length, in combination with mechanism adapted to open and close said sets of jaws successively, whereby the nuts are permitted to drop from one set on to the other and then off the end of the tap without the necessity of bringing the tap to a standstill; (3) the means whereby a nut blank is carried forward in its proper position over the tap and is held in contact therewith by spring pressure until engaged with the tap; (4) the combination, with the continuously operating tap, as described, of the delivery spout, the oil pan, pump, and oil conduits.—No. 9242. June 14th, 1890. 11*d.*

Pressure Reducing Valves.—*J. Kirkaldy, London.*—A reducing valve such as is embraced by the present invention is shown in sectional elevation herewith. A represents the inlet for steam and B the outlet, C is a disc valve closing the passage from one to the other, D is the valve stem, which is prolonged upwards, and has upon it a piston E fitting within a



cylinder F, which is of the same diameter as the opening through the valve seat. The pressure of steam upon the top of the valve is therefore balanced by the pressure of steam on the bottom of the piston. The stem D is prolonged above the piston and made to pass out through the top of the cylinder F. Outside the stuffing box it has a disc G fixed upon it, against which a coiled spring H is made to bear. The upper end of the spring rests against a bar I, which is held fast at a distance from the top of the cylinder by two rods J. These rods are at one end secured to a flange around the top of the cylinder, and at the other are made to pass through holes in the bar, and have screw threads cut upon them on to which are screwed nuts K, and by these nuts the bar is locked to the rods. By screwing the nuts along the rods the bar can be fixed at any desired distance from the cylinder, and so any desired pressure can be put upon the spring. The valve C is held open by the action of the spring, and steam or other fluid under pressure passes from the inlet to the outlet until the pressure in the outlet is sufficient to overcome the downward thrust of the spring and to press the valve upwards and close it. Claims: The reducing valve constructed substantially as described.—No. 5277. April 5th, 1890. 6*d.*

Machine for Charging Gas Retorts.—*C. Eitle, Stuttgart, Germany.*—The apparatus embraced by this invention is for the purpose of charging horizontal gas retorts. A tramway is made in front of the charging ends of the retorts, on which runs a carriage carrying a framework on one side of which the charging apparatus slides, said apparatus being connected to a suitable balancing weight by means of cords or chains passing over pulleys fixed on a shaft journaled at the top of the framework, and carrying a large grooved wheel around which passes an endless rope. By means of the latter the said wheel may be revolved, and so the charging apparatus may be raised or lowered. The charging apparatus consists essentially of a hopper, into which the coal is fed. Connected to the lower end of this is one end of a horizontal cylindrical chamber, in which revolves an open screw, which feeds the coal forward from the receiving to the delivery end of said chamber. The delivery end of said chamber is connected to the upper part of a drum, in which revolves suitable wings to impel the coal supplied to it through a suitable horizontal shoot connected to the lower part thereof into the retort to be charged. A driving shaft is journaled on the upper part of the drum and is connected by suitable gearing to the shaft operating the open screw and wing propellers. In two claims the inventor embraces the apparatus substantially as described.—No. 17921. November 7th, 1890. 6*d.*

Compound Steam Engines.—*R. Richardson, Inchinnan Road, Renfrewshire, N.B.*—The inventor's object is to so construct compound double-acting engines that the pressure on the crank and cross-head pins and main bearing is always in one direction, and also to provide an improved means of slightly rotating the pistons when the latter act as the steam distributing valves. In the annexed illustrations is shown in Fig. 1 a front sectional elevation, at Fig. 2 a side sectional elevation, and at Fig. 3 a sectional plan through the cylinders of a compound engine embracing these improvements. The high and low pressure cylinders A and A^1 are connected at about midway in their length by passage B, diametrically opposite which are the supply and exhaust ports B^1. Ports are formed in the pistons of A A^1 leading to the upper and lower ends thereof, which, as the pistons are revolved, are brought opposite the ports B and B^1 in such a manner as to supply and exhaust steam from the opposite ends of the cylinders. The rods of these pistons are connected to slides C C^1, to the underside of which are connected by a ball joint D the rods E, the lower ends of which embrace the main crank shaft F. The slides C C^1, and so the pistons of A A^1, are revolved by a tooth on the upper ends of E engaging teeth on the underside of C C^1. The pressure on the main crank shaft, &c., is effected by means of a lever G pivoted at G^1, the ends of which press upon the upper faces of C C^1, the lever and its pivot being forced downwards by means of a screw H. Four claims are made.—No. 8824. June 7th, 1890. 8*d.*

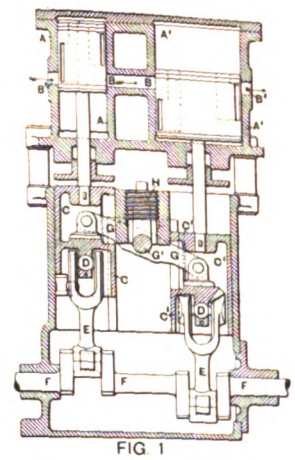


FIG. 1

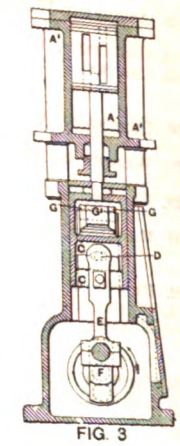


FIG. 3

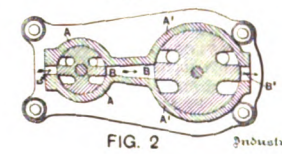


FIG. 2

Steam Engines.—*P. W. Willans, Thames Ditton, Surrey.*—The inventor's aim is to prevent the collection of water of condensation in the working cylinders of steam engines. To effect this two annular grooves or recesses, one at each end, are formed in the working surface of the cylinder, in which are arranged small steam pipes, whose ends are connected to the supply and exhaust pipes of the engine or otherwise supplied with steam. The ends of the piston and the grooves are so formed that any water of condensation in the cylinder will be forced into one or the other of said annular grooves, where it becomes converted into steam by the heat of the small steam pipes. Claims: (1) The method described for preventing the accumulation of water in the steam engine, such method consisting in applying heat to a small receptacle, which receives the water condensed in the cylinder by means of a steam pipe or similar heater so arranged in the said receptacle as to become immersed in the water contained therein as soon as an appreciable quantity of water collects, and so keeping such receptacle and its contents hot relatively to other parts of the cylinder; (2) the combination with the cylinder of a vertical steam engine of receiving cavities and heating pipes as described.—No. 6354. April 25th, 1890. 6*d.*

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ANTI-FRICTION JOURNAL BOXES.—*T. N. Subers, Philadelphia, Pennsylvania, U.S.A.*—Two loose rings are placed upon the journal of the axle or shaft, and are held at a suitable distance apart by means of stay bolts. Journaled in recesses in the opposite faces of these rings are the anti-friction rolls, the peripheries of which project beyond the inner and outer peripheries of the two rings, and are of a diameter equal to the space between the journal and the journal box. Between each of the ends of the journal box and flanges on the journal are held two other rings in which are journaled radially other anti-friction rolls. The peripheries of these project beyond each side of the ring, and are in contact on one side with the end of the journal box, and on the other side with the flange on the journal. In two claims the inventor includes the general construction and arrangement of anti-friction journal boxes substantially as described.—No. 19427. November 28th, 1890. 6*d.*

APPARATUS FOR PRODUCING OXYGEN GAS.—*R. D. Bowman, East Dulwich, Surrey.*—The preparation of the material for the above purpose is, according to this invention, effected by first half filling a suitable closed vessel with sodium hydrate and

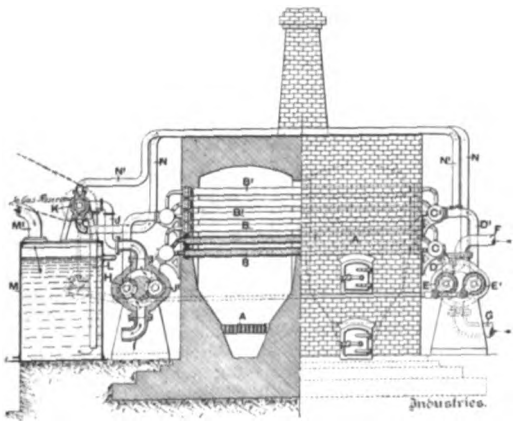


FIG. 1.

raising it to a red heat, and maintaining it so until ebullition ceases Small quantities of sesquioxide or peroxide of manganese are then added until the mass attains, after constant stirring, a plastic granular condition. The proportion of sodium hydrade and manganese salt used is two-thirds of the latter to one-third of the former or thereabouts. As soon as the granules refuse to stick together they are dusted over with black oxide of copper, and are then exposed at a red heat to a full current of air until they assume a dark green or black colour. They are then ready for use in the tubes of an apparatus also embraced by this invention, and shown in the annexed illustrations, of which Fig. 1 is a half sectional elevation and Fig. 2 a half sectional plan. Arranged horizontally in the double furnace A are two sets of tubes B B¹, containing the granules above described, and connected at one end to the mains C C¹ communicating through pipes D D¹ with the interior of the hollow plugs of the two-way cocks E E¹. Mains F G for supplying air and steam are connected to the interior of the body of the cocks E E¹. The other ends of B B¹ are similarly connected to two-way cocks H H¹, the interior of the body of said cocks being connected respectively to the nitrogen exit pipe I and the oxygen exit pipe J. This pipe J is connected to the interior of the plug of a tap K, and is also by pipe L connected to the interior of the cooling tank M, from which the oxygen escapes to a suitable reservoir through M¹. The opposite parts of the shell of K are connected by pipes N N¹ to the pipes D D¹. The cocks E E¹, H H¹, and K are connected together and are operated from the pulley O, as shown in Fig. 2. The parts are so arranged that steam is first passed through the

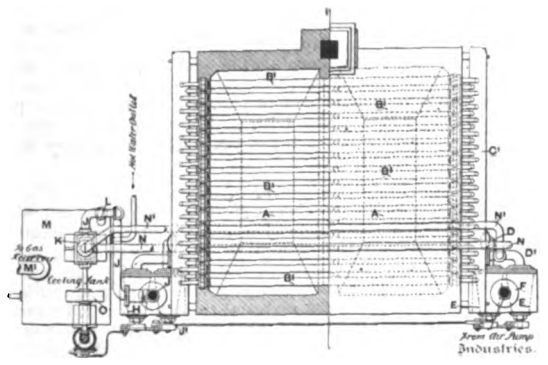


FIG. 2.

retorts, with the result that the material is decomposed into sodium hydrate, manganese, and free oxygen. The oxygen is then conveyed to the gas-holder, being cooled as it passes through M. As soon as all the free oxygen has been given off, the current of steam is replaced by one of atmospheric air. The oxygen of the latter is absorbed by the material, and its nitrogen isolated and allowed to escape. When the absorption of oxygen has ceased the air current is cut off, and that of steam again turned into the retorts to liberate the absorbed oxygen, and so on. The two sets of retorts are so connected to the governing taps that steam is admitted to one set whilst the other is being supplied with air. Seven claims are made.—No. 7851. May 20th, 1890. 11*d.*

AXLE LUBRICATORS.—*H. H. Lake, London.* (*J. A. White, Concord, New Hampshire, U.S.A.*)—Resting on the bottom of an ordinary car axle box is a projection or fulcrum of a curved lever. On that end of this lever which projects beneath the journal is formed a suitable receptacle for holding the felting. The other end of this bent lever projects upwards beyond the end of the journal, and carries a weight which, when the journal oscillates, will rock the lever sufficiently to keep the felting against the underside of said journal. Projections are provided on the bottom of the car axle box to keep the bent lever in place. Claims: (1) A car-axle lubricator provided with a casing or a receptacle for the purpose of containing the felting, and the said receptacle provided with journals on opposite sides adapted to oscillate in the bearings secured to one end of the casing to allow a vertical movement of aforesaid receptacle, and also to allow the felting to keep an equal bearing on the journal; (2) a support having a fulcrum point adapted to rest on the bottom of the box, the aforesaid support supplied with a receptacle of the proper size to hold the felting in contact with the journal, and to take up any wear in the journal or felting as set forth.—No. 20882. December 22nd, 1890. 6*d.*

REVERSING GEAR FOR STEAM ENGINES.—*J. Wild, Oldham, Lancashire.*—Pivoted at some distance from but in about the same horizontal plane as the actuating eccentric is the reversing lever, on that end of which nearest to the eccentric is pivoted a segmental lever, having its lower end connected to and operated from the eccentric by means of a suitable connecting link. Formed in this segmental lever is a slot running the whole length thereof, into which slot projects a pin carried by a slide on the valve spindle. The action of the gear is as follows:—When that end of the reversing lever nearest the eccentric is lowered to its full extent, so that the pin in the slide on the valve spindle projects into the upper end of the slot in the segmental lever, the latter will then act as a lever of the first order. If, however, said segmental lever is raised by the reversing lever, so that the pin of the valve spindle projects into the slot below the point at which the segmental lever is pivoted, said lever will be changed into a lever of the second order, and the motion of the valve spindle will be reversed. Claims: (1) A reversing gear for steam or other motive power engine with a radius or reversing lever, slotted lever, driving rod, and return crank or eccentric as described; (2) a reversing gear in which the backward and forward motions are given by the same agent, and in which the angle of advance for either motion is obtained by moving the driving rod and slotted lever through any angle equal to double the angle of advance.—No. 5878. April 18th, 1890. 6*d.*

RAILWAY AXLE BOXES.—*C. C. Longridge, Conway, Carnarvon, North Wales.*—An axle box embracing the principle of this invention is shown in the annexed illustrations, respectively side and end sectional elevations. The oil box which encloses the axle journal A is provided with a removable cover and is supported at its outer end by means of a flange B resting on the end of A. Resting on the upper periphery of A is the brass bearing block

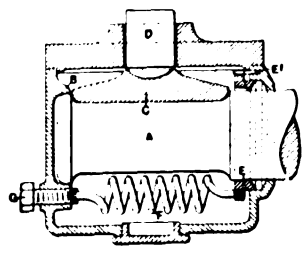


FIG 1

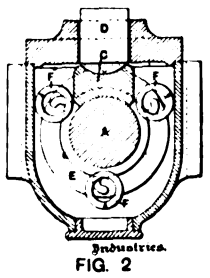


FIG. 2

C which receives the downward pressure of the carrying spring by means of the rod D, the surfaces of C and D forming a spherical joint. To prevent the liquid lubricant escaping around A from the inner end of lubricant box an internal stuffing box gland E, prevented from revolving by means of pin E¹, is forced forward by means of three or more helical springs F, and presses the packing tight around the shoulders of A. The opposite ends of the springs F are held in the ends of set screws G so that the tension of said springs may be varied. The inventor also describes several structural modifications of the above. Five claims are made.—No. 5585. April 12th, 1890. 8*d.*

SELF-ACTING MULES.—*W. E. Dixon, Rumworth, Bolton.*—The invention is intended to dispense with the quadrant, quadrant arm, winding bands, and their appendages, and substitute therefor the following:—On the cylinder shaft is mounted a differential scroll in place of the parallel winding drum at present employed. In fixings attached to the mule carriage is mounted a shaft on which is fixed a second differential scroll, the latter being connected to the scroll on the cylinder shaft by means of a chain. The shaft carrying the second scroll is fitted with a spur wheel gearing with an adjustable rack guided in a box or casing secured to the mule floor. This rack is mounted on a suitable screw spindle, the latter being rotated by means of a ratchet wheel mounted on the end thereof and a pawl mounted on a shaft journaled in a bearing on one side of the guide box. On this shaft is fixed an adjustable lever, against which a projection on the mule carriage strikes at each outward stroke, so as to swivel said shaft, and through the medium of the pawl, ratchet wheel, and screwed rod to automatically alter the position of the second scroll at each outward run of the mule carriage according to the requirements necessary for building the cops. Four claims are made.—No. 4923. March 29th, 1890. 8*d.*

SELF-ACTING MULES.—*W. H. Kershaw, Sowerby Bridge, Yorkshire.*—This invention has reference to the "snarling" motion of self-acting mules, the object of which is to prevent the snarling of the yarn. The object of the inventor is to effect the reversing of the loose half of the ordinary catch or roller clutch box, after it has done its work, preparatory to the next operation. This is done by placing around the loose half of the clutch box a spring clip, the tension of which around the clutch box may be regulated by means of a spiral spring. A finger or arm projects from the spring clip, to which is connected a cord with a weight at one end, so that when the clutches are liberated the weighted cord, acting upon the finger of the spring clip, moves the loose half of the clutch box partially round, ready for the next operation. One or more studs, one of which is adjustable, project from the headstock of the mule, against which the finger of the spring clip acts, so governing the latter's movement. Claims: (1) In the snarling motion of mules the use of a spring clip on the loose clutch box, the tension of which clip is governed by a spiral spring; (2) the use of a spring clip on the loose clutch box operated, when released, by a cord and weight; (3) the use of a spiral clip on the roller clutch box operated, when released, by a deadweight.—No. 6067. April 22nd, 1890. 6*d.*

TYPE DISTRIBUTING MACHINE.—*J. R. Topliss, Melbourne, Victoria, Australia.*—In the annexed illustrations Fig. 1 is a plan, Fig. 2 a front elevation, Fig. 3 an end elevation, and Fig. 4 an enlarged detail of a type distributing machine constructed on the principle of this invention. A is the cabinet formed with vertical channels A¹ (a few only of which are shown), into which the type is to be distributed from a plate B, supported as shown, along which the column of type is carried by means of a pusher C operated by means of a screw D. This screw has on one end of it a ratchet wheel D¹, in which engages a pawl D² (Fig. 3) carried on a lever E, in a slot in which projects

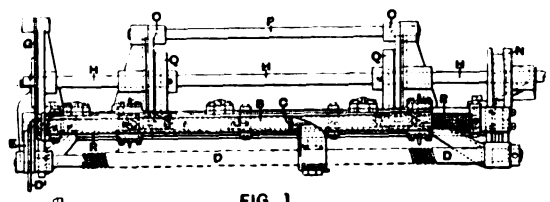


FIG. 1

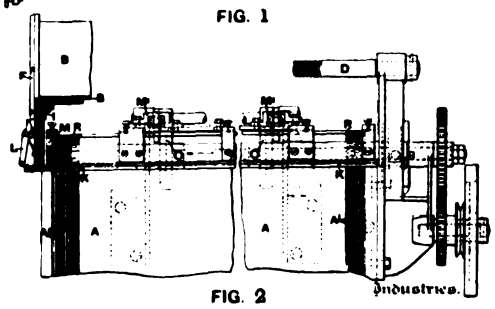


FIG. 2

a roller carried by a slide F sliding in guides F¹. This slide, and consequently the screw D, receives motion by means of a lever G operated by means of a crank on the driving shaft H. The lines of type are fed into a slot I, the rate of supply being governed by a pawl J on the slide F, and are fed forward upon a plate K, with holes corresponding with the channels A¹ by means of a lever L operated as shown by a projection on the lever G. A slide or box M is adapted to be reciprocated horizontally on the plate K by a projection thereon engaging in a cam disc N on the shaft H. This slide is carried by two levers O pivoted on a shaft P, and moved up and down, so raising and lowering M, by means of two cam discs Q. This box M has divisions or slots M¹ formed in it, in which slide the spring pushers R. The action is as follows:—After the type has been fed forward upon K, the box M, being in a raised position, then descends, and is moved forward, so carrying the type with it until it is brought

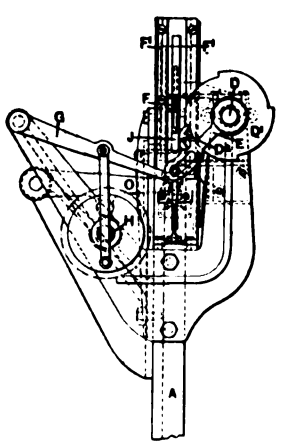


FIG. 3

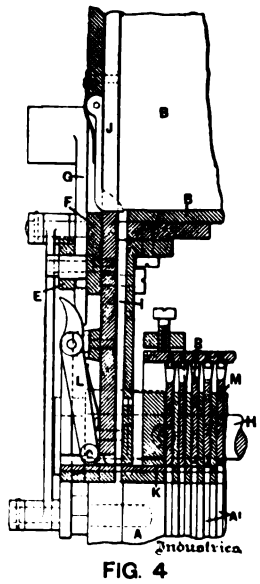


FIG. 4

opposite one of the channels A into which it can pass, and into which it is then forced by one of the pushers R. The box M is then raised and carried back to its normal position, and the operation repeated, so that any type remaining on K will be carried forward until falling into one of the channels A¹. Eight claims are made.—No. 4911. March 28th, 1890. 11*d.*

APPARATUS FOR SEPARATING AND DISINTEGRATING FIBRES.—*C. Kellner, Vienna, Austria.*—The apparatus for the above purpose is constructed as follows:—A cylinder formed of segments, bolted together by means of suitable flanges formed thereon, is supported by suitable framework, and has revolving concentrically in it a cylindrical roller, the shaft of which passes through stuffing-boxes in the end plates of the casing and is supported in bearings in suitable brackets, one end of the shafting extending beyond its bearing and carrying the driving pulley. The inner surface of the cylindrical casing and the periphery of the roller are formed with rings of V-shaped teeth, the projecting ends of those of the former projecting into the grooves between those of the latter. An opening is formed at each end of the casing, one in the upper and the other in the lower part thereof, for the supply and the delivery of the fibres. Between the flanges of the segments of the cylindrical casing packing pieces are placed, so that, as the teeth of the parts become blunted, the said parts may be adjusted to one another by reducing the thickness of the packing pieces. Claims: (1) The improved ap-

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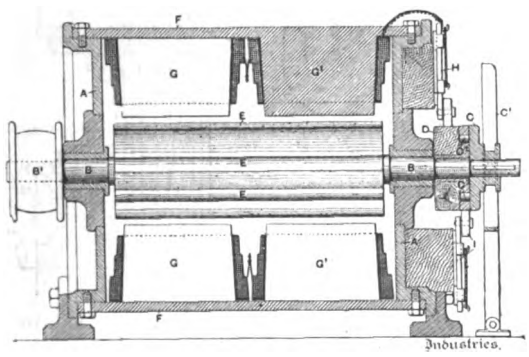
paratus for separating and disintegrating fibres in the manufacture of paper constructed and operated as described; (2) the combination of an externally pyramidal toothed cylinder revolving inside a fixed cylinder constructed of flanged sections similarly toothed internally, substantially as described.—No. 6993. May 6th, 1890. 6d.

APPARATUS FOR CHANNELING WOOD.—*E. Müller, Sorau, Silesia, Germany.*—The apparatus for the above purpose is constructed as follows:—A suitable oblong framework formed of two side bars and two end plates, the latter of which carry suitable clamps for clamping said frame to the board to be operated upon, carries, upon the two side bars, a vertical plate or frame in which slides a flat steel bar carrying on its lower end the cutting tool. This bar has formed on one side of it rack teeth, in which engage the teeth of a small pinion journaled in the vertical frame. The steel bar, and thus the tool, can so be adjusted vertically as desired. One of the side bars of the oblong frame on which the vertical frame is carried is screw-threaded, and may be revolved by means of a suitable hand-wheel fixed in the end thereof. The hole in the vertical frame through which this screwed bar passes is also screwed, so that the vertical frame, and thus the steel bar and tool, may be adjusted horizontally. The operation is as follows:—A hole is first bored in the wood to be operated upon; the operating tool is then adjusted horizontally so that when forced down it will shave the side of said hole, thus elongating it. The chisel is then raised and advanced horizontally, so that when again forced down it further enlarges the hole, and so onward until a groove of the desired length has been made. For the purpose of adjusting the depth of cut of the chisel an adjustable ring is placed on the rack bar, which ring is adapted to strike a projection on the vertical frame. Claims: The apparatus for cutting grooves in wood as described.—No. 4147. March 17th, 1890. 6d.

ELECTRICITY.

SAFETY DEVICE FOR ELECTRIC CIRCUITS.—*W. Lowrie & C. J. Hall, both of London.*—The safety device embraced by this invention has for its object the prevention of a dangerous electrical pressure existing latent in any circuit by providing an outlet to earth should a given limit be exceeded. For this purpose a pair of spring conductors, placed within a closed vessel containing rarified gas, are used, which conductors tend to make contact with one another, but are prevented from so doing by means of a suitable material placed between them, which however, becomes carbonised when the electrical pressure exceeds a given limit. One of these spring conductors is permanently connected to earth, and the other to the circuit to be protected. An indicator to show when the connection to earth has been closed may be combined with said safety device. Five claims are made.—No. 6475. April 28th, 1890. 8d.

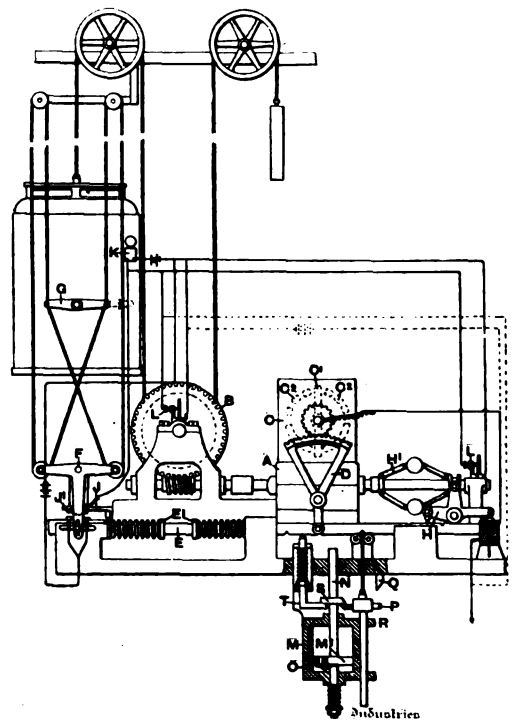
ELECTROMOTORS.—*G. R. Postlethwaite, Aston, near Birmingham.*—A motor embracing the principal features of this invention is shown in the annexed illustration, representing a sectional elevation. Journaled in the end plates A of the framework of the motor is the armature shaft B with driving pulley B^1. On the opposite end of B to B^1 is a clutch C fixed by means of a feather, so that it can be moved longitudinally along B by means of a lever C^1, but revolves therewith. This clutch is adapted by studs C^2 to engage holes in the metallic facing on the commutator D mounted loosely on B. The armature E is in cross section of cross shape. The field magnets are connected to a circular casing F, and are formed with web-shaped cores G G^1, the winding of the opposite parts G G^1 being connected in series so as to practically form one electromagnet. There are twelve such magnets divided into four series and connected to three positive



brushes H in the following manner:—Supposing these magnets to be numbered from 1 to 12, the positive wires of 1, 2, and 8 are connected together so as to form one terminal. The negative wire of 1 is then connected to the positive of 4, the negative of 4 to the positive of 7, and the negative of 7 to the positive of 10. The wires of 2 are similarly connected to those of 5, 8, and 10, and those of 3 to those of 6, 9, and 12. The negative ends of the coils 10, 11, and 12 are connected to the slides or brushes H. These brushes are adapted to press upon the commutator D, which has four metal straps connected electrically to its metallic facing, upon the edge of which facing presses the negative brush I. Nine claims are made.—No. 2337. February 13th, 1890. 8d.

FLASH SIGNALLING LANTERNS.—*W. S. Rawson, London, & C. S. Snell, Culver Park, Saltash, Cornwall.*—Arranged in a suitable cylindrical casing one above the other are two solenoids, the common core of which carries upon its upper end the extinguishing shutter of the lamp, said lamp being fixed above the axis of the cylindrical casing in a suitable lantern casing. The uppermost solenoid is wound with coarse wire, and the lower one with fine wire, and the former is arranged so that, when the light is obscured, it is in circuit with the lamp, and reduces its intensity, whilst the latter solenoid is arranged to work in a shunt to the lamp, and it is this solenoid which pulls down the shutter against the action of suitable springs. A suitable switch is provided for regulating the current through the solenoids, said switch being so arranged that the two solenoids shall be momentarily in action simultaneously, so as to prevent sparking. In a modification, several shutters are used. Claims: (1) In an electric signal flashing lamp, the employment of two concentric solenoids which have a common core and actuate a shutter as set forth; (2) the employment of springs acting in opposition to one another and in combination with the core; (3) the arrangement of the circuits as described; (4) a method by which the colour of the shutter used can be altered; (5) the combination and arrangements of the parts of a lantern and operating switches as described.—No. 3937. March 18th, 1890. 8d.

ELEVATORS.—*The American Elevator Company, London. (Otis Bros. & Co., New York, U.S.A.)*—In the annexed illustration is shown a view of the operating mechanism of an elevator such as embraced by this invention. The motor A, of any suitable description, actuates by means of a worm the wheel B around which the cable for raising or lowering the elevator cage



passes. The actuating current of said motor is regulated by means of a resistance device C provided with a switch C^1, so connected with the conductors and arranged in respect to the resistance terminals C^2, and connected with the armature winding, that the movement of the switch from its mid-position to one side will close the circuit through the resistance, and will gradually cut out the resistance and impart motion to the armature in one direction, while the movement to the other side will gradually cut out the resistance and impart movement to the armature in the other direction. The switch is actuated by means of a a gear wheel on the shaft thereof and the tooth sector D, an arm on which is hinged to a rod E, normally held in the position shown by springs E^1. This rod receives motion through the medium of a lever F and ropes, as shown, from the lever G in the car. When the switch is moved in either direction as far as possible it will be so held by means of a lever H, a catch on one end of which engages in V notches in E. It will, however, be released by means of the governor H^1 should the speed of the motor fall; and should the tension of the supply current become too great it will also be released by an electromagnet I in the supply circuit. On a bracket J is a contact J^1, which, when E is moved in either direction, makes contact with one of two contacts on the end of E, so completing a circuit through the bell K in the car. Circuits connected with thermostats L on all the bearings also include K, so that, should the bearings become heated, an alarm will be sounded. In order to return E to its normal position after a certain length of time, an arrangement is used consisting of a dash-pot cylinder M, piston M^1, piston rod N, and circulating channel O. The motion of E either way from the centre lifts the piston, until the bolt P is pushed back by the inclined cam Q by the pin R on the bolt travelling on the inclined face of the cam. The piston returns now to its bottom position and the toe S in its down path strikes the detent bolt T and releases E, which then returns to the centre and opens the circuit, shutting off the current. Twelve claims are made.—No. 624. January 13th, 1891. 8d.

METHOD OF CONNECTING CONDUCTORS.—*J. Marx, Sachsenhausen, Frankfurt-on-Maine, Germany.*—According to this invention the ends of the wires to be connected are connected electrically with two circular or other shaped plates, which are then placed opposite one another, and at a suitable distance apart, in a cylindrical box or container. The opposite faces of the plates are provided with projections. When in this position a mixture consisting of a good conducting material, such as powdered carbon or graphite, and a conglomerating material, such as paraffin wax, is run into the box between the plates. When this mixture has cooled, the box or container which has acted as a mould is removed, and the joint is then complete. Claims: (1) A safety device for electric circuits consisting of a mixture of a conductive material with a material which softens or fuses when undue heating of the conductors occurs, the said mixture being placed in the circuit as described; (2) the interposition in an electric circuit of a mixture of powdered carbon or graphite and paraffin wax, stearine, pitch, resin, or the like; (3) a safety device as described, contained in a frame or box, and having the conductors connected therewith; (4) a safety device for electric circuits as described.—No. 6267. April 24th, 1890. 8d.

ARMATURES FOR DYNAMOS AND MOTORS.—*R. E. B. Crompton, Chelmsford, Essex. (W. Fritsche, Berlin, Germany).*—The invention relates more particularly to armatures of the disc or wheel form, which are constructed according to this patent in the following manner:—Fixed on the armature shaft are two hubs, between which are firmly held the ends of a number of radially placed spokes or staves of soft iron, having on their outer ends abutting segments such that when arranged in correct order they form a complete wheel. These staves can be connected electrically so as to form the required electrical armature circuits at points inside and outside the ring of field magnets by curved segments or connectors. The staves are made so that each alternate one is of greater length than the others. These longer staves are connected to properly formed segments which in some cases may form the commutator of the dynamo. In the upper and lower parts of the staves are formed notches by means of which the connectors may be attached to them, said connectors forming two concentric rings of connection. Claims: (1) A wheel armature composed of any number of parts of iron staves placed by the side of each other in one plane, only one stave of each pair having at one end or its side a collector segment, which construction, subject to a connection of the staves as described, forms at the same time the core of the collector, the support, and the winding of the armature; (2) the manufacture and use of armatures for dynamo electric machines and electric motors arranged and operated substantially as described.—No. 5750. April 16th, 1890. 8d.

CHEMISTRY.

APPARATUS FOR CONCENTRATING SULPHURIC ACID.—*C. S. Négrier, Périgueux, France.*—The apparatus for the above purpose is constructed as follows:—The space above the usual range of hearths is partitioned off, the partition being on an inclined plane. This partition consists of a number of iron plates formed each with a number of hemispherical depressions, and placed together and supported on suitable walls. These cavities are provided with small holes in their lower parts, plugged with clay to preserve the plates. Placed in each cavity (of which there are preferably four in each plate) are vessels of porcelain or other non-corrodible material, each having a lip projecting over the next below in series on the inclined plane. The sulphuric acid is passed into the uppermost vessels and trickles over into the next lower ones, and so on through the series, until it overflows from the last, in a more or less concentrated state, into a suitable duct, by means of which it is carried to the concentrated chamber proper, which latter is constructed with an inclined plane and vessels on a similar system. The acid, after suitable concentration, is carried into a leaden receiver, where it is cooled. The vapours arising from the acid are carried into a leaden vessel, and from thence into a second leaden vessel, in which they are cooled, and from which they then pass to the main lead chamber. Claims: (1) The method of concentrating sulphuric acid by passing the acid through a series of basins over the producing furnace previous to its treatment in the concentrating furnace proper; (2) the apparatus consisting of plates with hollows and basins therein arranged in the furnaces in the manner and for the purpose set forth; (3) the method and apparatus for carrying the acid vapours and steam which are products of the concentration of the acid from the spaces above the condensing vessels into the lead chamber as described.—No. 4171. March 17th, 1890. 8d.

MISCELLANEOUS.

PIPE WRENCHES.—*E. S. Hunter, North Shields.*—Pivoted on each side of the end of a suitable steel lever are a pair of long curved steel links, between the upper ends of which is pivoted a T piece, to which are connected the two end links of a chain, composed of a series of shorter curved alternate single and double steel links. The upper end of the main lever or handle on each side of which the long curved links are pivoted is rounded and serrated crosswise, as are the edges of the links on one side of the chain near the free end thereof. The gripping action is as follows:—The chain is bent round the pipe to be gripped, and the remaining end passes between the long curved levers. In this position that side of the links which is serrated is on the opposite side to the pipe, and the serrations on the end of the chain engage with those on the end of the handle lever when the latter is moved in the opposite direction to that in which the chain is wound around the pipe. Claims: (1) The long and short curved links with and without teeth; (2) the flat circular toothed end of lever.—No. 1401. January 26th, 1891. 6d.

DRYING MACHINES.—*J. F. Johnson, Belvedere, Kent.*—The invention relates to drying machines suitable for refuse and other such like matters, and consists of a number of semi-cylindrical troughs placed end to end and in steps, each trough being below the preceding one. Each trough has journaled in its ends a shaft driven from overhead shafting, and carrying suitable scraping blades, by which the material to be dried is led forward along the trough until it comes to the end thereof, when it drops into the next trough. These troughs are supported in the flue of a single furnace, and are heated therefrom by means of water-jackets surrounding them, so preventing undue heating by the furnace. Each trough is provided with a semi-cylindrical cover. This cover, at the feed end of the trough, is connected by a pipe to an exhaust fan, whilst at the other end of the trough is formed a hole to admit the products of combustion from the flue into the interior of the trough. Claims: (1) Drying machines, in which there are a number of troughs communicating with each other, each trough having within it a shaft supported at its ends only, and carrying scrapers as described; (2) drying machines, substantially as described.—No. 3383. March 3rd, 1890. 6d.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10d. *or fraction of* 10d. *Remittances exceeding one shilling must be made by Post Office Order.*

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BOILER CONSTRUCTION.*

INTRODUCTION.—I have the honour to invite your attention this evening to the construction of boilers adapted to forced draught, and, as the subject is obviously far too extensive to deal with at one meeting, I propose to confine this paper almost exclusively to the study of that branch of it which lately has given so much trouble—viz. leaky tubes. Our inquiry will be directed towards ascertaining what causes such leakages, this being the first step towards finding a remedy. Let us first consider a few matters of detail, which deserve far more attention than they generally receive.

WORKMANSHIP.—A certain amount of trouble must be attributed to insufficiently good workmanship and materials; for it must be borne in mind that, with forced draught and higher pressures, boilers are far more severely strained than formerly, consequently workmanship which was good enough but a few years ago is now quite unsuitable.

QUALITY AND CONDITION OF TUBES.—First, with regard to the quality of the tubes. The best that are procurable are none too good. Good tubes are of the most ductile material and carefully annealed at the ends, and will stand flattening and bending over without cracking, such as the samples which I have here. They should be perfectly straight, or if curved, as sometimes done, they should be all curved alike, so as to maintain the same water space throughout their entire length and secure a uniform elasticity. This elasticity will enable all the tubes to take an equal share of the strain thrown on them. The thickness of the tube at the part where it is expanded must be the same all round; this it frequently is not; and there should be no ridges inside caused by the weld, otherwise the expander meets with inequalities, leading to irregularity in the work. The outside of the tube where it passes through the tube plate must be free from scale or oxide, and should be bright, so that when expanded the metal of the tube should come in close contact with the metal of the plate. Tubes polished at the ends as supplied by the makers are generally well greased to protect them from rust. This grease, as well as the oil remaining in the holes of the tube plate after having been drilled, must be completely removed; if this is not done, there will remain in places a film of grease between the two surfaces, after the tube has been expanded.

METHOD OF EXPANDING TUBES.—The usual method of expanding is to bore parallel holes in the tube plate, and expand the tube with an expander, which will give a taper. Now, in no other part of the machinery should we think of putting a taper pin into a parallel hole. If the hole is parallel, an expander should be used, which will expand the tube so that it also becomes parallel, or, if a taper expander be adopted, then the hole in the tube plate should be bored to correspond, so as to ensure the perfect bearing of the tube throughout the entire

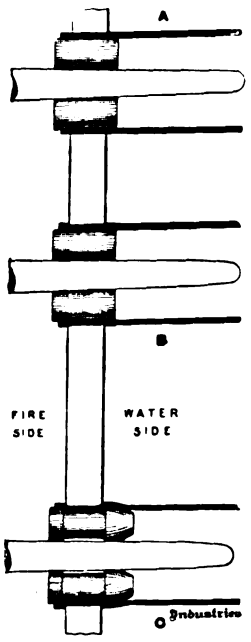


FIG. 1.

thickness of the plate. Unless one of these courses is adopted we get a bearing of the tube in the plate which will vary according to the inclination of the workman; no two tubes will be expanded equally, and the expanding will be carried out to an unknown and irregular extent. As an illustration of this, I have here a tube which has been expanded into a plate in a manner frequently met with (see A, Fig. 1). On the one side, as anyone closely examining it will see, the tube and plate do not touch. This is partly due to adopting a taper expander in a parallel hole, and partly to the rollers not going sufficiently far through (see B, Fig. 1). Special care should be taken that the rollers of the expander pass well through the plate, so as to swell out the tube, not only throughout the thickness of the plate itself, but a little beyond, ensuring thereby that the tube is in close contact with the plate throughout its thickness, and a slight swelling of the tube on the inside, forming, as it were, a small shoulder, and thereby preventing the tube from shifting in the hole when a compressive strain comes on it. This in actual practice is often neglected, the relative position of the rollers to the tube plate being left to the workman. In passing, I would allude to an expander C (Fig. 1) we use frequently. In it the rollers are

* Paper read by Mr. A. F. Yarrow before the Institution of Naval Architects, March 19th, 1891, and fully entitled "Boiler Construction Suitable for Withstanding the Strains of Forced Draught, so Far as it Affects the Leakage of Boiler Tubes."

BOILER CONSTRUCTION.

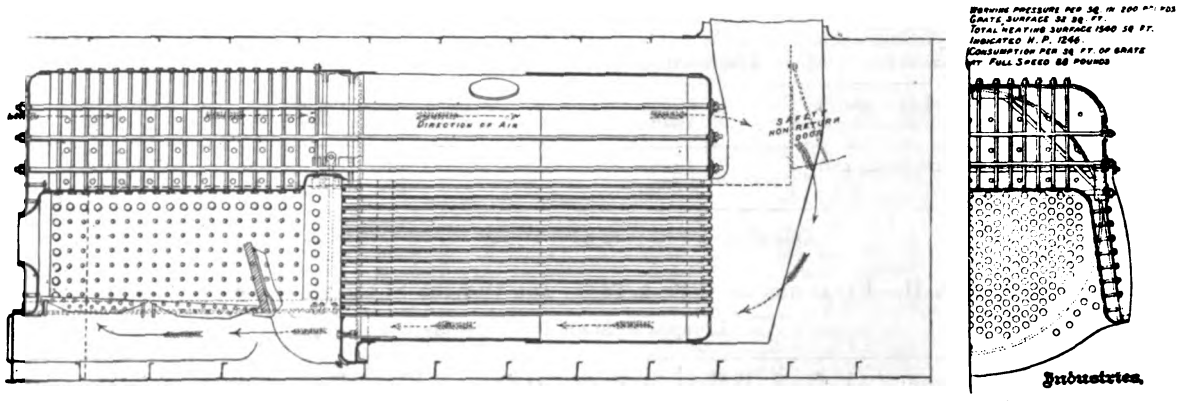


FIG. 2.

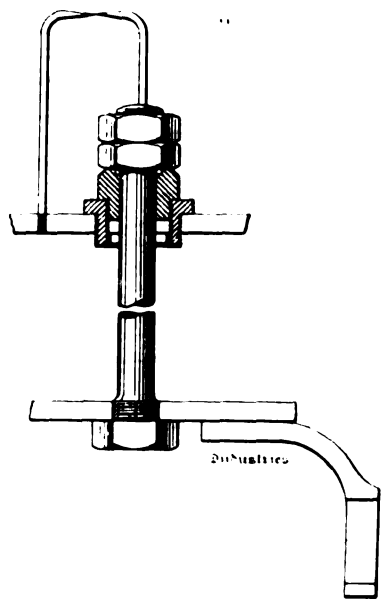


FIG. 3.

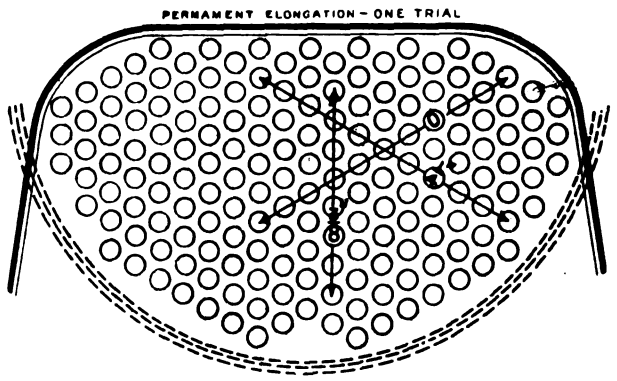


FIG. 4.

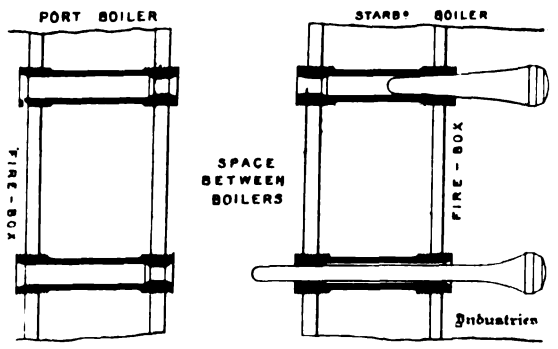


FIG. 5.

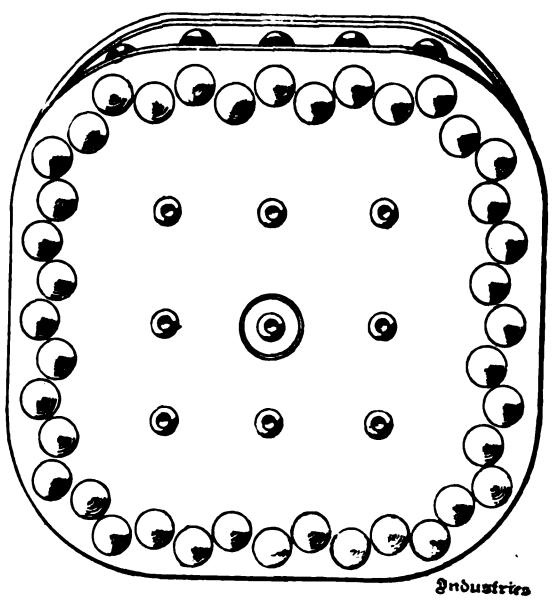


FIG. 6.

parallel for a length a trifle greater than the thickness of the plate, and are then slightly increased in diameter, thus ensuring pressure coming on the tube throughout the thickness of the plate, and raising a very defined shoulder on the tube both inside and out. In this way a very firm job is secured, and the tube is prevented from being either pushed or pulled through the plate. This bead on the tube at the inner side of the plate is very desirable. On the London and North-Western Railway at Crewe a tool is adopted which is specially designed for producing this bead, and also at the Baldwin Locomotive Works, Philadelphia, and many locomotive superintendents do practically the same thing by reducing the diameter of the tube where it passes through the tube plate, thus forming a shoulder against which the tube is driven up. Assuming we have a proper expander, let us now deal with the way the expanding is carried out. The custom is for the boiler-maker to settle himself down comfortably inside the box, and work away at one side or at one corner, expanding a large number of tubes, and then shifting his position. This is objectionable, because by expanding a great many tubes in one place a considerable strain is thrown on the plate, which is stretched, and in this way severe local strains set up. The better plan is to expand three or four tubes in one locality and then shift to another, expanding all over as gradually and uniformly as possible. Some people advocate screwing the tubes into the tube plate, and expect by that means to make them tight. We have done this, and abandoned it, as it does not deal with the root of the evil; moreover, it presents practical difficulties, especially when the time comes to retube the boiler. Sometimes a thin copper sleeve, or ferrule, is put over the end of an iron or steel tube and expanded with it into the plate. This frequently reduces the leakage of tubes. The explanation may, perhaps, be found in the fact that, with a rise of temperature, the copper increases to a greater extent than the surrounding material, and tends to fill up any gap which may occur.

STAY TUBES.—With regard to stay tubes, for many years we have not used them, and have found no injurious result. On the contrary, I believe, so far as the leakage of tubes is concerned, they are bad. In the first place, they are invariably thicker than the surrounding ones, and to have rigid tubes alongside those which are elastic is clearly undesirable. If stay tubes must be adopted they should be equally elastic with the others, and consequently of the same thickness and same material, only thickened up where they screw into the plates.

HOLDING POWER OF ORDINARY TUBES.—Some years ago we carried out a number of experiments with a view to ascertain the power required to withdraw from tube plates tubes expanding in the usual way. We found that a 2in. tube had a holding power in a steel plate of from 8 to 12 tons; and a number of specimens from these tests are here. In a fire-box, as shown in Fig. 2, at a pressure of 200lb., we have a total stress separating the two tube plates of 124 tons. Now the total holding power of the tubes to withstand such pressure, based upon 8 tons per tube, is 2,300 tons, giving a margin of security of nearly 20. It is for everyone to use his own judgment in the matter of adopting stay tubes or not. With very few exceptions locomotive engineers in this country and America are adverse to them.

FERRULES.—Concerning the use of ferrules, their adoption does not seem to affect the leaky tube question to any material

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BOILER CONSTRUCTION.

TABLE I.—Experiments to Ascertain the Strength of Water-space Stays.

Description.	Length between Plates.	Diameter of Stay over Threads.	Ultimate Stress.
Hollow stays screwed into plates and hole expanded	4·75in. 4·64in.	1in. (hole $\frac{7}{16}$in. and $\frac{5}{16}$in.) 1in. (hole $\frac{9}{16}$in. and $\frac{7}{16}$in.)	25,457lb. 20,992lb.
Solid stays screwed into plates and riveted over	4·80in. 4·80in.	$\frac{7}{8}$in. $\frac{7}{8}$in.	22,008lb. 22,070lb.

The above are taken as a fair average of numerous tests.

TABLE II.—Expansion of Copper Tubes and Outside Shell when Raising Steam.

Lit up at 10.20 a.m.; 4in. over fire-box.

Time	10·30	10·40	10·50	11·0	11·10	11·20	11·30	11·40	11·50
Steam	0	0	0	0	lb. 0–5	lb. 20–10	lb. 60–80	lb. 100–120	lb. 140–160
Elongation of barrel in m/m. Length measured, 3ft. 4½in. = 1,028 m/m.									
Boiler shell at water level	·2	·6	·8	·9	1·4	2 0	2·5	2·7	2·8
Top	0	0	0	·4	1·6	2·0	2·5	2·5	2·8
Bottom	·2	·3	·4	·8	1·6	1·6	2·5	2·5	2·5
Elongation of tubes in m/m. Length of tube, 3ft. 10in. = 1,168 m/m.									
Top tube	1·5	1·6	1·6	1·6	2·5	2·7	2·9	3·8	4·0
Bottom tube	·7	·9	1·5	1·4	2·0	2·5	2·9	3·6	3·6

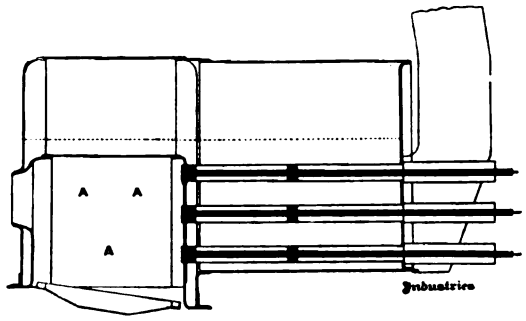


Fig. 7.

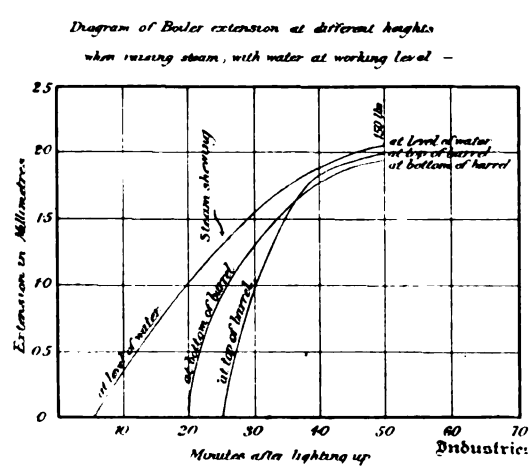


Fig. 8.

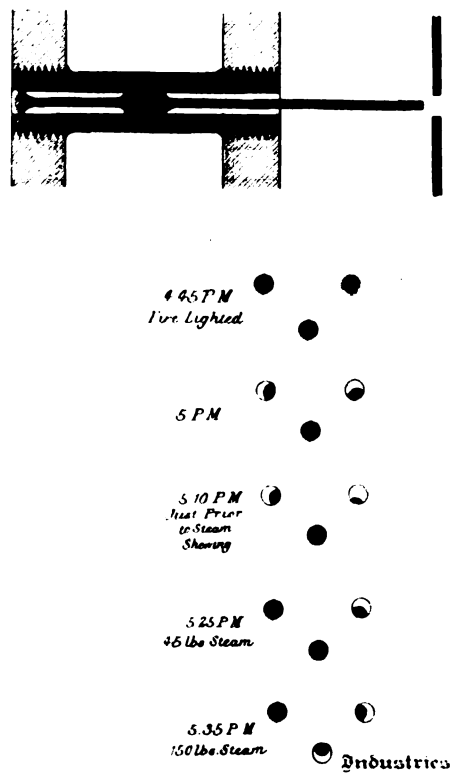


Fig. 9.

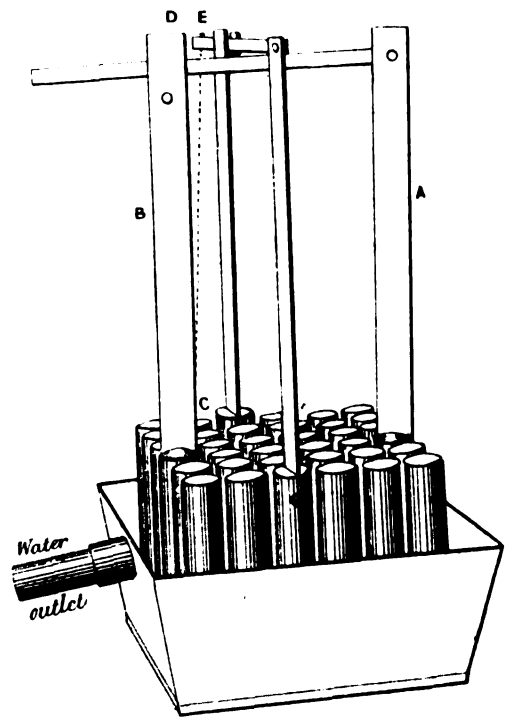


Fig. 9A.

extent. If the tubes leak without ferrules we have no reason, based on experience, to believe the ferrules will cure it. They do not strike at the root of the evil. They may be used with advantage for those tubes which are subject to the fiercest fire, as they interpose a resistance to the rush of flame by reducing the area, and thus cause the heated products of combustion to pass more uniformly through all the tubes. Although I occasionally refer to locomotive practice, I would point out to those not familiar with the subject, that an ordinary locomotive boiler is not applicable to marine purposes without considerable modification: water that has passed repeatedly through a surface condenser requires very different treatment to water such as is used on our railways, therefore the ordinary locomotive boiler must only to a limited extent be taken as a guide in the present investigation.

Water Space Stays.—With regard to the water space stays uniting the inside and outside fire-boxes, too much care cannot be exercised in arranging these with a view to secure for the inside fire-box the necessary freedom of movement due to the variations in temperature. In the year 1878 we built a torpedo boat for a foreign Government, and had no less than eight unsuccessful trials, in every case coming home with the tubes leaking (Fig. 3). To ascertain exactly what was going on in the region of the tube plate, we removed the row of stays nearest to the tube plate flange, on the sides and top of the box. We replaced these stays by others working in stuffing boxes and having a nut on the outside, so that if a tensile strain had to be met they were there to receive it, while if the inside box wanted to expand it had freedom to do so. This experiment was most interesting; every time the fire was urged these stays would all move outward through their stuffing boxes, owing to the expansion of the box. In some cases the movement was sufficient to enable a penny piece to be inserted between the nut on the stay and the gland. Each time the fire-door was opened and the temperature reduced these stays would move inward, and when the boiler was cool the nuts pressed hard on the glands. From the moment the new stays were fitted the boiler was altogether free from leaky tubes, and the boat was duly taken over by the Government. It is, of course, dangerous to draw a conclusion from one isolated experiment; at the same time, it seems more than probable that these stays, as originally fitted, had much to do with the leaking of the tubes, because it is evident that a tensile strain coming on a tube plate weakened by being perforated with a number of holes, is likely to distort the plate. As a matter of fact, prior to the new stays being fitted, this tube plate was more or less altered in shape after every trial. Fig. 4 shows exactly the change that took place on the first trial alone. It will be seen that between the points indicated on the diagram there was in one case an extension of ½in., and in the other an extension of ⅝in. I think we may assume that tube plates should be free from external strains, and, as far as possible, be allowed freedom to move as the changes of temperature require. With a view to carry this out we make a practice of having the first row of stays at least 7in. from the edge of the tube plate flange, and even these stays in large boilers are so designed as to be free to move.

Elasticity.—It will be seen, by reference to the section of the boiler (Fig. 2), that the greatest possible elasticity is allowed for throughout. Special care should be taken that the flange of the tube plate is made very thin, so as to secure elasticity and avoid the possibility of strains being thrown on the tube plate itself where the tubes pass through, also to avoid a large difference of temperature between the inside and outside of the double thickness. To ensure freedom for movement, the water space should not be cramped, otherwise trouble will be met with by the leaking and breaking of the stays. In order to gain elasticity, we follow the plan frequently adopted in locomotives, of turning the stays down between the plates. This ensures any bending of the stays being confined to the portion within the water space, and prevents movement of the stay in the plate itself, thereby causing leakage.

Hollow Stay.—Perhaps I may be permitted to draw your attention to a stay we occasionally use. It has been designed to meet a condition frequently occurring when several locomotive boilers are placed closed together, and in consequence, the stays at the sides are inaccessible for repair or renewal. It is shown in Fig. 5, and is a modification of what is adopted by Mr. Park, of the North London Railway. In his case, holes are drilled a short distance into both ends of the stay, into which a drift is forced; the stay is thus swelled out until it fits tightly into the plate, thus making a thorough mechanical job, and probably sounder work than if the stay were riveted over as usual. In the case of a locomotive, as both ends of the stay are accessible, the drift can be used at both sides. As will be seen, the new stay has been designed so as to be made tight at both ends, working from one side only. In an inch stay we drill a ½in. hole nearly all the way through, and then a ⅜in. hole for the remainder. The stay is screwed in from the inside of the fire-box, and a taper drift is passed through the larger portion of the hole and driven into the smaller, swelling the stay out and making it a tight fit at that end. A larger drift is then used for swelling out the end next the workman. By this means a stay can be put in or repaired, making it tight at both ends, the entire operation being performed from one side only. Mr. W. H. Maw has proposed to increase the diameter of the drift at the extreme end. This seems a decided improvement, as it causes the hole to be swelled out parallel, and also enables the drift to be more readily withdrawn. An inch stay with a ½in. hole gives the same strength as a ⅞in. solid stay. The exact stresses which both these stays can resist have been carefully tested, and the results are as shown in Table I. We have also here a water space (see Fig. 6) having 1in. hollow stays, 4in. centres. This, when tested by hydraulic pressure, gave way at 1,650lb. per square inch.

Tube Spaces.—The distance between the tubes should be determined with a view to ensure an ample supply of water to the hot surfaces, and to avoid the steam being imprisoned between the tubes, especially in the region of the tube plate, so that the heat should be carried away as soon as it arrives at the interior surface. Certainly nothing less than ¼in., or perhaps, better still, 1in. space should be adopted with 2in. tubes, when burning, say, 80lb. to 100lb. of coal per square foot of fire grate per hour. This space will give ample room for good circulation, provided the latter is not restricted or interfered with by any features in the design. Of late a number of unsuccessful marine locomotive boilers have been constructed with water bottoms. It may be a matter worthy of consideration whether the powerful

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upward current throughout the water space round the fire-box is not the means of drawing from the lower part of the barrel a large quantity of water, thereby robbing the tube plate of a portion of the supply which it would obtain if there were no water bottom.

Length of Tubes.—The length of the tubes should be of such proportion to their diameter as will ensure the necessary elasticity. For this reason, large tubes or short ones are objectionable, as they are too rigid.

Alteration of Tubes when Raising Steam.—In reference to this portion of the subject, I will refer to a very interesting experiment we carried out with a view to ascertain exactly what was happening to the tubes during the process of raising steam, and also when at work. I would call your attention to Fig. 7. (It should be understood that, in many cases, the diagrams referred to in this paper are exaggerated, so as to illustrate the reasoning more plainly). It will be seen that, through three of the tubes, which are at different levels, there are fitted three bars; the latter are fixed at the end next the fire, and also in the centre of the tube. The object of this experiment was to ascertain if the tubes remained straight, and, if not, to register the extent of the bending, which could be made apparent by the alteration in the position of the extreme ends of the rods. Almost immediately after lighting up, it was found that the top row of tubes was evidently heated in advance of the rest. The hotter water, as might have been expected, was near the surface; the cold water at the bottom remained undisturbed, and the top of the boiler was also cold, owing to there being no steam to heat it. The water near the surface, being raised in temperature, those tubes which passed through it strove to increase in length, but, owing to the tube plates being fixed, they were unable to do so, consequently there was a considerable bending of the tubes. This was made evident by the movement of the end of the rod. After the fire had been alight about ten minutes, the second bar began to move as the water at the lower level rose in temperature. In like manner, after a further interval, the third bar moved; and the bars all continued to move until such time as steam began to rise. As soon as 10lb. or 15lb. were registered, the pressure on the tube plates began, apparently, to make itself felt and forced them apart, throwing a tension on the tubes which straightened them. From thence up to 160lb. the tubes showed practically no curvature. This experiment proves how necessary it is to provide ample elasticity in the tubes, so as to comform to the conditions which have to be complied with in raising steam.

Distortion of Boiler while Raising Steam.—The strains which boilers have to withstand when lighting up are well known to be very serious and of an entirely different character, and in some parts far more severe than those met with when at full work. As evidence of the strains caused by unequal expansion when lighting up I would refer you to Figs. 8 and 9, and Table II. Table II. shows the longitudinal expansion of the boiler barrel at different parts and at varying periods during raising steam; Fig. 9 illustrates the movement of the inside box, and Fig. 8 shows the changes of length in another example. These examples illustrate that the distortion of form in some parts is greater during this process than when steam has been raised. With a view to reduce these strains and increase the temperature of the boiler as uniformly throughout as possible when raising steam, we make a practice, in the case of a large boiler, of filling it quite full, and, as the temperature rises, allowing the water to run out from the blow-off cock, so that by the time steam shows itself the water is at the working level. In this way the upper part of the boiler is warmed up, and the cold water at the bottom is got rid of. It is reasonable to suppose many boiler troubles might be avoided if this or some similar plan were adopted. In cooling down the strains are not so great, and are quite different in character from those met with in lighting up. One main principle must be borne in mind, that any changes of temperature should take place as slowly as possible. The sudden putting out of the fire is therefore bad, and may cause tubes to leak. This would not occur if the fire were allowed to burn out very gradually, as it ought; a fact which every locomotive driver knows perfectly well. The annealing of the tube plate, if of iron or steel, should be effected with exceptional care, so as to reduce changes of form when the boiler is first set to work. This annealing should of course be done when the plate is flanged, and possibly it might be desirable to do it after the tube holes are drilled, leaving a trifle to be rimered out finally.

Air Pressure.—I would here say a few words with reference to the amount of air pressure. In the passage of the air from the stoke-hold to the funnel, the greater part of the resistance to be overcome in most cases is due to forcing the air through the tubes; consequently, if a contractor be limited to a given amount of air pressure, the only means he has open to meet this condition without extra weight is by augmenting the diameter of the tubes, or reducing their length, thus producing rigidity, which I have already pointed out is bad. Because a certain boiler does not stand a given air pressure without the tubes leaking only proves that that air pressure is too much for that boiler, but does not prove that this air pressure is too much for every boiler, especially in face of the fact that locomotive engines are working all over the world at air pressures varying from 3in. to 8in. I would call attention to Fig. 10, showing the vacuum in the smoke-box of a Midland engine. This has been kindly given to me by Mr. Johnson. In confirmation of the high air pressure used on locomotives, I cannot do better than quote the following statement of a locomotive engineer of one of our leading lines:—"We do not consider from our experiments that a vacuum of 8in. in a smoke-box is anything exceptional, but should expect it when working full power, either going up a bank or drawing a heavy train on a level. In addition to the vacuum in the smoke-box we register a pressure of air in front of the ash-pan, due to the speed of the train, of 2in. of water, making a total air pressure of 10in." With these facts before us there ought to be no condition imposed upon the marine engineer limiting the air pressure. Would it not be good policy to leave the hands of the designer and maker free to adopt whatever air pressure he likes so long as he gives security that the boiler he supplies will stand it? It is surely better to adopt a high air pressure and have a reliable boiler rather than limit the air pressure and have a boiler which at any unexpected moment may give way altogether; in other words, a low air pressure involves a rigid boiler, and a rigid boiler is not reliable. I think we may fairly conclude that by limiting the air pressure the very best possible inducement is held out to supply a bad boiler, because it leads to a rigid one. If it be wished to limit the temperature of the furnace, which I am ready to admit is desirable, I submit that this may be better effected by limiting the rate of combustion, and when it is ascertained what air pressure corresponds to such rate of combustion, a correct limit of air pressure can be determined for that particular boiler.

BOILER CONSTRUCTION.

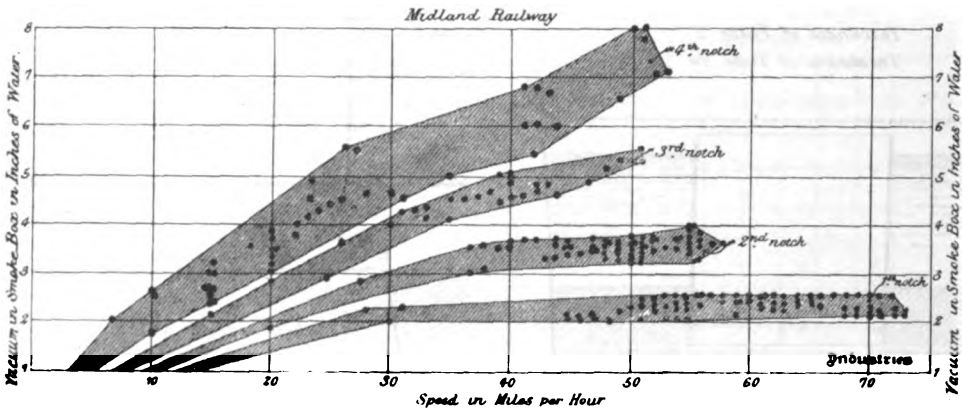


Fig. 10.

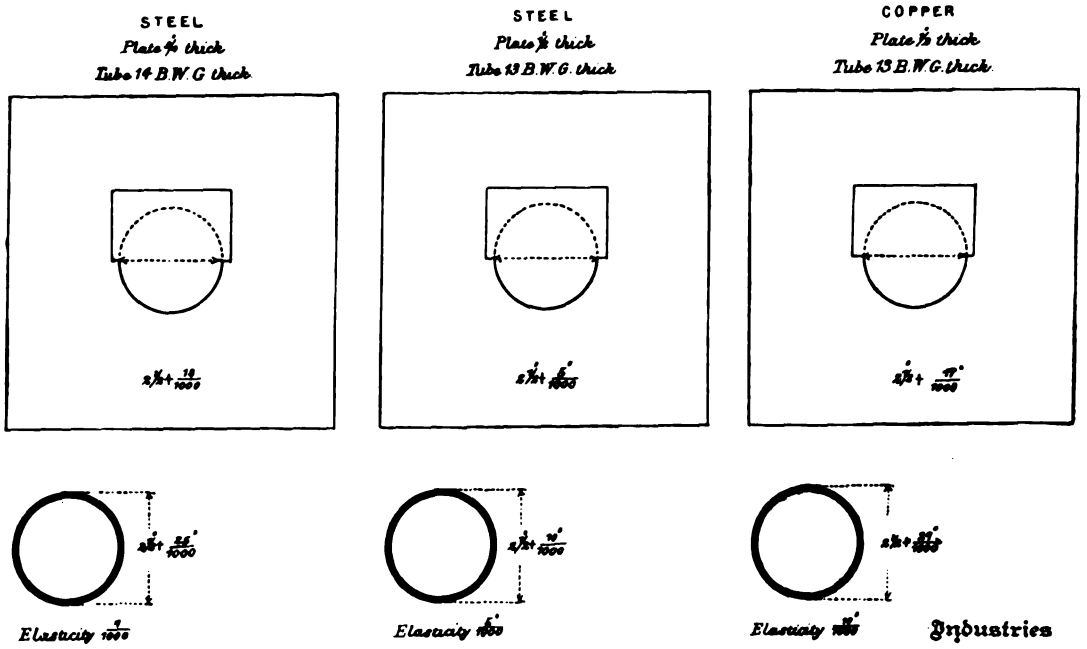


Fig. 11.

Grease.—I need not dwell upon the importance of avoiding grease gaining access to the interior of boilers, as this is well known.

Starting New Boilers.—The bringing into use of new boilers should take place gradually. An ordinary brick furnace when new is heated up very slowly, otherwise it cracks and falls to pieces. Were the same consideration extended to a steam boiler it would often avoid trouble by allowing the various parts to accommodate themselves to their new condition by slow degrees. Many trials have failed through over-anxiety to work up boilers to their full power too quickly. Boilers when new, however, frequently give more or less trouble from leaky tubes at the commencement of the trials. To this we do not attach importance, provided it is due to unavoidable changes of form, which are temporary. It need not be looked upon as of serious moment, as the leakage will soon disappear. Very frequently the tubes leak on cooling down, and, if this happen only to a small extent, it deserves little attention and is of everyday occurrence. Probably the best thing to be done is to leave the tubes alone. Often people take fright at this small leakage and start re-expanding, unnecessarily punishing the tubes. In the foregoing remarks I have simply drawn your attention to a few practical points which deserve consideration. There are many others which time will not admit of our dealing with, such as the position of the air inlet, the position and description of the fire door, the thickness of the fire, and the best mode of stoking. These should be determined, as far as possible, with a view to reduce variations in the temperature of the furnace and avoid cold air coming in contact with the tube plate. There are many other points of importance which we must also pass by.

Elasticity of Tube in Tube Plate.—Now let us study exactly what takes place in expanding a tube into a tube plate. The tube is increased in diameter and pressed against the sides of the hole in the plate, the pressure slightly increasing that hole. The two metals are not only in contact, but are actually pressing against one another. The tube, if it were free, would become slightly larger; and the hole, if it were free, would become slightly smaller. We know this from direct experiment (see Fig. 11). I have here some 2½in. tubes which have been expanded into plates, and then the plates have been cut in the manner shown, so as to enable the tubes to be removed without disturbing anything. On carefully measuring the diameters, both of the tubes and the holes, a very appreciable difference is found, and it is this difference which is to help us in keeping the tubes tight. The actual collective elasticity of the tube to expand and the plate to contract amounts, with steel tubes and tube plates, in one case to $\frac{7}{1000}$in., and in another to $\frac{6}{1000}$in., and $\frac{18}{1000}$in. in the case of copper tubes and tube plates. Assuming that a tube is well expanded, it will remain tight in the plate so long as nothing takes place—such as a sudden reduction of temperature—to cause the tube to be reduced to a greater extent than the collective elasticity of the tube plate and the tube. Now, when steaming hard, if the fire door be opened, and a blast of cold air admitted, the tubes through which it passes, being thin, will feel the effect and contract before the thick tube plate. The tubes will remain tight only so long as the chilling does not tend to reduce the diameter of the tube beyond the collective elasticity of the tube and the plate. Should this elasticity not be sufficient to make up for the change of form, the tube will leak. If the tube plate be thin, so that the rate of its contraction approaches that of the tube, difficulty from this cause will be reduced. Anything that can be done to increase the range of elasticity of the tube and tube plate, allowing thereby larger differences of temperature, is clearly desirable. One simple way in which this can possibly be augmented is by making the tubes a driving fit into the plate, and not simply slipping them loosely into the holes, leaving the expander to do all the work. Mr. Park, of the North London Railway, attaches great importance to making the tubes a very tight fit in the holes.

Thin Tube and Thick Tube Plate.—To ascertain the effect of heating and cooling tubes in a tube plate, we have tried some experiments, the results of which are shown on Fig. 12. We have here a $6\frac{7}{16}$in. tube, $\frac{1}{11}$in. thick, fitted into a 2in. plate. The plate was carefully bored, and the tube carefully turned and driven in tight. These extreme proportions were intentionally selected, in order to ascertain clearly what takes place. Round the tube plate we fitted some thin sheet steel, forming a tank. This was filled with water, and placed over a smith's fire, left there a few minutes, then removed and allowed to get cold; it was then replaced over the fire, this operation being frequently repeated. After the eighth time the tube commenced to leak, and after eighteen times leaked so badly that the experiment had to be stopped. Let us now investigate what has taken place. The heat warmed the tube plate and the tube, but owing to the tube being thin as compared to the plate, the tube got hot much more rapidly than the plate. It then tended to expand, but was prevented from so doing by the plate, which remained comparatively cold, consequently the metal of the tube was permanently crushed. The exact change of form is shown on the diagram, and it will be seen that the tube has been considerably altered from its original shape.

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BOILER CONSTRUCTION.

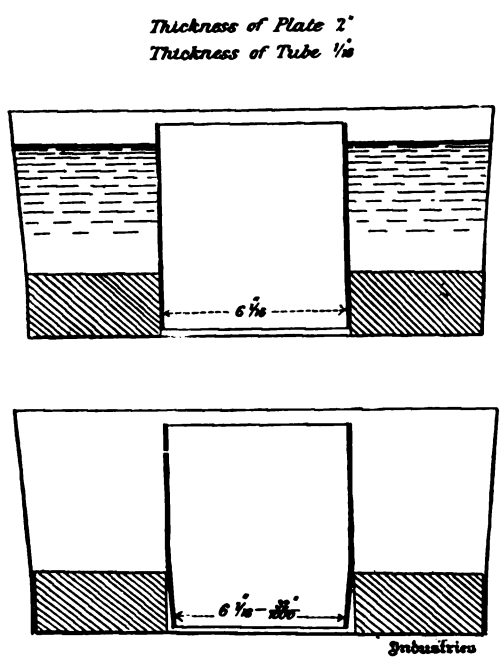


FIG. 12.

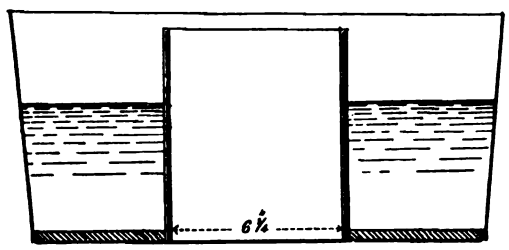


FIG. 12A.

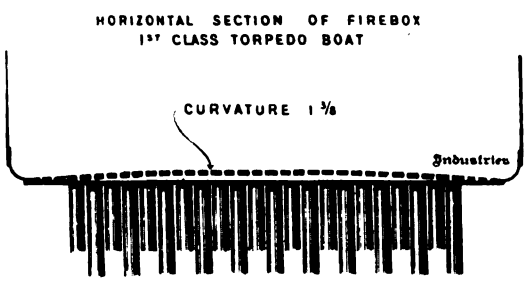


FIG. 13.

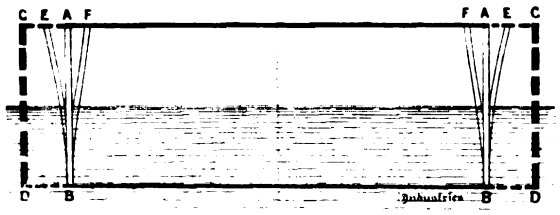


FIG. 14.

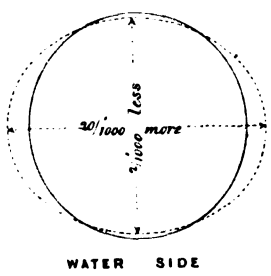


FIG. 15.

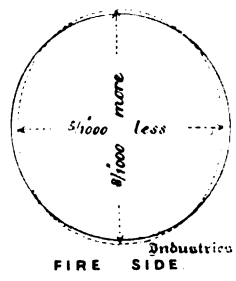


FIG. 16.

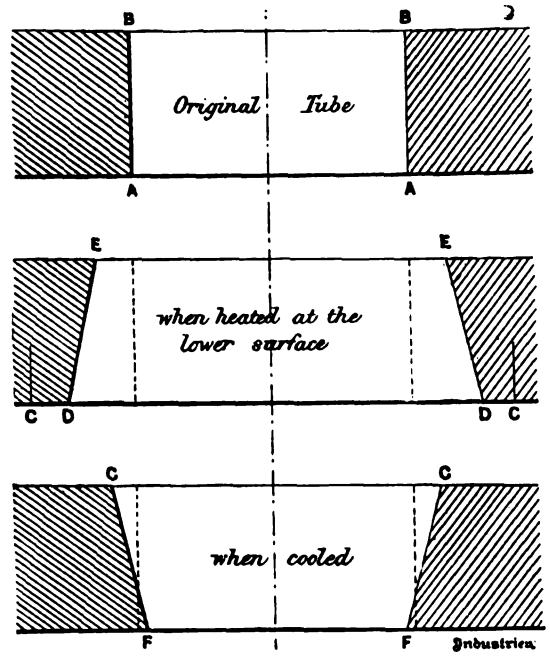


FIG. 17.

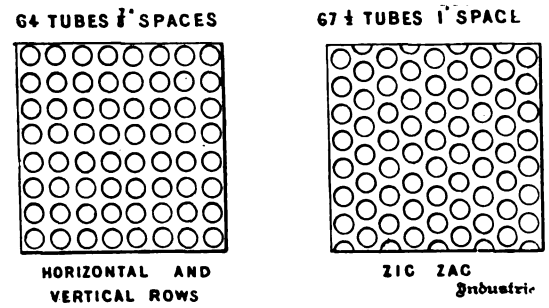


FIG. 18.

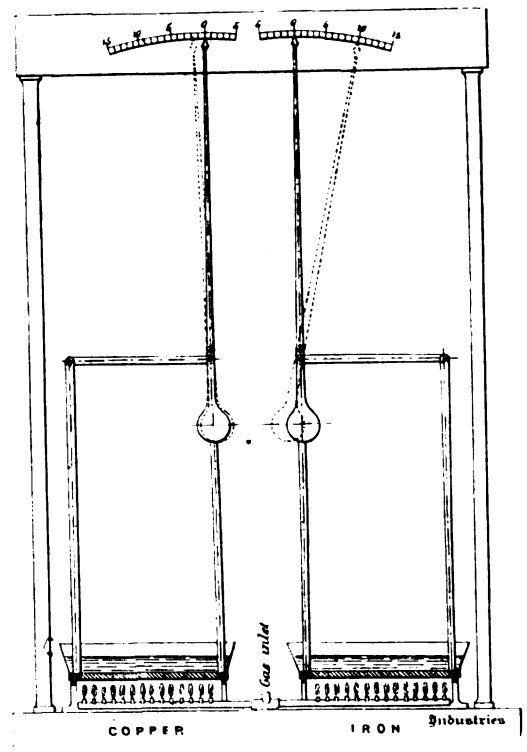


FIG. 19.

THICK TUBE AND THIN TUBE PLATE.—We have here a thicker tube and thinner plate, the tube being $\frac{1}{8}$in. thick, and the tube plate $\frac{1}{16}$in thick (Fig. 12A). The same process was carried out as in the former case, and, although heated and cooled forty times, no sign of leakage took place. Now, in the first example we had a tube and a tube plate differing greatly in thickness from each other, and therefore they were not heated up uniformly. This caused the crushing of the tube, its permanent alteration of form, and consequent leakage. In the second experiment we had a tube and plate more nearly approaching each other in thickness, and consequently heated up more uniformly, with an absence of leakage. From these experiments it is reasonable to infer that within certain limits the more nearly the tube and tube plate approach in thickness to one another the more nearly will they contract and expand in harmony, and the less chance there is of leakage. As the tubes cannot be thickened up much and retain the necessary elasticity, it follows that to conform to these conditions the tube plate should be as thin as other practical considerations admit. Some few locomotive superintendents have used steel tubes in copper tube plates with success, and in our small experience of this combination we have had good results. At the same time, a very large majority of locomotive engineers prefer copper or brass tubes, or steel tubes with copper ends. The latter plan secures the advantage of copper in keeping the tubes tight in the plate, and also the advantage of steel in having the same rate of expansion as the boiler shell. With steel tube plates steel tubes are nearly always used, and I know of no reason leading me to believe that tubes of any other metal would be better under these conditions.

On passing from this portion of the subject, let us bear in mind that troubles due to the causes which we have up to now investigated may all be diminished by having thin tube plates. This observation refers mainly to steel or iron tube plates, as will be seen later on.

TENDENCY OF TUBE PLATES TO CURVE.—We will now proceed to consider perhaps the most interesting cause of leaky tubes. It is one which seems to have been completely overlooked by the marine engineer, though there is good reason to believe it is perhaps one of the chief sources of trouble. With a view to its investigation we have here a steel tube plate 18in. long, 18in. wide, and $\frac{1}{4}$in. thick. In it there are thirty-six tubes. Secured round the outside of this tube plate are very thin sheet steel sides, forming an open tank. This was filled with water and placed over the fire of a smith's forge, with the following result:—The bottom of the plate next the fire, always being hotter and therefore expanding more than the upper side, which was kept cool by the water, caused the plate to take a curved form. It was impossible to accurately determine the intensity of the fire, but those of us who were present feel sure that the heat was certainly not greater, but considerably less, than in the furnace of a marine boiler worked under forced draught. As stated, the plate curved, the extent of which was indicated by the inclination of the uprights as marked on the cross bars. The right hand edge of the upright B moved from C D to C E (see Fig. 9A). Fig. 13 gives a horizontal section through a boiler of a first-class torpedo boat. The dotted line shows the tube plate set out with a curvature corresponding to that indicated by this experiment, being the shape it would take if free to move. It will be noticed that we are not dealing with small alterations of form, the amount of the curvature being no less than 1$\frac{3}{8}$in. Now in a boiler this plate is not free to move, and is forced to remain flat, or nearly so. Let us investigate what happens.

REDUCING THE SIZE OF A WHEEL TYRE.—Everyone here probably knows how a wheelwright reduces the diameter of a tyre which has become loose and too large to shrink on the wheel for which it is intended. So as to refresh your memory and make this operation perfectly clear, I would draw your attention to Fig. 14, which, to better indicate what takes place, is greatly exaggerated. The black lines A B represent the tyre when cold, in its original state. The tyre is made red hot and increases in diameter, as represented by the dotted line C D. It is then immersed half its width in water. This cools the lower half, which, in consequence, contracts, but cannot do so without pulling with it the upper half, which is still red hot, the two portions making a compromise, and assuming a shape something like E B. Now the upper part, which has been reduced in diameter by force, on cooling is further reduced in diameter by reduction of temperature, and then assumes the form F B, as shown. This upper half consequently becomes permanently smaller in diameter than it was originally. The tyre is now passed through the same process reversed, the upper part in the first operation being the lower part in the second. This is repeated as often as necessary, so as to reduce the diameter to that which is wanted. This example is introduced only to illustrate how permanent alterations of form may take place when plates are subject to differences of temperature on opposite sides. It may perhaps enable us to grasp what is going on in the case of the tube plate, although clearly the conditions are dissimilar. Some interesting experiments bearing on this subject are described in a paper read before the Iron and Steel Institute in 1879 by Mr. Thomas Wrightson.

MOLECULAR STRAINS ON TUBE PLATES THROUGH THE TWO SIDES BEING SUBJECT TO DIFFERENT TEMPERATURES.—The surface of the plate nearest the fire tends to expand; the surface furthest from the fire wants to remain as it is, being kept cool by the water. The result is that these two portions of the plate, being unable to separate, are obliged to enter into a compromise, the effect of which is that the surface next the fire expands to the full extent, due to the difference of temperature, except in so far as it may be prevented through its connection with the cooler surface which it permanently stretches. Now, when the boiler is cooled down, what happens? The surface next the fire wants to contract, but that in contact with the water, not altering its temperature, does not want to contract. The two surfaces therefore enter into a fresh compromise, the result of all these compromises being, if the plate is thick and the variations of temperature are great, that a permanent distortion of the plate takes place, through this differential expansion and contraction. The holes are drawn out oval—some in one direction and some in another. Let us look at this subject from another point of view. I think we will all agree that it would be undesirable to take a plate, say $\frac{1}{4}$in. thick, and bend it from the curved form shown in dotted lines in Fig. 13, then flatten it, then curve it again, and then flatten it again, frequently repeating this operation. We should certainly expect to find the plate permanently damaged. Now, if we keep the plate flat when it wants to bend, as is the case with a tube plate, we are doing very much the same thing, although not quite so apparent. When we consider that every time the fire door is opened and closed, the plate wants to change its form and cannot do so, and when we bear in mind that the fire door in a large forced draught boiler is frequently opened and shut, say once in every minute, which in twenty-four hours corresponds to 1,440 times, it is easy to understand that the varying expansions and contractions set up severe molecular strains, and that the tube plate is undergoing very harsh treatment.

DISTORTION OF HOLE IN PLATE REPEATEDLY HEATED ON BOTTOM SIDE.—I will now describe an experiment which confirms this. We have here a plate which was kept flat, only being

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allowed to move longitudinally. It was heated and cooled on the lower side, water being on the upper. It thus approached the condition under which the plate would be in an ordinary boiler. The plate was 1¼in. thick, and it had a hole very accurately bored in it 3⅛in. in diameter. It was placed over a forge arranged in such a way that a blast of hot and cold air alternately could be made to strike the plate on its bottom surface as often as required. After fifty times heating and cooling, the hole became distorted, as shown in Figs. 15 and 16, the hole at the upper surface, or water-side of the plate, being longitudinally extended $\frac{22}{1000}$in., and contracted transversely $\frac{2}{1000}$in., the hole at the bottom surface of the plate next the fire was much less altered, as shown. The black lines on the diagram indicate the original hole, and the dotted lines the distorted hole. So that the change may be clearly seen the alteration is considerably exaggerated. Fig. 17 illustrates in another way this change of form. To withstand repeated straightening and bending without damage, we shall all agree that the thinner and more flexible a plate is the better, as the reduced stretching, due to alteration of form, is then not so likely to exceed the elastic limit of the material and produce permanent distortion. It is sound argument to conclude that a thin and flexible plate has, for the same reason, an advantage over a thicker one when heated on one side and not allowed to take up the altered form which it desires.

Glass Plates Experiment.—I will illustrate in a simple manner the effect of thickness on a body, the two sides of which are subject to difference of temperature. We have here two glass plates, heated by gas on one side and kept cool on the other by water, as in a boiler.

To sum up the results, I would submit that, not only on account of the strain on the tube plate itself, which we have just investigated, but in order that the expansion and contraction of the tubes and the plate should take place as much in harmony with one another as possible, which we previously considered, it has, I think, been proved beyond all question how very essential it is to have a thin tube plate; and I think we may conclude that, so long as marine engineers adopt steel as the metal, and thick plates, they must expect trouble from leaky tubes. Probably for the same reason all flat surfaces exposed to the intense combustion of a forced draught furnace should be thin, if of steel.

Practical Conclusion.—To come to a practical determination as to what the foregoing leads, I would venture to say that any greater thickness in a steel or iron tube plate than ½in. will probably lead to trouble; ⅝in., or more, will certainly give trouble, and be always unreliable when worked in combination with forced draught. I would go a step further, and say that whoever is bold enough to adopt a ⅜in. tube plate will, I believe, not regret it. There is no good practical reason of which I am aware why a tube plate should not be made in accordance with this. As regards the width of the joint between the tube and the plate, we, as engineers, know perfectly well that, in making a steam joint, a narrow surface and a good one—say, ⅜in. wide—is all that is necessary. As far as strength is concerned, I believe it is correct to state that no part of a boiler is so well supported and so strong, stayed as it is by all the tubes, as the tube plate itself. Mr. Webb has drawn my attention to a change in the nature of the steel in fire-boxes subject to the influence of intense combustion. It appears the steel gradually absorbs carbon, and therefore alters its character, becoming more brittle. In the same way that a smith, in welding two bars of iron together, often tells us that the weld is the strongest point. If the weld is sound he is correct, because that part of the bar which comes in contact with the fuel absorbs carbon, and consequently at the joint the iron has been converted into a species of steel. The effect on the tube plate and sides by the continual absorption of carbon makes them brittle after long usage, and causes them to crack. This is well known to everybody who has had experience with steel in combination with forced draught.

Plastering Tube Plates.—We have heard of late much about plastering tube plates over with a non-conducting cement. This is an old and long since abandoned plan; none of us, I am sure, will consider it a practical solution of the problem. It is simply a temporary device, and must be looked upon as worse than useless; because it gives a power of fictitious value, and when some of the cement falls off, leaving part of the tube plate bare, the heat is concentrated upon that portion, and possibly worse strains are set up than if the entire plate were exposed. Boilers may doubtless be got through their trials by such means, or by exceptional skill and careful nursing by experienced stokers; but these must be considered as quite abnormal conditions. A boiler to be thoroughly satisfactory should undoubtedly be capable of management by men of moderate experience, and such, as in case of emergency, would be available. It is obvious that a power which cannot be obtained on service without causing boilers to leak is a mere delusion.

Setting Out of Tube Plates.—With regard to the setting out of the tubes, Fig. 18 shows two systems: in one they are zigzag, and in the other in horizontal and vertical rows. The areas of the two plates are the same, and the number of tubes is nearly so. It will be seen that with the zigzag setting out we get 1in. spaces, while with the other we get only ⅞in. spaces. From a leaky tube point of view, I believe the former to be preferable. It will be seen in that case the plate is wounded in three directions—that is, there are three directions of least sectional area of metal—while in the other case there are only two directions of least section, but the wounding of the plate at those two is greater than the wounding in the previous three. Bearing in mind the tendency of the plate to bend through being heated on one side, and that it is forced to remain flat, it follows that it is desirable to maintain as large a section of metal as possible, provided that section is not obtained by thickness. A corresponding example would be to take two bars of iron; into one make two nicks 1in. deep, and into the other three nicks ⅞in. deep. All will agree that the bar with three small nicks would be better able to withstand a transverse strain, and for this reason the zigzag setting out probably is the better. This is confirmed by the locomotive practice in this country and America.

Comparison of Copper and Steel for Tube Plates.—As to the material for tube plates, we have already seen that there is a tendency to produce curvature, owing to the difference of temperature between the two sides of the plate. In selecting a material we must, therefore, keep in view the desirability of adopting a metal which has as little such tendency to curve as possible, and, therefore, will not be much strained when kept flat against its will. To test the relative tendencies of copper and steel to curve when heated on one side only, we have here two plates precisely the same in every respect, excepting that one is of copper and the other of steel. They are 24in. long, 2in. wide, and 1in. thick. There are two uprights (see Fig. 19) and cross-bars arranged to each plate in such a way that as the plates bend the amount of curvature will be indicated by the pointers. Now, we have a row of gas-burners below these plates, and will subject them to the same treatment. On the top of the plates we have made tanks of light, flexible sheet brass, which contain water. We will light up, and on watching the pointers it will be seen to what a much greater extent the one plate curves than the other. We will now blow the flame away. This corresponds to opening the fire door, allowing cold air to rush in. Now let us put in a little cold feed. It is instructive to watch the much greater sensitiveness of the steel plate as compared to the copper one, and when we bear in mind the intensity of the combustion in a forced draught boiler, and the enormous fluctuations of temperature, as compared with what we have in this experiment, we cannot help being forced to the conclusion that copper is greatly superior to steel. In confirmation of this we have the entire locomotive practice of the country. Fig. 20 represents the respective curvatures of the two metals during such an experiment. We need not look far for the reason why a steel plate is so much more sensitive than one of copper. In Table III. will be seen their relative conductive

BOILER CONSTRUCTION.

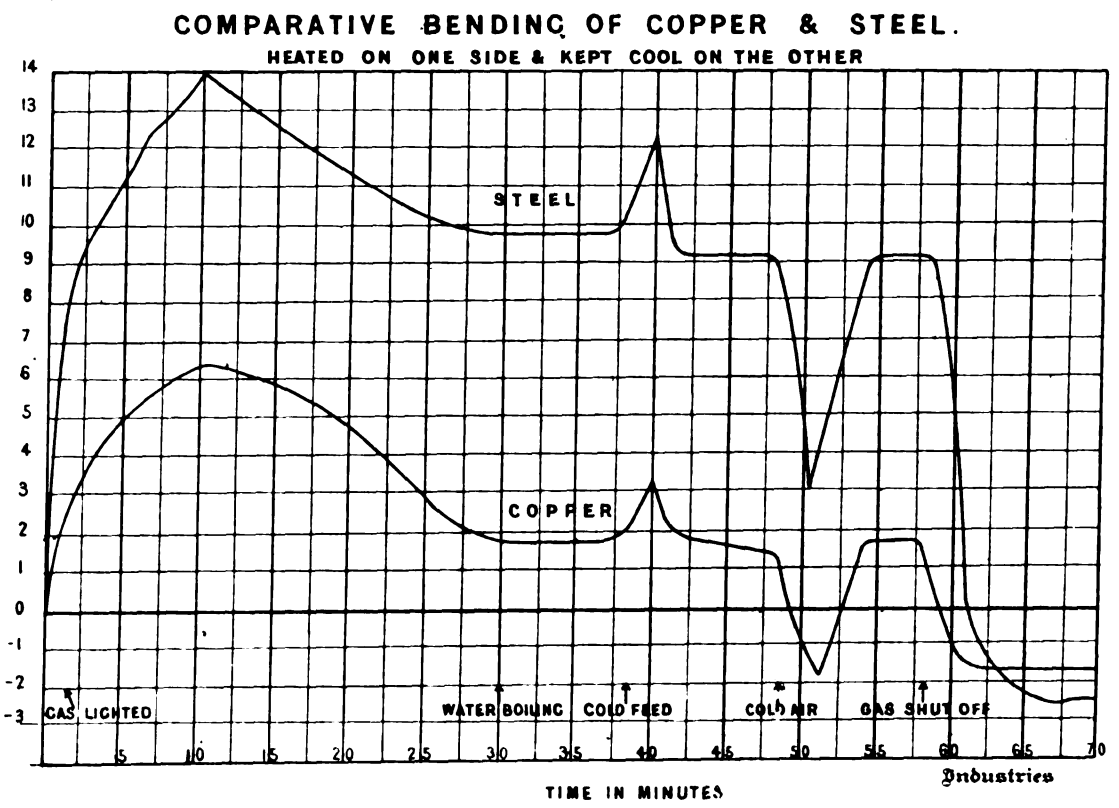


Fig. 20.

TABLE III.

Approximate Comparative Rates of Expansion.

Copper	3
Iron	2

Approximate Comparative Conducting Power.

Copper	6
Iron	1

powers, and the rates of expansion due to increase of temperature. Copper expands most with an increase of temperature, and is therefore inferior to steel in the proportion of 2:3; but as regards conductive power the copper is superior in the proportion of 6:1. Consequently the figures of merit may be considered to stand approximately as 12 in favour of copper and 3 in favour of steel. To put it more plainly, the copper, owing to its better conductive power, never gets heated to anything approaching the same extent as the steel, because the heat is conducted away from the surface exposed to the fire more rapidly. For these reasons we decidedly prefer copper, and have used it in all the torpedo boats we have built for foreign Powers and in a few constructed for the British Government, and we have had no reason to regret the selection of that material. It also shows why a tube plate of copper may be much thicker than if made of steel. Summing up the comparative merits of copper and steel for fire-boxes, every locomotive superintendent in this country, without exception, has far more confidence in copper. I have taken great pains to ascertain the results of actual working of the steel boxes adopted in the United States, and I am fully convinced they have more trouble from leaky tubes on the other side the Atlantic, with their steel boxes, than we have on this side with ours of copper. Our own experience in torpedo boats is unquestionably in favour of copper, in addition to which I believe we have had the reason for its superiority clearly pointed out this evening. The only point I know of against copper fire-boxes is their cost, which in the case of marine work may be estimated at from 2 to 4 per cent. of the total value of the completed vessel. It is not within my province to offer any opinion, but I submit that it is well worthy of the consideration of those whom it concerns, to determine whether this small additional cost may not be advantageously incurred, in order to obtain more reliable machinery which can withstand the extra forcing necessary when exceptionally high speeds are desired.

Galvanic Action.—The question has been sometimes raised whether any galvanic action takes place in consequence of the contact of the two metals. Experience has proved that if there exist any such action it is to a very unimportant extent, and nothing like sufficient to counterbalance the advantages of copper. In proof of this, there is the fact that many foreign Governments for whom we have built torpedo boats with copper fire-boxes many years ago, now insist upon the adoption of the same material at the present time.

Elasticity the Element of Success.—Every design is more or less a compromise, but the investigation which we have made this evening points to the importance of leaving nothing undone to ensure a design conforming to the requirements of changes of form due to changes of temperature. It also points to the importance of adopting only the highest classes of material, so as to ensure ample elasticity to help in conforming to these changes, some of which are considerable. In fact, success without elasticity is impossible. To secure this, however, people must be prepared to pay the price which such care entails; and herein lies one great difficulty, for in the present day many firms and some Governments, in their struggle for cheapness, have in reality to pay for this false economy by failure.

Conclusion.—I must now bring my remarks to a close, and only regret that time prevents my dealing with many other points which deserve attention affecting leaky tubes. I hope the few observations which I have had the honour of making may, together with the discussion to follow, point to a means of dispersing the cloud, which we must all admit hangs over our reputation as marine engineers so long as we are unable to design a boiler capable of conforming to natural laws. I trust the way may be seen to ensure to war vessels the speeds for which they were originally designed, and that naval officers may look upon forced draught, not in the light they naturally do now—as an unreliable and dangerous device—but that they may consider it as one of the greatest improvements of modern times.

In conclusion, I will take this opportunity of expressing my thanks to several members of our profession who now, and in the past, have given me valuable information bearing on the subject: among whom I might mention Mr. Adams, of the South-Western Railway; Mr. Aspinall, of the Lancashire and Yorkshire Railway; Mr. Holden, of the Great Eastern Railway; Mr. Park, of the North London Railway; Mr. Webb, of the London and North-Western Railway; and the manager of the Baldwin Locomotive Works of Philadelphia; also I wish to thank those members of my staff who have helped me in this investigation, and you, gentlemen, for having spared me so much of your time.

We have received a copy of the first number of a new journal entitled *The Optician*. The object of *The Optician* is to represent in a journalistic sense the optician and jeweller, and it will deal with the optical, mathematical, philosophical, electrical, and photographical instrument industries, as well as with the jewellery and allied trades. The first number contains articles on the Optical Exhibition, the Photographic Lens, the Meteorological Exhibition, &c., and is very neatly printed.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 7th April, 1891.

Iron.—The state of the iron market generally throughout France shows signs of a steady improvement. On the Paris market there was no change in the prices of last week, but there is a decided tendency to a further advance in quotations. In the North, as elsewhere, prices are firm. In one or two works in this district the puddlers' strike continues, but the disaffection is local, and confined to the above-named class of workmen. A contract for an iron bridge for the Nile near Mansourah has been secured by Messrs. Daydé et Pillé, Oise, who have already on hand another large bridge for the Nile near Cairo.

Copper, Tin, Lead, and Zinc.—The copper market is very firm, and there is a general rise in the prices of all classes of this metal. Best Chilian bars are quoted at £57 5s., ordinary Chilian bars at £55 5s., and best selected ore at £60 5s. per ton. There is a tendency to a further rise in quotations, as the cessation of work in the Anaconda Mines will probably cause the mineral to become scarcer. The price of tin has improved 10s. a ton on the Paris market, where the quotations during the past week were:—Banca, £99 8s.; Billiton, £96 8s.; Detroits, £95 5s.; and Cornwall, £100 5s. A large contract has been entered into for 25 tons of this ore for the Pyrotechnic School at an average price of £91 16s. per ton. The lead market is slightly firmer, and the price is quoted at £13s. 7s. the ton. Zinc is quoted at about £24 5s. the ton. The market for this metal is just now very weak throughout France.

International Congress of Miners' Representatives.—The meetings now being held at the Paris "Bourse de Travail" by the representatives of the various European coal mining centres, with the view of determining, amongst other matters, whether a general strike shall be commenced on the 1st of May next, are creating much interest here. England has 41 delegates, representing 448,636 miners; France has 23 delegates, representing 127,000 miners; Germany has 19 delegates, representing 141,531 miners; Belgium has 15 delegates, representing 92,000 miners; Austria has 1 delegate, representing 100,000 miners. The English delegates are generally adverse to a strike, as they consider the organisation in most of the Continental mining districts is far from satisfactory, and the question of throwing 8,000,000 of men out of work should not be considered lightly. The Belgian delegates are in favour of an immediate suspension of work. The French are inclined to agree with the English view of the subject, which is also favoured by the Germans, while the Austrian delegate declared that although unorganised his countrymen were ready to strike when called on.

Electric Lighting of the Orleans Railway Station.—It has been decided to light the Orleans Railway Station electrically. The system of lighting decided upon by the railway authorities is that of Messrs. Ganz & Co., and the installation will be carried out by Messrs. Schneider & Co., of Creusot.

BERLIN, 6th April, 1891.

The Zone Tariff System.—The association which advocates the introduction of the zone tariff system in Germany proposes that there shall be three zones—the first with a radius of 100 kilometres, the second with a radius of 200 kilometres, and the third zone to include distances beyond 200 kilometres. There is also a demand for an acceleration in the speed of the train service, which is at present very slow. Before the zone tariff can be introduced in Germany, considerable improvements must be made in the permanent way, and the rolling stock will have to be largely increased.

The Rhine-Weser-Elbe Canal.—This canal, which is to be 473 kilometres in length, will be cheaply constructed, and easily worked, as only twenty-five locks will be necessary. These conditions are favourable, as may be seen by comparing them with those of other canals. The Ludswigs Canal is 141 kilometres long, and has 100 locks; the Maine Canal is 33 kilometres long, and has 5 locks; the Bromberger Canal is 28 kilometres long, and has 10 locks; the Finow Canal is 45 kilometres long, and has 15 locks.

International Hygienic Exhibition at Leipzig.—An International Hygienic Exhibition will be held in the months of January and February, 1892, in Leipzig. The Exhibition will comprise, amongst others, sections devoted to hygiene, food stuffs, and ambulance.

Official Testing Establishment.—For this establishment, which is situated in the grounds of the Royal Technical College, Charlottenburg, Messrs. C. Koppe, in Berlin, are building an additional testing machine, at a cost of £2,900, which is to test up to 500 tons. Besides the mechanical testing department, there is a department for testing paper and a department for testing oil. This establishment is presided over by a competent engineer, who has a staff of about thirty assistants, and experiments are carried out for Government or private works without any profit being made.

Berlin Industries and the Chicago Exhibition.—At a meeting of influential representatives of the industries of Berlin, held on the 2nd inst., it was resolved that in the interest of trade and for political reasons it was most important that Germany should be well represented at the Chicago Exhibition. It was arranged to petition the Government to grant the necessary funds and appoint a commissioner to act in conjunction with a committee of German manufacturers in making the preliminary arrangements.

VIENNA, 6th April, 1891.

The Iron Market.—The iron market is becoming more steady, as may be seen in the continually increasing sales. The demand has considerably increased, and large stocks have been taken off the market. Merchants have been compelled to resort to bigger transactions in order to complete their stocks. Besides the demand for iron used for constructive purposes, agricultural implements and thin plates are in request.

The Coal Market.—The fluctuations in the price of coal are detailed in the following table, which gives the prices paid by the sugar industries during the past two seasons. The prices are given in kreuzers per 100 kgr.:—

District.	1889-1890.	1890-1891.	Difference per Cent.
Bustichrad-Kladno...	39·3	58·4	48
Brux	17	25·5	50
Dux Ladowitz	9·5	18	90
Bilin	18·5	25	35
Mariaschein	14·8	26·2	77
Schwaz	9·5	18·5	94
Ostrau	35	48	37
Dombrau	37·8	47·8	26

The table shows a general increase in the price of coal. In Bohemia there is an average increase of 66 per cent., but in the Moravian district there is a much smaller rise in prices. The market last week was more active than it was during the previous week, when difficulties in the loading of ships threatened to become serious.

The Harvest of Last Year.—The Ministry of Agriculture has collected statistics with reference to last year's harvest, which show the following results. The figures give the number of thousands of hectolitres, and the totals in parentheses the results of the harvest of the previous year:—

	Wheat.	Rye.	Barley.	Oats.	Maize.	Wine.
Lower Austria...	1,625	3,964	1,220	4,667	272	1,017
Upper Austria...	900	2,000	961	2,318	—	—
Salzburg	88	145	12	268	—	—
Styria	915	1,171	262	1,660	888	477
Carinthia.....	239	598	194	682	205	0·7
Carniola	305	252	248	461	378	164
Tyrol	262	409	157	152	455	250
Maritime State	305	56	152	7·4	518	545
Dalmatia.....	367	57	308	38	701	937
Bohemia	4,048	8,821	7,196	10,598	—	6·2
Moravia	1,488	3,457	2,794	4,006	138	216
Silesia	170	605	416	1,155	—	—
Galicia.....	4,482	6,395	4,478	9,989	1,700	—
Bukowina	335	458	766	665	1,464	—

The production of wheat, 15,529 (13,524); rye, 28,388 (24,945); barley, 19,137 (16,137); oats, 36,733 (28,527); maize, 6,719; (5,806), wine, 3,613 (4,106).

BRUSSELS, 7th April, 1891.

The Iron Market.—The iron market appears to be a litttle brisker, and some important orders are expected. Iron sheets are in demand, but there is a diminution in the sale of joists. Much is expected from the decrease in the price of coal, but whether this decrease will produce the results anticipated is somewhat doubtful.—The contract for the supply of turntables for the Belgian Government has been given to the Houdeng manufactory. The Conduit Supply Company has obtained an important order from the Caracus Waters Company for 40,000 metres of pipes to be delivered this year, and a large quantity of taps.—The report of the Association of Iron Masters shows that during last year the state of trade was very unfavourable, whereas in the previous year the results were most favourable. The production of foundry pig iron has much increased, but that of forge pig iron and of pig iron for steel has diminished. On the whole there was a diminution of 50,000 tons in the Belgian production last year. Out of a total of 48 blast furnaces, 34 were in blast at the beginning of the year—16 in the Charleroi district, 14 in the Liége district, and 4 in the Luxembourg district. At the end of the year there were 27 in blast—12 at Charleroi, 11 at Liége, and 4 at Luxembourg.

The Coal Market.—The placing of contracts, which is to take place to-day, is awaited with interest, and the terms of the tenders submitted are not yet known. There has been no serious fall in prices, although the market is less strong than it was a few months ago. A few sales, chiefly of steam coal and of domestic sorts, have been made at slightly lower prices. Sales of the best manufacturing sorts have been made at 12fr., and 14fr. has been asked in the open market. Coke, after remaining for a long time at 18fr., has been reduced to 17·50fr., and has even been quoted at 17fr. for large sales.

Electric Lighting at Brussels.—Tenders under new conditions for the electric lighting of Brussels are to be invited from those firms which competed under the previous conditions. The installation is to be capable of lighting 20,000 lamps, and will be erected in the centre of the city, where some ground has been made vacant by the demolition of houses. The installation is to be made with a view to future enlargement, if an increase of business should render this necessary. The conditions of tender previously issued were found to be too general, and the new conditions, which have been carefully considered by Mr. Wybauer, are more explicit and detailed. The scale of charges to be paid by the public has not yet been definitely fixed. The question is a difficult one in view of the recent diminution in the price of gas and its extended use.—Messrs. Tudor, an important firm engaged in the manufacture of accumulators, have established a branch of their business at Lille, in order to extend the use of their accumulators in France, and the shareholders of the company have taken up the new shares which have been issued for the purpose. The Tudor accumulator is likely to make rapid progress, which will be increased by certain combinations now in prospect. The Tudor system is one which yields a very fair profit on its manufacture, and the question of maintenance is solved in a satisfactory manner. Conferences have recently been held between French and Belgian electricians in order to extend the sale of accumulators in Belgium and France. As soon as certain tests now in progress have been completed the business will be started on a large scale. This new combination amongst manufacturers will cause an increase of competition, and may lead to certain claims being made by reason of an arrangement between the Faure-Sellon-Volkmar Company and a large Belgian company. Large orders of accumulators are in prospect, and this fact serves to make the competition more keen.

DÜSSELDORF, 7th April, 1891.

Iron and Steel.—The condition of the market is unchanged since the last report. Foundry pig iron, No. 1, is at 71 marks; No. 3, at 60 marks; best forge pig at 53 marks; and Thomas pig iron at 48 marks, Bessemer at 61 marks. Makers of finished iron complain of the absence of orders, and are slow to purchase raw materials.

The Coal Market.—The demand for coal and coke continues very brisk, and prices are well maintained. Tenders for the supply of 200,000 tons of coal for locomotives for the Left Bank Rhenish State Railway are under consideration at Cologne. Six of the Westphalian collieries tendered at 11 marks per ton. The "Société Anonyme de Charbonnage du Hazard" (a Belgian colliery) offered to supply the whole quantity at 10·60 marks at the pit. The award will probably be in favour of the German collieries. On the 9th inst. the State Railway at Magdeburg will award a contract for 300,000 tons of coal. The result of this award is awaited with interest, as many consumers have held back in the hope of getting cheaper rates.

Ironmasters' Meeting.—The "Vereindeutscher Eiser und Stahlindustrieller" will hold its annual meeting on the 11th inst. in Berlin. The list of agenda includes the report for the past year and a discussion of the Austro-Hungarian trade contract.

The Late Mr. F. C. Euler.—On the 27th ult. Mr. F. C. Euler died at Kaiserslautern, where he was the manager of the Kaiserslautern Ironworks. He was well known as an able engineer. In early life he founded the "Verein Hütte," from which institution sprang the "Vereindeutscher Ingenieure." This association has now more than 6,000 members, distributed over the whole of Germany and foreign countries.

AMSTERDAM, 6th April, 1891.

Dutch Chamber of Commerce in London.—The establishment of a Dutch Chamber of Commerce in London, which was first suggested by Mr. Maas, the Dutch Consul in the Metropolis, has created much enthusiasm in Holland. It seems strange that such an institution has not been in existence and flourishing for some time past, considering the many and important commercial and industrial interests that link the two nations together. However, the scheme is now fairly on its way to fulfilment. A large number of chambers of commerce and industrial and agricultural societies in Holland have joined the movement, and the new Chamber will start in London with 240 ordinary members and several life members. The Netherlands Minister at the Court of St. James's, Count von Bylandt, is the honorary president of the Chamber.

Railways.—A new and improved service of fast through trains was commenced by the State Railways Company on the 1st inst. between Paris and Amsterdam, *viâ* Brussels and Utrecht. Before that date there were only two daily express trains from Paris, one starting at 8.15 a.m., and the other at 11 p.m. This third and fast service leaves Paris at 12.40 p.m., arriving in Amsterdam at 11.35 the same evening, and thus performs the journey in less than eleven hours. Towards Germany the train service is also to be improved. The day service from Flushing to Basle will be conducted *viâ* Strassburg instead of *viâ* Cologne-Heidelberg.

Railways in the Dutch East Indies.—The Government is preparing a Bill for dealing with certain lines of railways in the Dutch East Indies, of which the necessity has been recognised, although neither the State nor private contractors are found willing to embark the necessary capital. For these railways—the principal one, of four lines, runs from Sheribon to Samarang, a distance of 244 kilometres—the Bill will recognise the necessity of granting a Government guarantee on the capital required for construction account during a certain number of years.

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NEW TOBACCO COMPANY.—The Queen has approved the articles of association of the Dutch Tobacco Company "Holland," formed, with a capital of 400,000 guilders, with the object of manufacturing and trading in inland and foreign tobacco.

STOCKHOLM, 4TH APRIL, 1891.

BEET SUGAR WORKS.—The beet sugar manufacturers in Helsingborg and Landscrona have entered into an arrangement by which the area has been defined for the purchase of beets by the respective works. The growers of beets are, however, not so well pleased at this compact, as it may tend to abolish competition among buyers and to lower the prices. A large number of growers have agreed to apply to the Helsingborg Works for an advance in the price of 15 öre (2d.)

PERMANENT BUTTER EXHIBITIONS.—Two Scanian agricultural societies have voted a sum of 10,000kr. towards the holding, at Malmö, of permanent butter exhibitions for South Sweden similar to the permanent butter exhibitions in Copenhagen.

THE STONE INDUSTRY.—The stone industry in the Kelmar district appears to be annually extending, and the export, which is now considerable, comprises both common stones, for street paving, and stone for more finished work, such as monuments. Several stone-cutting works have been started, and what was formerly looked upon as valueless rock is now becoming an important source of income.

SIGNALLING THE STARTING OF MACHINERY.—At the large Husgrarna Works appliances have recently been fixed for the purpose of warning the men that the machinery is being started. From three different turbines wires are conducted to twelve different places in the works, where bells are rung as soon as the turbines are in motion. In case of accidents, the signal for stopping the turbine can be given immediately by merely pressing a knob.

"THE SHEFFIELD OF SWEDEN."—The Swedes have become very skilful in the manufacture of cutlery. The town of Eskilstuna, lying not far from the western end of Mælar Lake, is now widely known as the "Sheffield of Sweden." Here are situated a dozen or more factories, which turn out the finest cutlery and tools. Eskilstuna razors, pen-knives, and scissors are well known and highly prized in almost every country.

CHRISTIANIA, 4TH APRIL, 1891.

TELEPHONE BETWEEN CHRISTIANIA AND STOCKHOLM.—Telephonic communication between Christiania and Stockholm is likely to be soon established. The telephone line will go from Christiania to the frontier at Magnor. For the Swedish portion of the line the Stockholm-Orebro-Carlstad line will be used, with requisite extension. This arrangement has the advantage of bringing Christiania into connection with several towns in Central Sweden. It is proposed to reserve the line during several hours each day for direct communication between the two capitals.

ELECTRIC LIGHTING AT HAMMERFEST.—The installation of electric lighting at Hammerfest, which has been carried out by the Thomson-Houston International Electric Company, consists of twelve arc lamps for the lighting of the streets. The lighting of private houses is effected by means of an alternating current machine with an output of 35 amperes at a pressure of 1,000 volts. During the winter months the current will be supplied uninterruptedly, both by day and night, and the cost of working will, therefore, be very economical.

COPENHAGEN, 4TH APRIL, 1891.

THE ALUMINIA PORCELAIN COMPANY, COPENHAGEN.—This company, with which the Royal Danish Porcelain Works were amalgamated some years ago, did a larger business last year in both branches than the year before, but the net profits have not increased in proportion, owing to the high price of fuel. The balance-sheet showed, however, an increase of 151,000kr., as compared with five years ago, and a dividend of 5 per cent. was paid.

TRAMWAY COMPANIES.—The Sölvgode Tramway Company, which is the youngest of the Copenhagen tramway companies, has not yet managed to make a profit, last year's balance-sheet showing a loss on the working of 14,143kr. On the whole the Copenhagen tramways are doing very well, but several of them have required some years to attain this result.

THE COPENHAGEN FREE HARBOUR.—The Free Harbour Bill has now become law, and has already been signed by the King. Great satisfaction exists at this important measure having at last been carried through.

THE COPENHAGEN HORSE-SHOE MANUFACTURING COMPANY.—This manufactory continues to extend its business. These horse-shoes are of the best manufacture, and the home demand steadily increases as the prejudice against their use gives way. There is a large export to Brazil, Argentina, and Australia, both of horse and mule shoes, and the proprietors are now reaping the reward of their perseverance.

THE DANISH CHICORY WORKS.—The net profits last year of the Danish Chicory Factories amounted to 24,343kr. There had been a keen competition in the beginning of the year, but the company had managed to hold its own. The production was 1,934,000lb. A dividend of 3¾ per cent. on last year was declared.

MADRID, 6TH APRIL, 1891.

PURCHASE OF COAL MINES.—It is reported that Mr. Doestch has visited the Andalusian coal district of Belmez and Espiel with a view to the purchase of a group of coal mines. The coal from these mines would find a market in the province of Huelva, which requires a supply of 200,000 tons per annum, and would be carried by the Zafra and Huelva Railway, which is in the hands of the largest shareholders of the Rio Tinto mines.

BILBAO MINES.—About 2,000 workmen have been dismissed from the Bilbao mines in consequence of a decrease in the demand for the local ores. Most of them will readily find employment on the various railways now under construction in Viscay and Asturias.

IMPORTS OF COAL AND COKE.—The imports of coal and coke continue to increase notwithstanding the efforts made by owners of coal mines in Asturias to increase the output. The scarcity of skilled miners is the chief difficulty, and one of the most practical managers has stated that he will not be able to increase the output of his mines above 10 per cent. in each year for this reason. It seems strange, under these circumstances, that engineers should not resort to improved mechanical appliances. Managers of mines in Asturias would certainly gain much benefit from such enterprise, and makers of electrical plant would do well to turn their attention to the Asturias district.

EMIGRATION FROM SPAIN.—Since the year 1873 1,492,654 persons have emigrated to other countries, though several provinces in Spain are still thinly populated. This may be due either to agricultural difficulties or to defects in administration. It is certain that every article of food is dearer in Spain than in any other country in Europe.

ELECTRICAL TRACTION FOR TRAMWAYS.—The English Company, which owns the most remunerative system of tramways in Madrid, is intending to make a trial of electrical traction on a level portion of their lines. The company would thus be able to abolish the use of mules, which are a great source of difficulty.

ROME, 6TH APRIL, 1891.

WAGES OF WORKMEN.—From official reports it appears that the daily wages of workmen in 1889 compare with the wages paid in 1862 as follows:—

	1862. Lire.		1889. Lire.
Cantoni Cotton Works—spinners	1·10	...	1·94
" " " weavers	1·35	...	1·65
Rossi Wool Works—spinners	—	...	5·50
" " weavers	—	...	3·96
Sella Wool Works—spinners	2·86	...	4·35
" " carders	1·50	...	2·50
Italian Paper Manufactory—			
Rag works	0·99	...	2·28
Paper works	1·10	...	2·56
Candle Works of Messrs. Lanza Brothers—			
Men	2·16	...	3·25
Women	0·72	...	1·00
Sulphur Mines of Romagna	3·39	...	2·04
" " Sicily	2·33	...	2·35
Mines in Sardinia—native workmen	1·80	..	2·40
" " foreigners	2·25	...	3·80

The average wage of a workman in Italy is 2 lire per day. If, however, overtime is also taken into consideration, the amount is probably larger. Labour in Italy is evidently very cheap, but, notwithstanding this fact, production is more costly than in other countries owing to the fact that Italian workmen do a smaller amount of work, even though the working day is 12 hours.

SULPHUR EXPORT FROM SICILY.—During the year 1890 4,472,077 cantaras of sulphur were exported from Porto Empedocle, Catania, and Licata (Sicily) as follow:—From Porto Empedocle, 2,038,404 cantaras; from Catania, 1,320,701 cantaras; from Licata, 1,112,972 cantaras. Of these quantities, 78,763 cantaras were exported to the United States, 164,516 to Great Britain, 45,684 to France, 150,588 to Greece, 138,711 to Turkey, 1,114 to Sydney, 3,982 to the British colonies in Asia, and 327 to the French colonies in Africa.

LAUNCH.—On the 28th ult. a fine steel sailing vessel was launched from the shipbuilding yard of Pertusola. This is the fourth steel vessel built in that yard. Lord Brassey and his brothers were present at the launch.

EXHIBITION OF THE BUILDING INDUSTRIES AT PADUA.—This Exhibition, which was to have been held in the town of Padua in the months of May and June next, has been indefinitely postponed.

NEW YORK, 28TH MARCH, 1891.

EXTENSIONS OF WORKS.—The Illinois Steel Company announce that they are about to build an extensive plant at Bay View for the manufacture of cast-iron pipes of every description. The new plant will cost $500,000, and will give employment to 500 men. It will cover about three acres, and will be located about a quarter of a mile north of the rolling mills. The buildings are to be of stone, brick, and iron, and the material for pipe casting will be conveyed direct from the company's blast furnace. This will be by means of an elevated railway from the blast furnace to the new mills, the molten metal being conveyed in small iron cars. Between 400 and 500 tons of pipes will be turned out daily.—The Brown & Sharpe Manufacturing Company, of Providence, R.I., are adding a new four-story brick building, 100ft. long and 56ft. wide, to their already large works. The new building will be devoted to the manufacture of a variety of small tools and instruments for accurate measurements.

PROFIT SHARING.—The profit sharing system adopted by the Ingersoll-Sergeant Rock Drill Company has worked very successfully. During the past year the company declared an employés' dividend of about $6,000, dividing it as a bonus among the employés of the shops and offices. The sum was larger during the year 1890 than previously, due to the large increase in business.

TELEPHONE RATES IN NEW YORK.—The New York Legislature is considering a Bill which provides for a reduction of the price of telephone service in cities of over half a million inhabitants. It provides that telephone companies must furnish service to all persons within their districts applying for the same in cities of more than 500,000 inhabitants at the rate of $75 per year. A higher price may be charged where an exclusive wire is furnished. The supporters of the measure say that a $75 rate will yield a liberal dividend on the capital invested in the Metropolitan Telephone Company, and add that single subscribers in some parts of the city are refused instruments and service, even at existing rates, on account of the trouble and expense of connecting them. The company contends that it cannot furnish the service at a $75 rate, and that if the Bill is forced the improvements now in progress and contemplated must necessarily be discontinued. It is expected that the assembly committee will report favourably on the Bill.

MORE MINING INSPECTORS.—A Bill has been introduced in the West Virginia Legislature increasing the number of mine inspectors from two to four, and establishing rules and regulations for the more careful inspecting of mines. The Bill provides punishment for the operators and the men under them if they neglect to see that ventilation and other matters of importance to safety in mining are properly looked after. The Bill provides for one mine inspector for each congressional district, and as the congressional districts are now arranged each inspector will have as much as he can possibly do to properly attend to his duties and cover his district. This is made necessary by the rapid growth of the mining industry in all sections of the Mountain State.

PHILADELPHIA, 27TH MARCH, 1891.

NAVAL.—The gunboat "Bennington," which was built by the Delaware River Iron Ship Building and Engine Works, at Cluster, Pa., and which failed to develop the necessary speed on her recent trial trip, was docked at New York on the 19th inst., that her propeller might be examined and altered. The "Concord," which was built on the same lines by the same company at the same time as the "Bennington," on her trial trip recently exceeded the requirements imposed by the Government.

PUBLIC WORKS.—The fourth and last annual report of the Department of Public Works under the present administration shows an increase in receipts of $1,420, and a decrease in expenses of $44,470. In the water bureau the receipts have increased by $896,000, and the total profits in the past four years were $4,260,000. The total rainfall in 1890 was 34·68in., which is 16in. less than during the previous year. Notwithstanding this decrease, the water of the Schuylkill was ample for all purposes. The report suggests the necessity of authorising the Department of Public Works to prepare plans for a permanent water supply for the city of Philadelphia, other than by pumping from the Rivers Delaware and Schuylkill within city limits, the water in these rivers being frequently polluted by the discharge from factories and mills.

STANDARD STEEL WORKS' STRIKE.—The strike among the moulders of the Steel Casting Works at Thurlow still continues. The company sent for a number of moulders from New York and Brooklyn, but upon their arrival here they were persuaded by a committee from the Brotherhood not to work. The Standard is the most successful of about eight companies of its kind in this country. A great quantity of Government work and many orders for the general trade are in hand at this time. About fifteen out of eighty moulders have remained at work. A moulder requires at least two years' experience at the open-hearth process before he can do the work efficiently, however successful he may have been as a moulder at other processes.

THE COKE STRIKE.—Some of the workmen have decided to resume at the 10 per cent. reduction. At present the following works are running:—Raimy's, 1,018 ovens; Mt. Braddock, 130 ovens; Pennsylvania, 88 ovens; Percy, 62 ovens; in all 1,358 ovens, out of 16,119 ovens. The Dunbar Furnace Company's plant, and others, amounting to about 500 ovens, will resume shortly. The McClure and Frick Companies, which control the remainder of the ovens, have as yet made no move.

COAL PRODUCTION IN THE WEST.—The Census Office has issued a bulletin showing the production of coal in the States west of the Mississippi River. The production in 1889 was 16,067,500 tons, of which 10,051,229 tons were mined in the Trans-Mississippi Valley, 4,836,368 in the Rocky Mountain region, and 1,179,903 on the Pacific Coast. The production in 1880 was 4,854,324 tons. But while the product in 1889 was more than three times as great as that in 1880, the value is shown to have decreased from $1·93 per ton at the mines in the Mississippi Valley to $1·52. The kinds of coal found in the Western States and territories comprise lignite, bituminous, and anthracite, all suitable for steam and heating purposes, as well as for gas, coking, and smelting.

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THE ROYAL NAVAL EXHIBITION.

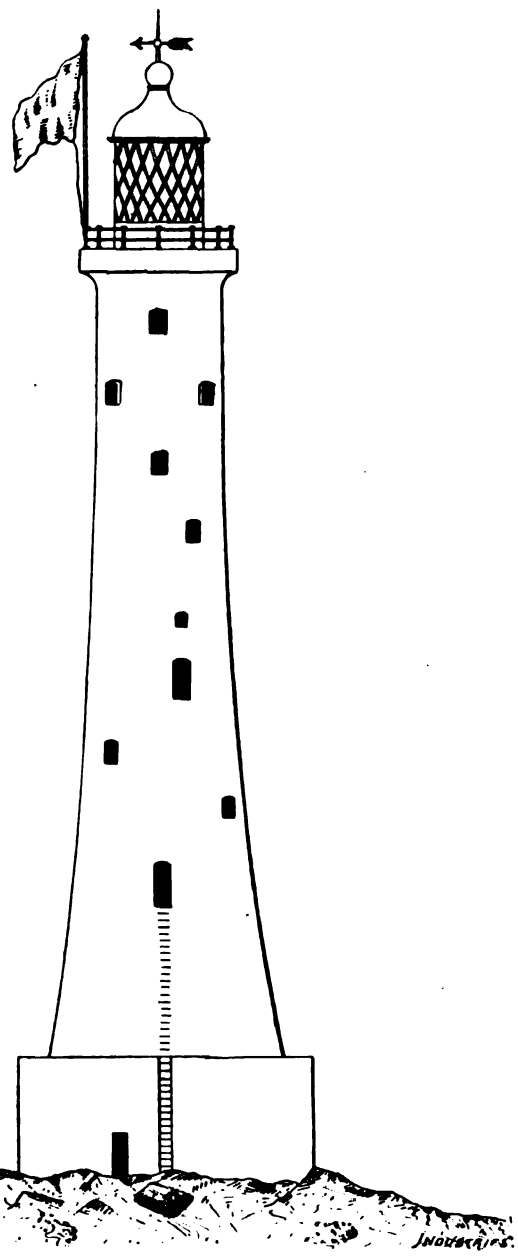


FIG. 1.—ELEVATION OF EDDYSTONE LIGHTHOUSE MODEL.

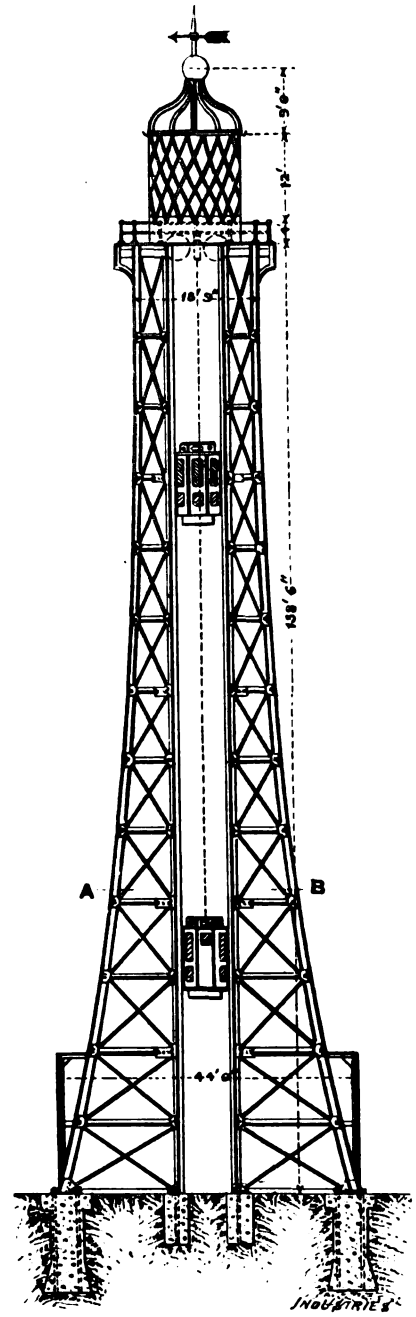


FIG. 2.—VERTICAL SECTION OF MODEL.

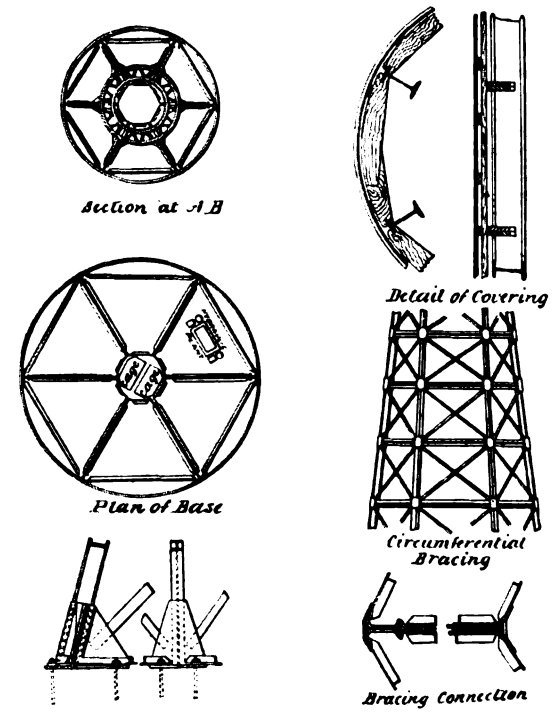


FIG. 3.—STRUCTURAL DETAILS OF MODEL.

THE ROYAL NAVAL EXHIBITION.

IN our issue of the 6th ult. we gave a general description of the work now being carried on at the site of the Naval Exhibition, and now propose to refer to one of the most interesting features of the Exhibition. This will be a full-size representation of the new Eddystone Lighthouse. Externally it will be a perfect representation of the original structure; the windows, doors, ladders, lantern, and even the courses and size of the stones are being accurately copied, and the rocks upon which the original structure is erected as they appear at low water will be faithfully represented in the Exhibition model. Internally, the structure consists of a steel and iron framework, covered first with wooden battens and laths, which in their turn receive the fibrous plaster slabs, the natural colour of which very nearly approaches that of the granite in the original structure. The framework consists of six braced main ribs radiating from the centre, and so constructed that when erected a clear hexagonal space, 9ft. wide, is left in the centre, in which are placed the two passenger lifts for taking visitors to the top. The ribs are constructed of steel and wrought-iron rolled beams, tee, angle, and flat bars firmly bolted together, each rib being divided into thirteen bays, the level of each bay corresponding with the floor lines in the original structure. The main ribs are secured by thirty-six strong iron bolts firmly attached to strong anchor plates embedded in cement concrete nearly 20ft. below the surface of the ground, the stability of the structure in the heaviest possible gale being thus ensured beyond doubt.

The height of the structure from the ground to the centre of the focal plane is about 150ft., and to the top of the lantern roof is about 170ft.; the base is 44ft. diameter and 19ft. high. From this base—which has vertical sides—springs the curved structure, having a diameter of 35ft. 6in. at the bottom, and of 19ft. at a point 6ft. below the lantern platform. From this point the structure swells out to a diameter of 24ft. at the platform, upon which is erected the lantern to receive the lighting apparatus. The lantern is 14ft. diameter, thus leaving a gallery 5ft. wide all round; it is 16ft. 6in. high, and is glazed with diamond-shaped panes as in the original, the whole being surmounted by the wind vane, which is a copy of the original, and is 8ft. long. There are nearly 100 tons of iron and steel in the structure, made up of over 1,000 pieces, all of which have been marked, drilled, cut, or bent to the required shape; so some idea can be formed of the immense amount of planning and labour entailed in the construction of what is only a temporary structure.

The passenger lifts referred to have been specially designed for the structure, the first consideration having been given to the safety and comfort of the visitors ascending. They consist of two cages, each capable of holding eight passengers, worked somewhat on the principle of those on the cliffs at Scarborough and at Folkestone. A tank is placed under each cage, with valves so arranged that it can be filled or emptied in a very short space of time. The cages act simultaneously, being connected by steel wire ropes over pulleys at the top, so that while one is discharging the passengers at the top the other is being filled at the bottom. To put the cages in motion, the tank of the top cage is filled with water, and that of the bottom one emptied, so that the top car descends by the action of gravity and pulls up the other one. The speed of the cages is regulated by an ingenious "cataract" cylinder, actuated by the man in charge, and automatically when the cages approach the top or bottom. This cataract cylinder ensures perfect safety, and is most simple in its action. An additional security, however, is obtained by means of a powerful friction brake on the top shaft; so there is not the slightest possibility of the cages running away. The steel ropes which sustain the cages are four in number, although one rope alone is sufficient to bear the whole load of the cages when full of passengers and after allowing a large factor of safety. Again, should the ropes break, powerful grips immediately clutch the vertical guides, and the cage would not fall more than an inch before it would be brought to a standstill. It will thus be seen that the cages may be considered absolutely safe. Powerful steam pumps are fixed in the basement to force the water into the tanks at the top, whence the water flows to actuate the cages. These pumps are in duplicate. The cages are made of polished walnut and other ornamental woods, well upholstered, and fitted with bevelled mirrors and ornamental lead lights in the roofs.

Referring to the illustrations, Fig. 1 shows an outline view of the model of the Eddystone lighthouse; Fig. 2 shows a vertical section; Fig. 3 some details of the structure, and Fig. 4, on page 348, gives a general view of the lighthouse as it appears during construction.

The structure, the framework of which is illustrated above, will be illuminated at night by a powerful revolving electric light constructed by Messrs. Chance & Co., of Birmingham. Visitors will be allowed to go either inside the lantern, where they will have an opportunity of inspecting the magnificent lighting apparatus, or on the balcony outside, from which a splendid panoramic view of the winding of the River Thames and of the country for miles around will be obtained. To prevent any accidents from the top, the balcony is protected by strong wire netting securely attached to the structure; this security also gives visitors confidence when looking out from such an elevation.

The whole structure was designed by Mr. John J. Webster, M.Inst.C.E., and has been erected under his superintendence by Mr. D. Charteris, builder and contractor, of Page Street, Westminster, the passenger lifts being constructed by Messrs. R. Waygood & Co., of Falmouth Road, London.

In connection with this Exhibition, we may mention that the Fire Brigade appliances are under the control of Messrs. Merryweather & Sons' fire inspectors, who are engaged to instruct a brigade to be formed from ordinary seamen.

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THE INSTITUTE OF MARINE ENGINEERS.

A MEETING of this Institute was held on the 24th ult., at which was read a paper by the President, Mr. G. W. Manuel, on "The Influence of Mountains on the Health, Wealth, Political Independence, Habits, and Pursuits of Mankind." Mr. Manuel in his paper drew attention to the works of the Great Engineer whose laws we should endeavour to learn and obey. The author spoke of the beneficial influence of mountains, and showed that, were it not for mountains, man could not exist in some parts of the earth. The effect of mountains on the rainfall and temperature was particularly noticed. As an instance, the city of Quito, in the torrid zone, had a mean temperature of 53°. The rise of the Nile, and the consequent fertility of Egypt, was due to the mountains in Central Africa. Were it not for mountains, much of the mineral treasures would be beyond our reach.

The Chairman said that Mr. Manuel had found out that they had more than one section of engineers in the Institute; there was the sea-going section, and the stay-at-home section. He thought that a paper like the one Mr. Manuel had read was an agreeable change from dry mechanical papers, and gave the members much pleasure. A hearty vote of thanks was given to the author and the members who had joined in the discussion.

The following meetings of the Institute are fixed for the second and fourth Tuesdays in April and May.

SHIPBUILDING NOTES.

ON the 24th ult. Messrs. Richardson, Duck, & Co. launched from their building yard the steel screw steamer "Velleda," of the following dimensions, viz.:—Length, over all, 307ft. 4in.; depth, extreme, 40ft.; and depth, moulded, 21ft. 8½in. This vessel, which has been built to the order of Messrs. Carlisle & Co., London, is classed 100 A1 at Lloyd's, and has been built under special survey. The engines are triple-expansion, by Messrs. T. Richardson & Sons, Hartlepool.

ON the 26th ult. Messrs. Ropner & Son launched the steel screw steamer "Aymestry" of the following dimensions, viz.:—Length, over all, 324ft.; breadth, 40ft. 6in.; depth, moulded, 23ft. 7in. She will be classed 100 A1 at Lloyd's, and carry 4,400 tons deadweight on Lloyd's summer freeboard. The vessel is provided with a cellular bottom for water ballast, and is built on the web frame principle. The engines are by Messrs. T. Richardson & Sons, on their improved triple-expansion principle, of 1,200 indicated horse-power, with two large steel boilers working at 160lb. The steamer has been built for Messrs. Sivewright, Bacon, & Co., West Hartlepool.

ON the 31st ult. the steel sailing ship "Bardowie" was launched by Messrs. Wm. Hamilton & Co., Port Glasgow. The length of the vessel is 267ft.; breadth, 41ft.; depth, 24ft. 6in. The register tonnage is 2,060. The carrying capacity is 3,500 tons. The ship has been built to the order of Messrs. Hamilton, Harvey, & Co., Port Glasgow.

ON the 31st ult. Messrs. Thomas Russell & Co., Greenock, launched a steel sailing ship of 1,700 tons, which they have built to the order of Mr. G. T. Soley, Liverpool.

ON the 7th inst. the "Chilian," a steel screw steamer, was launched by Messrs. Robert Napier & Sons, Govan. The vessel has been built to the order of the Campania Sud Americana de Reanores, Valparaiso, and is intended for the Pacific coasting trade. The two sets of engines are of the triple-expansion type.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, April 10th, at 9 p.m. Lecture on "Electric and Magnetic Screening," by Sir William Thomson, Pres. R.S. Saturday, April 11th, at 3 p.m. Lecture I., on "The Dynamo," by Professor S. P. Thompson.

INSTITUTION OF CIVIL ENGINEERS.—Friday, April 10th, at 7.30 p.m. Students' meeting. Papers to be read: "Modern Locomotive Construction," by Mr. W. W. F. Pullen; "The Design of Locomotive Cylinders," by Mr. J. H. Barker.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Friday, April 10th, at 7.40 p.m. Discussion on Mr. W. C. Mountain's paper on "Electrical Engineering with Special Reference to Electric Lighting." Paper II., on "The Unsinkability of Cargo-Carrying Vessels," by Mr. W. Hök.

SOUTH STAFFORDSHIRE INSTITUTE OF IRON AND STEEL WORKS' MANAGERS.—Saturday, April 11th, at 7 p.m. Papers to be read: "Electric Cranes," by Mr. W. D. Sandwell; "Varieties of Tap Cinder," by Mr. T. Turner.

MANCHESTER ASSOCIATION OF ENGINEERS.—Saturday, April 11th, at 7 p.m. Paper to be read: "The Manchester Ship Canal," by Mr. T. Ashbury.

NEXT WEEK.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 14th, at 8 p.m. Paper to be discussed: "The Cost of the Generation and Distribution of Electrical Energy," by Mr. R. E. B. Crompton, M.Inst.C.E.

ROYAL INSTITUTION.—Tuesday, April 14th, at 3 p.m. Lecture on "The Geography of Africa," by Mr. J. S. Keltie. Thursday, April 16th, at 3 p.m. Lecture on "Recent Spectroscopic Investigations," by Professor Dewar.

SOCIETY OF ARCHITECTS.—Tuesday, April 14th, at 7.30 p.m. Paper to be read: "Wood Carving," by Mr. W. Aumonier.

ROYAL VICTORIA HALL.—Tuesday, April 14th. Lecture on "The Extinct Volcanoes of France," by Dr. Crosskey.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, April 15th, at 7 p.m.

SOCIETY OF ARTS.—Wednesday, April 15th, at 8 p.m. Paper to be read: "The Sources of Petroleum and Natural Gas," by Mr. W. Topley, F.R.S.

PRICES CURRENT, 8TH APRIL, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	37/9	Cash.
Scotch Warrants, m/n	42/6	„
Hematite Warrants, m/n	47/1½	„

Stocks in Stores.			
Scotch	524,059—Dec. for week	4,470	Tons.
Middlesbro'	121,529—Dec. „	1,165	„
Hematite	177,943—Dec. „	6,076	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.	
Coltness	65/-	58/-	f.o.b. Glasgow.
Gartsherrie	60/-	56/-	„ „
Summerlee	60/6	56/-	„ „
Eglinton ex store	49/-	47/-	„ „
G.M.B. „	48/-	42/9	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	68/6	56/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£24	12	6	to	24	17	6
Copper:	British Cakes and Ingots	56	10	0	„	57	0	0
„	Chili Bars, G.O.B.'s	52	10	0	„	52	15	0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	52	10	0	„	52	15	0
„	Manufactured (strong)	65	0	0		.....		
Lead:	Common Pig	13	10	0	„	13	15	0
„	English Sheet	14	5	0	„	14	10	0
Tin:	Straits	90	17	6	„	91	7	6
„	Australian	90	17	6	„	91	7	6
„	English Ingots	94	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER remains inactive, with small business taking place. Chili bars have been unsteady during the week, having touched as low as £52 5s., but have again recovered, quotations to-day being £52 10s. to £52 15s. cash. The total visible supply of copper decreased about 670 tons during March. Manufactured steady at £65, "strong."

TIN: Firmer, an advance of about 10s. having taken place to-day in foreign.

LEAD: Quiet; values a shade lower.

SPELTER keeps firm, and stocks continue unusually small.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 8½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 15 0	—	.....
„ Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	23 10 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 7 6	—	.....
„ Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 0 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 5	—	.....
„ (50/90 %)	„	0 3 3	—	.....
Copper Sulphate	ton	16 10 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	26 0 0	—	.....
„ Brown	„	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 8¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 10 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
„ White	„	0 3 6	—	.....
Salts: Epsom {Bags	ton	3 0 0	—	.....
Salts: Epsom {Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	10 10 0	—	.....
„ Recovered	„	7 0 0	—	.....
Soda: Ash	deg.	0 0 1⅝	—	.....
„ Caustic (White 70%)	ton	10 17 6	—	.....
„ „ {„ 60%)	„	9 12 6	—	.....
„ „ (Cream 60%)	„	9 5 0	—	.....
„ Crystals	„	3 7 6	—	.....
„ Bicarbonate	„	7 0 0	—	.....
„ Hyposulphite	„	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 7	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: The course of business continues uneventful, many articles being very dull. Sulphate of ammonia is lower in value, and few orders are being placed at present. Carbonate of ammonia also is quiet. Carbolic acids are without change. Benzoles are easier, and very little doing. Sulphate of copper is weak, second-hand parcels being plentiful. Arsenic is lower. Yellow prussiate of potash is firm. Sulphur of all qualities is scarce.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	36 0 0
„ Ceylon	„	30 0 0
Cottonseed	„	21 10 0
Cod	„	23 0 0
Lard	„	35 10 0
Linseed	„	22 5 0
Olive, Spanish	„	44 0 0
Palm, Lagos	„	26 10 0
Rapeseed: English	„	30 0 0
Seal: Pale	„	.....
„ Brown	„	.....
Sperm	„	48 0 0
Whale	„	21 0 0
Turpentine	per cwt.	1 9 0
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 5¾
Spirit	„	0 0 7

WE have received a small work, entitled "Architectural and Enriched Casings for Electric Wires," by F. A. Fawkes, which is really a highly illustrated price list of artistic casings. Mr. Fawkes' designs are especially good.

WE have received a copy of the latest catalogue issued by Messrs. Bowes, Scott, & Western, engineers, Westminster, of their mining machinery, which embraces all the usual machinery and appliances required in mining, such as engines, pumps, winding gear, crushing and stamping machinery, wire ropeways, portable railways, &c.

ELECTRIC LIGHT CABLES.—The India Rubber, Gutta Percha, and Telegraph Works, Company, Limited, Silvertown, send us a book that resembles a catalogue, but is mainly really a treatise on highly insulated cables. Though it is avowedly written to push the sale of the Silvertown cables, it will be found well worthy of careful perusal by electric light engineers generally.

POCKET EDITION OF THE DIRECTORY OF PAPER MAKERS FOR 1891 (London: Marchant Singer & Co.).—The contents of this little book are practically the same as those of the "Directory of Paper Makers of the United Kingdom for 1891," which we noticed a few weeks ago. The "Pocket Edition" is, however, of such a size that it can easily be carried in the pocket. It should therefore prove very convenient as a means of reference.

WE have received a copy of the third edition of a little work by Mr. H. Swan, entitled "Travellers' Colloquial French." The book is full of very useful idiomatic French phrases, with the pronunciation represented in English on a new system based upon a scientific analysis of French sounds. In addition to the useful French phrases, the little work contains much information relating to the manners and customs of the French people, which will be found useful by intending visitors. The third edition has been enlarged by the addition of a number of phrases for cyclists and amateur photographers which should prove useful.

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HOME INDUSTRIES.

LONDON, 9th April, 1891.

The Money Market.—The payment of the dividends on the Government Funds at the beginning of the week supplied the market plentifully with money, and rates at once fell away until loans from day to day were worth little more than 1 per cent. The discount rate has also moved in the direction of ease, but not to the same extent, the apprehension of gold withdrawals keeping it steady. No revival has yet manifested itself in Stock Exchange business, in which very little interest is shown. The account dealt with at this week's settlement was very light, and easily arranged. No new feature was revealed by it, but the continued existence of a large speculation for the fall in home railways was further proved. The prices of these stocks hardened in consequence, and a number of the more nervous "bears" have been buying to cover their commitments. American railways, after a couple of days of improving quotations, have received another check, and Canadians, notably Grand Trunks, have been similarly disappointing after giving fair promise of a sustained recovery. In the foreign market fears regarding the political equilibrium in South-East Europe have disturbed the stocks belonging to States in that quarter. South American bonds are little favoured, and show, without an exception, a strong tendency to fall to a still lower level of prices. Among miscellaneous and industrial shares, those of the Hammond Meat Company and the Middlesborough Town Company of Kentucky have been attacked, and have fallen lower. Copper shares are steady, but there is little doing in mining values in general.

The Great Northern Telegraph Company.—The traffic returns of this company show that the receipts during March were £22,800. The receipts from 1st January to 31st March, 1891, were £64,400, whilst for the corresponding months of 1890 and 1889 they were £60,200 and £63,000 respectively.

The Patent Office.—The indices of patents, published at the Patent Office, have of late years been in a state of great confusion, to the annoyance and inconvenience of readers. Some practical and experienced searchers recently presented a memorial on this subject to the Patent Institute, with a view to representations to the Board of Trade. In consequence of this memorial a deputation of searchers met the sub-committee of the Institute, on the 24th ult., in order to discuss the matter. The deputation pointed out the comparative excellence and uniformity of the "Bennet Woodcroft" indices, up to 1870, and urged that the 1881 index should be as closely imitated as possible, and that the whole of the indices, from 1870 to the present time, should be made uniform with that model.

Electric Light Exhibition at the Crystal Palace—The directors of the Crystal Palace have decided to organise a second Electric Light Exhibition, which will be opened in the autumn. Every endeavour will be made to render this second Exhibition complete and popular. In addition to the various systems of lighting, the exhibits will comprise telegraphs, telephones, signals, batteries, electromotors, cables, lightning conductors, magneto-electric and dynamo-electric machines, and all other apparatus, instruments, machinery, and material connected with the production and transmission of electricity.

Smokeless Fuel.—On the 7th inst. a trial of a new smokeless fuel was made before the Prince of Wales and other members of the Royal family, at the premises of Messrs. Brewis Brothers, York Road, King's Cross. The trial was made by Mr. Koopman, the inventor, and Mr. Guy Rottmann, of 11, Lovell's Court, Paternoster Row, London, who is introducing the fuel into this country, on a small Cornish boiler which supplies the steam required for driving an adjacent works. The fuel, which we have had an opportunity of inspecting, consists of dust or waste coal reduced to a fine powder, and then incorporated with a small proportion of pitch and some other mineral substances to the extent of from 7 to 10 per cent., according to the nature of the coal used. It is then, while in a plastic condition, moulded in presses, where it is submitted to a pressure of two tons per square inch, and assumes the form of briquettes about 8in. long by 5in. wide and 4in. thick. It is stated that the mineral ingredients thus added produce during combustion a gas which not only consumes the smoke that emanates from the coal, but also all noxious fumes. The sulphur is said to be rendered innocuous, and the heat generated to be greater than that produced by ordinary coal alone. The briquettes are manufactured at the Cossall Colliery, near Nottingham.

Electric Launches on the Thames.—Messrs. Woodhouse & Rawson United, Limited, have decided to erect a permanent charging station on the banks of the Thames at Chertsey, under the management of Mr. J. Taylor. The station will be quite ready to undertake the charging of electric launches of all sizes at the beginning of the river season.

Institution of Civil Engineers.—Last night the annual dinner of the Institution of Civil Engineers was held at Merchant Taylors' Hall, under the presidency of Sir John Coode. The Duke of Teck was present, together with a large number of other guests and members of the profession.

Exhibition of the Painting Trade.—An exhibition and competition of graining, marbling, sign writing, and decorating, suggested by the *Journal of Decorative Art*, is to be held in the Painter Stainers' Hall, Little Trinity Lane, London, E.C., from the 18th to the 27th inst. inclusive. Numerous prizes are offered for the various classes of exhibits. The hall will be ready for the reception of exhibits on the 13th inst., and none will be received after 4 p.m. on the 14th inst. The Exhibition will be open each day from 11 a.m. to 9 p.m., and admission will be free.

MANCHESTER, 9th April, 1891.

Electric Lighting.—Some time ago the Gas Committee of the Manchester Corporation appointed a sub-committee to inquire into the best method of lighting the central portion of the city by electricity. This committee has visited Bradford and London, and investigated both the low-pressure continuous and the high-pressure alternating current systems. They report that, although ample evidence is forthcoming with reference to the first cost of installations, the cost of working was not so readily ascertained. The opinions obtained and the methods examined vary so largely that the committee cannot themselves come to any definite conclusion, but recommend that the best professional advice should be obtained, so that a complete scheme may be drawn up for carrying into effect the provisional order. The Gas Committee, after considering the report, has authorised its sub-committee to take such action as they may think advisable.

Purifying Coal Gas.—The Dukinfield Local Board have determined to apply the new oxygen process of purification at their works. The cost of the plant is about £4,000, and it is anticipated that a great saving will accrue from the less frequent "changes" in the purifiers. The purification of gas is a question of much interest at present in this district, and much dissatisfaction is expressed with the quality of the gas supplied by some of the local bodies.

The Ship Canal.—By a large majority the citizens of Salford have expressed an opinion that the Corporation of that borough ought to render immediate aid to the Ship Canal Company. At present the Corporation is considering the subject, but its action is thought to be rather sluggish, especially in view of the introduction of a Bill into Parliament.

"Cleaning Time" in the Cotton Trade.—A dispute has arisen between the employers' and operatives' associations in the spinning trade, owing to the demand of the operatives that the time for cleaning the machinery should be extended. In view of pending legislation the employers decline to grant any extension, and the operatives have been empowered to strike in any case where their demand cannot be obtained by negotiation.

The Linen and Jute Trades.—A better tone is now evident, and distributors are hopeful of recovering any losses incurred during the period before Easter by increased activity between now and Whitsuntide. Prices of pales and roughs have been improved by an advance in quotations for tow yarns, while a rise in high counts of linens helps manufacturers of fine linens to keep up prices, and even to obtain fractional advances where goods are required for special orders. A slight increase in the demand for sheetings and other descriptions of bed linen is noticeable, and the Barnsley section of the trade appears to be improving slightly. It is evident from what has taken place in the markets for raw and finished material during the past week that linen prices show a tendency to rise. A steady effort has been made by manufacturers to raise quotations to a higher level, although with dearer flax, and therefore dearer yarns, little advantage is to be gained. Linen cambric handkerchiefs, embroidered by machine in Switzerland, are now being introduced into the United States, and the goods will compete keenly with the hand-embroidered product of Belfast. Jute goods are rather slow, although reports from northern markets are cheerful. The mills are fairly busy on United States' account.

Electric Lighting of Victoria Station.—An installation of forty arc lamps of 2,000 candle-power each, of the Brockie-Pell type, has been erected by the Lancashire and Yorkshire Railway Company for the lighting of Victoria Station. The lamps are arranged on four circuits of ten each. The generating plant consists of three dynamos constructed by Messrs. Mather & Platt, which are placed in the engine-house adjoining the head offices in Hunt's Bank. Two locomotive engines have been adapted, so as to be used for driving the countershaft to which the dynamos are belted. Two only of the dynamos are used at once, the third being held in reserve. Each machine will generate sufficient current for half the lamps in the station. It is intended ultimately to lay down a much larger plant in a more central position, from which the whole of the station, offices, and approaches will be lighted.

GLASGOW, 9th April, 1891.

Export Trade.—As might have been expected from the slackness of trade during the past three months, and from the partial paralysis of it during the month of January caused by the strike of railway servants, the quarterly returns for the Clyde are very low. The tonnage of vessels arriving at the Clyde ports during the quarter is less than the corresponding tonnage for the last quarter of 1890, and also less than for the March quarter of 1891, by fully 25 per cent., the falling off being about 70,000 tons. The departures show a similar decrease, having fallen from 476,984 tons for the last quarter of the year 1890, and 422 141 for the March quarter, 1890, and 533,877 tons for the quarter ending December, 1889, to 385,061 tons for the quarter just closed. The principal falling off is in iron and general machinery, and in a less degree in cotton. Locomotives, steel, sewing machines, and linen goods show an increase. The decline in cotton shipments has been chiefly in exports to the United States. The increase of about 15 per cent., amounting to £40,000, in the exports of linen to the United States is remarkable. The returns prove that foreign trade is at present declining, though, as was observable during similar conditions about ten years ago, miscellaneous industries have not suffered so much as the staple trades. The increase in linen shipments and the falling off in cotton shipments are an incidental confirmation of this. Even if we take into account the balancing of one commodity in a complementary group against another, there is a general falling off, which can only be attributed to an approaching period of depression of trade.

Electric Lighting in Glasgow.—The Corporation of Glasgow are still undecided about their provisional order. Deputations have been visiting Bradford, Leeds, and other places, but so far they have come to no decision whether to accept one of the tenders already received or to embark in central station lighting on their own account. This indecision is retarding the development of electric lighting in the city.—The Central Railway Station and Hotel have just been completely fitted with electric light by Messrs. Mavor & Coulson. The work has been done under the superintendence of Mr. Dunn, superintending engineer of the Caledonian Railway Company.

Shipping.—Messrs. J. & N. Allan, who have acquired the State Line steamers, and who have just established a line from the Clyde to New York, have appointed as their agents in the latter city Messrs. Austin, Baldwin, & Co., who have represented the State Line there for the past twenty years.—Freights are still very dull. Several contracts forward have been made at low rates, including Glasgow to San Francisco (ship now building), 15s. 6d.; San Francisco, homewards, 38s. 9d., for loading twelve months hence.

The North Railway Service.—The fast train service from London to the North began for the season on the 1st inst. The distance between London and Aberdeen, *viâ* the Forth and Tay Bridges, 526 miles, is covered in twelve hours by the train leaving London at 8 p.m. By the East Coast route the first train leaving London at eight o'clock on the 1st inst. reached Aberdeen at 7.55 a.m. next morning, five minutes before time. On the same evening the London and North-Western train leaving at the same hour reached Aberdeen at 8.3 a.m., only eight minutes later than the East Coast train. The difference in distance is fourteen miles, the West Coast route being 540 miles against 526 miles by the East Coast. Since both trains travel on the same line north of Kinnaber Junction, near Montrose, it is arranged that whichever train reaches the junction first proceeds first, the line being blocked from station to station.

Railway Bills.—The Clyde Trust have determined to petition Parliament against the Steam Vessels Bill promoted by the Glasgow and South-Western Railway. If this Bill should be passed there will be an end to individual private enterprise in the Clyde coasting traffic, as the whole of the traffic will fall into the hands of the three leading railway companies.

(From our own Correspondents.)

LIVERPOOL, 8th April, 1891.

The Timber Trade.—Although the deliveries have been satisfactory for the time of the year and the imports moderate, the stocks are far too heavy, and the prices have not improved, contracts being made with difficulty. The stock of yellow pine, waney and square, is excessive, and the demand moderate, and red pine is not in demand, the stock also being heavy. The consumption of pitch pine has improved, and there have been no arrivals of hewn wood, four cargoes of sawn having arrived from Pensacola, three for contract, and one to be sold by auction; the stock is very heavy and prices are low. There has been no import of New Brunswick and Nova Scotia spruce deals; the stock is heavy, prices low, and no prospect of improvement. No Quebec and United States oak has been imported in the log, but several lots have changed hands; the stock is heavy and the prices low. Oak plants are in fair request, the deliveries have been good; the stock is moderate, and prices are firm. There has been a strong inquiry for greenheart, and the consumption has been about 10,000 cubic feet; the market is empty and prices are high. The stock of teak is exceedingly heavy, and the consumption has equalled the import. The stock of elm is moderate, the demand fair with no change in prices. There has been a good demand for ash, but the stock is heavy.

Large Imports of Live Stock and Dead Meat.—During the past three months there have been landed from the Canadian and American ports 40,724 cattle, 213,496 quarters of beef, and 1,344 hogs, being an increase on the imports during the corresponding period last year of 9,105 cattle, and 12,941 quarters of beef.

LEEDS, 8th April, 1891.

Iron and Steel Trades.—Business in the finished iron and steel branches of the trade of this district continues very quiet. There is no greater disposition to place orders than before the Easter holidays, and the fall of

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prices has not been arrested. Locomotive builders are fairly well employed, and in the large establishments activity prevails. There is no change in the state of the agricultural machinery trade, and little improvement in the demand for cut steel and iron nails, prices remaining unchanged.

THE COAL TRADE.—The household coal trade since the holidays has been very active, and there is a good demand for shipping and steam coal. Gas coal is somewhat quieter. Engine coal of all qualities is also in less request.

SHEFFIELD, 8TH APRIL, 1891.

IRON AND STEEL.—There is no decrease in the demand for iron or steel for the manufacture of rolling stock. Tyres and axles continue to be ordered for both home and colonial railways, and manufacturers generally are fairly supplied with work. The question whether iron or steel is better fitted for axles is exciting much interest here. Local steel makers consider that steel is the better material. Steel is now made by the open-hearth process of an almost uniform quality, and capable of undergoing the most severe mechanical tests. Locomotive cranks have been in great demand for the past twelve months, and one firm in this district is turning out eight finished cranks each week. These cranks are guaranteed to run 100,000 miles, and are made of mild open-hearth steel. The propeller shaft trade is quiet at present, and there is little doing except a few three-throw solid forged cranks for the Spanish cruisers now being built. The armour plate mills are fully employed at present, and have sufficient orders to keep them going for some time to come. The recent tests of "all steel" and "compound" plates has left the whole question of their relative merits undecided, and further trials are anxiously awaited. Pig iron of all grades still shows a tendency to decline.

FUEL.—The output of coal from this district continues undiminished, and prices are fully maintained. In some cases colliery proprietors are obtaining in the open market double the contract price for their best coal. The best qualities of coke are firm in price, with no immediate prospect of a reduction. Smiths' washed coke is actively inquired for. Some simple method of eliminating the sulphur in this class of fuel is much needed.

THE MERCHANDISE MARKS ACT.—The Sheffield Federated Trades Council have secured a conviction against a Blackpool auctioneer for selling xylonite-handled knives as ivory.

INDUSTRIAL EXHIBITION.—An Industrial Exhibition was opened at Sheffield on the 28th ult. A marked feature of the Exhibition is the great variety of trades that are represented. In the Artisans' and Women's Industries Section a very good show is made of machinery models of all kinds. In the Iron and Steel Manufacturers' Section there are good exhibits of machinery and cutlery.

NORTH STAFFORDSHIRE, 8TH APRIL, 1891.

COAL AND IRONMASTERS' ASSOCIATION.—The quarterly meeting of this association was held at Stoke-on-Trent on the 6th inst. The reports relating to the present prices in the iron trade were rather unfavourable, and some anxiety as to the future was expressed. Sales were generally deferred until the meeting at Birmingham on the 9th inst.

COLLIERY EXPLOSION.—On the 3rd inst. a serious explosion occurred at the Sladderhill pit, belonging to the Midland Coal, Coke, and Iron Company, which resulted in the loss of ten lives and much damage to the underground workings.

THE POTTERY TRADE.—A meeting between the potters and their employés, held last week, seems likely to result in the reconstitution of the Conciliation Board and in a friendly settlement of the wages question.

BIRMINGHAM, 8TH APRIL, 1891.

GENERAL TRADE.—Trade generally is very quiet in this district, and there seems to be no sign of improvement. Wages and fuel are high in proportion to selling prices, but seem likely to decline before long. The general prices of manufactured goods are going down in anticipation, and if reductions in fuel cause a further depression in the prices of iron goods they will be unremunerative. The outlook is not cheerful, but it is hoped that workmen will agree to such reductions of wages as will enable employers to face the situation. The Midland Iron Trade Wages Board met last week and received the accountant's return of the average selling price of iron in January and February. The price was £6 13s. 7½d., and according to the sliding scale it should cause a reduction of 2½ per cent. in ironworkers' wages, but since wages had not been reduced in the North of England the employers decided not to press for the reduction. Sheet iron is quoted at £8 per ton.

MESSRS. W. & T. AVERY.—This business, carried on by Messrs. J. & Henry Avery, is being transformed into a limited company. The works have been much extended of late, and are well employed. The capital is £200,000.

LEICESTER, 8TH APRIL, 1891.

COAL MINING.—Considering the period of the year a very fair business is being done. Railway companies are beginning to make contracts, and this has considerably strengthened the prices of steam coals, which are also in good demand. In most household coals there has been a fall of about 6d. per ton. Most of the collieries are making very fair time, and stocks are generally small. The prospects of this district are cheerful.

WOOL SPINNING AND YARN TRADES.—Since the holidays the local wool market has assumed a more cheerful tone. The feeling prevails that the lowest prices have been touched, and the tendency of the market is towards a rise. Staplers, finding stocks cannot be replaced on better terms, do not press for business, and hold out for a fractional increase. Choice lots of short fleeces are scarce, but buyers only venture to supply pressing wants and resist the attempt to obtain better prices. Spinners have resumed work, and a fair amount of business is being done. In fancy yarns there is a brisker demand, but cashmeres and lambswools are quiet.

SWANSEA, 8TH APRIL, 1891.

TINPLATES.—There is much activity at all the works, mostly on contracts which terminate between the end of May and June, but it is difficult to form any idea as to the future of the trade. The tin bar makers declare that the present price of £5 per ton for Bessemer, and £5 5s. for Siemens bars, is unremunerative, and yet no contracts of any importance are heard of at these prices, which, with tinplates at 17s. 6d. to 18s. per box for common sizes, should leave a good margin to the makers. No improvement is looked for before the 9th inst., when the various members of the trade will meet in Birmingham. The pig iron makers are also complaining that neither iron ore nor coke can be obtained at a price to yield any profit, so that a considerable fall in the price of tinplates is not unlikely. The disorganised condition of the Tinplate Workers' Union makes submission probable if the masters should feel obliged to make a reduction in wages.

COPPER.—At the end of February the stocks of copper ore remaining unsold amounted to 6,366 tons, but they had already decreased to 3,239 tons in the third week of March. The total stocks of Chili copper produce—viz., ore, regulus, copper, and precipitate—remaining unsold on the dates named were equivalent to 5,286 tons and 4,900 tons of fine copper respectively.—We regret to announce the death of Mr. John Cady, who, for about twenty-five years, managed the Morfa Copper Works, until they passed out of the hands of Messrs. Williams, Foster, & Co. a few years ago, when he took charge of Mr. Dillwyn's spelter works.

LARGE TEMPORARY BUILDING.—The designs of Mr. Edward Bath, architect, Swansea, have been accepted for a pavilion to accommodate some 15,000 people during the forthcoming Eisteddfod. The building will be oval in shape, the main structure being 220ft. by 180ft.

BARROW-IN-FURNESS, 8TH APRIL, 1891.

HEMATITE.—There is less business in hematite pig iron this week. Prices have gone down further to 47s. 1d. per ton for hematite warrants, and makers are compelled to ask 49s. to 50s. per ton for mixed Bessemer numbers net f.o.b., although the value of iron ore has been reduced to 10s. to 10s. 6d. per ton net at mines for ordinary qualities, and although coke has at last come down 2s. per ton to 18s. 6d. to 20s. 6d. for East Coast qualities delivered at West Coast furnaces. The decrease in stock this week was 6,210 tons; the aggregate of stocks now amounts to 178,889 tons. Forty furnaces are still in blast.

STEEL.—A quiet tone prevails in the steel trade, but makers in the Barrow district are fairly supplied with orders. In West Cumberland, however, the reverse is the case, and the mills in some cases are stopped. There are a few orders offering for rails, and heavy sections are done at £4 10s. to £4 12s. 6d. per ton. Steel shipbuilding material is not in brisk demand, but makers are fairly supplied with orders, and expect new contracts.

SHIPBUILDING.—A great blow to the prosperity of the shipbuilding and marine industries of Barrow has been received by the death of Mr. Bryce-Douglas, the managing director of the Naval Construction and Armaments Company, Limited. His was a useful life, and gave promise of great things for the future. He raised shipbuilding in Barrow from absolute inactivity to its present great prosperity.

MIDDLESBROUGH, 8TH APRIL, 1891.

PIG IRON.—The quarterly meeting of the iron market, held yesterday, was well attended, but no improvement in business was reported in any direction. Buyers will not buy iron, as they expect to see prices go down still further; indeed, the prices of pig iron were almost 1s. per ton less than on the previous market day. It is difficult for some of the ironmasters to make No. 3 pig iron at less than 43s. per ton, and it is therefore not surprising to hear of more furnaces being blown out. At the Thornaby Works, South Stockton, a furnace is to be blown out, and it is probable that one will be blown out at the Newport Ironworks. Merchants are quoting 38s. per ton for prompt f.o.b. deliveries of No. 3 G.M.B., but some makers are getting more for iron for the Continent, which could not be had from second hands. Middlesbrough warrants are 37s. 10d. cash sellers and 37s. 9d. cash buyers, but in the absence of actual business these prices are only nominal. Grey forge pigs, which are in smaller consumption, both locally and in Scotland, are obtainable at 37s. 3d., and even 37s. would not be refused by some sellers. Local hematite is 51s. per ton for mixed numbers, but some sellers would not accept orders under 52s.

COKE.—The tendency is downward in coke prices, and it may be had for 13s. 6d. per ton delivered at furnaces.

SHIPMENTS.—The shipments of pig iron from Middlesbrough this month are very poor, being only 11,108 tons, against 16,700 tons to 6th March and 21,048 tons to 6th February. This is, however, partly due to the bad weather delaying steamers at sea.

MANUFACTURED IRON AND STEEL.—The prices of finished iron and steel are weak, but competition is keen among manufacturers. The Darlington Iron and Steel Company have paid off some 300 hands, but they will be taken on again after some repairs are completed if orders come in. Prices are as follow:—Common bars, £5 12s. 6d.; best bars, £6 2s. 6d.; best-best bars, £7 2s. 6d.; iron ship plates, £5 12s. 6d.; steel ship plates, £6 2s. 6d.; iron boiler plates, £6 12s. 6d.; iron ship angles, £5 10s., all less 2½ per cent. on trucks at works. Heavy steel rails are £4 12s. 6d. net at works.

IRONMASTERS' RETURNS.—The return of the Cleveland Ironmasters' Association for the month of March show that there were 94 furnaces blowing, as against 97 in February and 105 in March last year. The make of pig iron of all kinds was 226,544 tons, an increase in February of 15,362 tons. The stocks held by makers and in public stores were 289,986 tons, an increase for the month of 2,645 tons.

WORK AND WAGES.—At a meeting held to-day of the members of the Cleveland Ironmasters' Association and representatives of the blast furnacemen, the latter agreed to accept the sliding scale on the old basis. At the former meeting the masters demanded 12½ per cent. reduction or a return to the sliding scale which regulated wages up to the end of June last year. The men were in favour of a return to the sliding scale, but wanted certain concessions which the masters refused. The official ascertainment of realised prices for the past three months shows the net average selling price of pig iron to have been 43s. 2 37d., as against 47s. 7·65d. during the previous quarter. This gives a reduction of about 4 per cent. on the present rate of wages.

NEWCASTLE, 8TH APRIL, 1891.

THE IRON TRADE.—The finished iron trade shows no signs of briskness, and only for a few special products is there a good demand. In spite of the unsatisfactory state of business generally, Messrs. Raine & Co., of Winlaton Rolling Mills, appear to be confident of the future, and will, in the course of the present month, open new works in the neighbourhood of Dunston.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending the 4th inst. amounted to 86,809 tons, being a decrease, as compared with the shipments for the corresponding week last year, of 1,345 tons.

SHIPBUILDING.—The outlook in the shipbuilding industry becomes more discouraging as the season advances, and at several establishments large numbers of men are being paid off each week. Some firms are busily completing their last orders, and in these cases there is no immediate prospect of any further contracts being secured. Shipowners who contemplate additions to their fleets are holding back for a further fall in builders' quotations, and, so far as home orders are concerned, very little business is expected to be done during the next few months. It is probable, however, that some foreign orders of importance will shortly be placed with Tyne builders, and one leading firm is at present negotiating for the building of two very large steamers for Russia. Two oil-carrying steamers of large tonnage are in course of construction at Messrs. Armstrong, Mitchell, & Co.'s Elswick yard, and it is understood that they are ordered by German owners. The yards of Messrs. Palmer at Howden and Jarrow continue very busy with the Government contracts now in progress.

ENGINEERING.—The whole of the marine engine works keep fairly busy, as the contracts taken last year are not yet completed. In locomotive establishments business is also good, and one or two good orders have recently been received. By a recent arrangement Mr. W. F. Snowdon, of 32, Side, Newcastle, has become the sole vendor of Bell's Asbestos Company's manufactures, in the counties of Northumberland, Durham, Cumberland, and Westmoreland. Mr. Snowdon has, in consequence, extended his warehouse accommodation.

DUNDEE, 8TH APRIL, 1891.

JUTE AND FLAX TRADES.—From a compilation showing the shipments of jute from Calcutta for the last three years, during the season extending from 1st August to 28th February, it appears that the number of bales exported last season was 2,195,588. In the previous season the export was 2,057,733 bales, and in 1888-89 it was 2,147,086 bales. Although the totals do not show much change, the figures bring out some interesting facts with reference to the distribution of the exports. Comparing the exports for the season 1890-91 with those for the season 1888-89, we find that London has taken 412,468, as against 618,085; Liverpool 13,376, against 17,617; and Barrow 12,450, against 25,646. On the other hand, the exports to Dundee have increased from 1,041 622 to 1,060,864, those to the Continent from 355,249 to 573,014 and those to America from 88,867 to 123,016 bales.

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THE ROYAL NAVAL EXHIBITION.

(*For description see page* 344.)

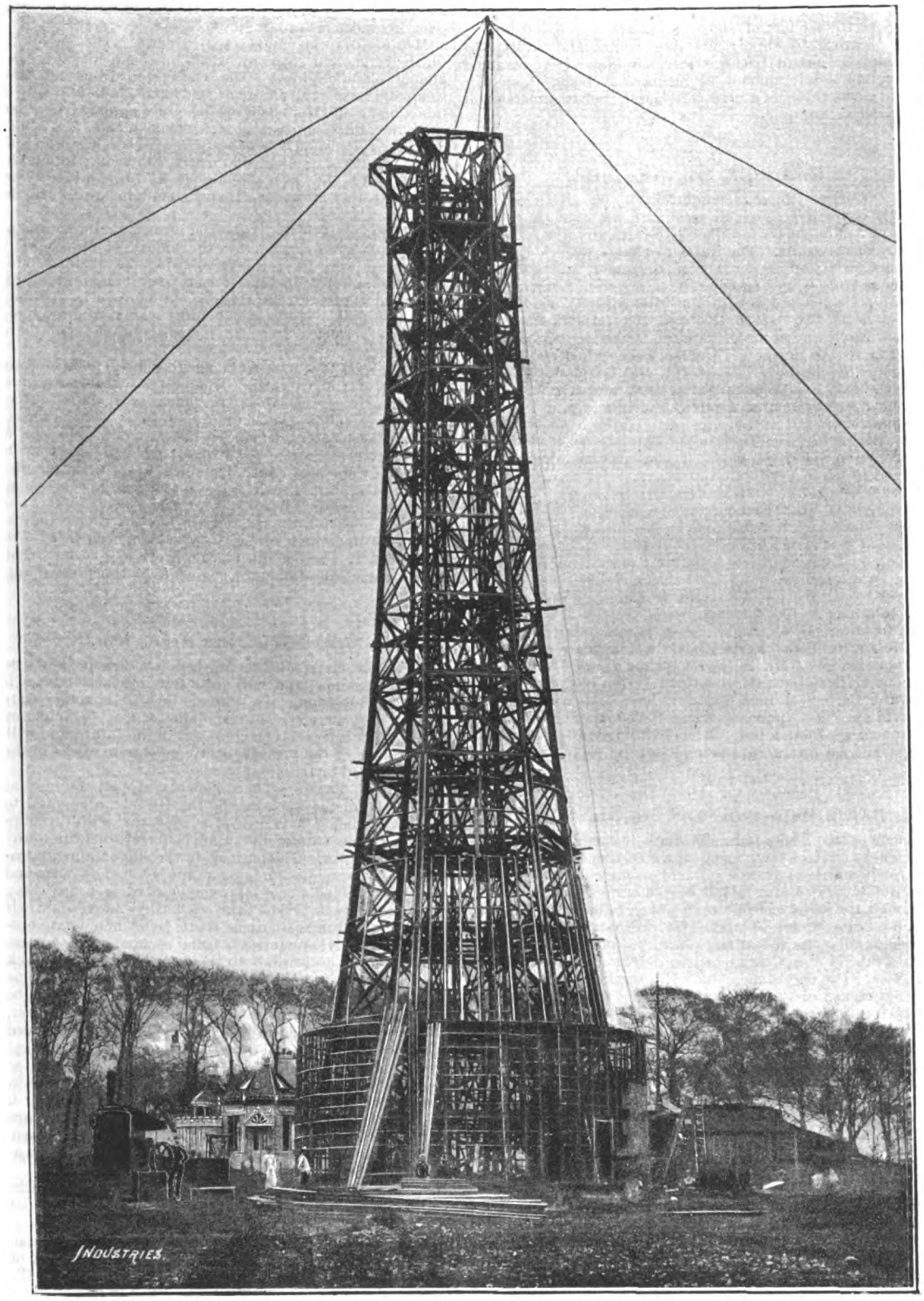


FIG. 4.—VIEW OF MODEL OF EDDYSTONE LIGHTHOUSE DURING CONSTRUCTION.

THE INSTITUTION OF CIVIL ENGINEERS.

AT a meeting held on the 7th inst., the President, Sir John Coode, K.C.M.G., being in the chair, a paper was read on "The Cost of the Generation and Distribution of Electrical Energy," by Mr. R. E. B. Crompton, M.Inst.C.E. Machinery for the supply and distribution of electrical energy came under two heads—namely, the generating plant, comprising boilers, steam dynamos, and switching apparatus, and the distributing plant, consisting of a network of conductors, supplemented in some cases by accumulators, and in other cases by transforming apparatus to change energy from high pressure to low pressure.

Cost of Generation.—With the high efficiency of 96 per cent., which was now attainable in dynamos, the cost of the electrical energy ought only to be a small fraction in excess of that of a corresponding amount of mechanical energy. The wide difference between the calculated amount and the figures attained in practice were considered. The three items of cost—namely, material, labour, and up-keep—were influenced chiefly by the "load factor," the design and arrangement of the plant, and the local cost of material and labour. The author had given the name of load-factor to the relation which the actual output of any given plant bore to what would be its output if it were worked continuously at the full load. In order to compare the relative economy of fuel, water, or other material used in generating electrical energy, he had fixed on a consumption of 25lb. of water and 2½lb. of Welsh coal per unit generated as a standard which might be reached in the future, although nothing approaching those figures had yet been attained in practice.

The author proceeded to describe the electrical supply stations from which the data for the paper had been obtained—namely, the Kensington and Knightsbridge Electric Lighting Company and the St. James's and Pall Mall Electric Lighting Company. The load-factor of these stations varied from the exceedingly low figure of 2·5 for the Kensington Station in the month of August to 41·5 on one occasion, which was the best load-factor of the St. James's and Pall Mall Company's station, and showed how these varying load-factors affected the cost of productions. It was pointed out that a limited use of storage plant could reduce the consumption of fuel, &c., and shown by a diagram that the proportion of accumulators should be about 20 per cent., or one-fifth of the whole generating plant. The author recommended a return to the older type of internally fired boilers; the chief cause of the small evaporation in low load-factor stations was the loss of heat incurred in getting up steam in several boilers for only short periods every evening. Several types of boilers which had been found to have special advantages were described, one important consideration being that in electric light stations the space from front to back was frequently limited, so that a boiler which could be built up to a height of from 14ft. to 16ft. offered several advantages.

Distribution.—The cost of distributing electrical energy was made up of that of the up-keep of the distributing plant and of the percentage of the energy which was lost by the fall of pressure in the conductors. It followed that the merit of competing systems was inversely as the cost of generating the units so wasted divided by the up-keep of the conductors. For instance, if in distributing 20,000 units to a given distance system A wasted 1,000 units in a given time, the cost of up-keep for the same time being £10, whereas system B wasted 3,000 units at a cost of up-keep of £3, B was slightly better than A, because $\frac{2000}{10} : \frac{1000}{3} :: 300$ to 333. It was difficult to apply the method of comparison to the systems now in use, as the cost of up-keep was not yet known with sufficient accuracy. The author's opinion was that whenever underground mains consisted of continuously insulated cables, the sum required for up-keep would be not less than 4 per cent. of the original cost, and was not likely to exceed 7 per cent. When, however, the underground mains took the form of bare copper conductors with glass or porcelain insulators the cost of up-keep might be as low as from 1 to 2 per cent. A table given showed the load-factors for the Chelmsford station for the months of August and December, 1890, and a twenty-four hours' load-diagram, taken on the 20th of January, 1891, was exhibited. The annual load-factor was found to be 31·0, and the pounds of coal per unit generated, 8·88; the pounds of coal per unit delivered, 10·70, hence the efficiency reached 83 per cent. But this was an extremely favourable example, and an alternating-transformer installation in a medium-sized private house in the Kensington district, tested by Professor Ayrton, was found to have a mean annual efficiency of only 53 per cent. The remedy for this defect in the alternating system consisted in what had been called "banking" the transformers. This meant that a district to be supplied with electricity should be laid with a low-pressure network, in all respects similar to that provided for the direct low-pressure system; but in place of the feeders, and at the point where the feeder-mains were connected to the network, a fireproof and incombustible chamber should be formed under the surface of the roadway. In this a number of transformers of graduated sizes were arranged, with the high-pressure mains connected to them, so that the transformers might be switched into action automatically as required—that was to say, during the hours of light load the smallest only would be in action, the others being automatically added as the demand increased.

Summarising his experience, the author endeavoured to show:—

1. The actual cost of generating and distributing electrical energy on the scale at which it was now produced, and with the machinery that was already installed.

2. The direction in which improvements might be introduced to secure greater economy.

3. The important effect of a variable load-factor, which might be almost entirely eliminated from the cost-sheets of those who desired to employ electrical energy continuously.

4. That the losses on distribution in low-pressure supply were already so low that further improvement could not be expected.

5. That the existing systems of alternating supply would have to be greatly modified if they were to be used in residential neighbourhoods having low load-factors.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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FRIDAY, 10TH APRIL, 1891.

AMERICAN WARSHIP DESIGN.

IN our issue of the 27th ult. we indicated some of the features which were likely to be found in the ships of the future, especially in those designed for passenger and cargo traffic. But not less interesting and important from a scientific point of view are the probable developments of the ships of war in so far as these can be recognised in the vessels which are now being built by the leading Powers. The paper recently read by Mr. Biles on "Some Recent Warship Designs for the American Navy" was of great value from this point of view. When the Americans first began to build ironclads, under the inspiration of men like Stevens and Ericsson, the designs were of great originality, and, although the vessels were deficient in speed, they were, nevertheless, formidable instruments, both of offence and of defence. At the present time the American authorities seem to be content to follow our lead. As Mr. White has remarked, all the details of our warships are obtainable for a few pence from the Parliamentary returns, and many of the points in American ships are copied directly from those of the British Navy. The American Naval Department systematically carries out its method, which consists in obtaining the details of all foreign ships, analysing them, and then producing rival designs. They even invite foreign naval architects who have had experience in warship design to send in plans, and those of the "Texas," for instance, were supplied by the late Mr. John, while the "Baltimore," "Philadelphia," and "Charleston" are from designs supplied by Mr. White. Our cousins seem, however, to be in great part at least able now to do their own work, for Mr. Biles expresses the opinion that American ship designers and builders have shown that they are capable of producing vessels quite equal to their promises, and at least equal to the best European practice. Mr. White also stated that they not only have begun to build the ships themselves, but they also produce all the materials necessary for their manufacture. Hence they are likely to produce results that will compare with or even rival ours. These are important facts to be borne in mind by our shipbuilders in considering the designs of the ships which are now being built for the American Navy, and also on account of their bearing on the probable future of the shipbuilding industry in this country.

The American Naval authorities, feeling no doubt how much they owe to foreign naval architects, are willing to give the fullest information with regard to their own operations and the designs they are carrying out. As to the designs, although there might not be very much in them which the Americans could call original, still they embody many of the leading features of the most modern European ships of war. Mr. Biles' paper will be found exceedingly useful, as it gathers up the many details in a compact form, and gives suggestions as to the future. The Secretary of the American Navy not only gave all the information which was wanted, but stated that he courted the fullest criticism, and hoped that it would not be confined to commendations. We should, therefore, be glad to have the the opinions of some of our readers concerning these war vessels.

The keel of the first modern American warship was laid in 1883, and a glance at the figures we gave on page 291 of our issue of the 27th ult. will show that the progress made has been great, if we measure it by the difference between the "Chicago" and the "Baltimore." These vessels are of practically the same displacement, though the "Baltimore" has a smaller main battery, having only 10 guns, against the 14 of the "Chicago." Her speed is, however, more than 3 knots greater than that of the "Chicago," and she has a protective deck 2½in. thick on the flat, and 4in. on the slope. The "Philadelphia," which is a sister ship to the "Baltimore," attained a still higher speed; and the "San Francisco," which is a little over 4,000 tons displacement, attained a speed of over 20 knots, while the "Newark," a sister ship to the "San Francisco," has attained a speed of 20·4 knots. With regard to the workmanship of the "Newark," Mr. Biles stated that he carefully inspected it at the yard of Messrs. Cramp, Philadelphia, and he feels sure that it is quite equal to our best shipbuilding practice. There are no vessels in the British Navy which can be closely compared with those named, as during the period 1883–87 the cruisers built in this country were either belted, and therefore larger and more costly for the same fighting power, or, if of the same type, smaller and slower. The recently published Navy Estimates of this year, however, give some particulars of eight vessels of 4,360 tons displacement about to be built, which are to have forced draught speeds of 19½ knots and a coal supply of 400 tons, and in dimensions and speed are very similar to the American ships. We may mention that the trials of the American ships were made at load draught and with the boilers working under forced draught, and the speed is a mean of four hours' run, two with and two against the tide, the speed of the tide being carefully measured at several points on the route by boats stationed for that purpose. One of them, however, the "Baltimore," has, since her trial, been on a long cruise, and has shown herself to be a good sea vessel. She steamed from New York to Stockholm at a speed of about 11 knots without stopping to coal, and she could have steamed 1,500 knots further at the same speed with the coal that she actually carried. After the spurt made in 1883, it was not until the end of 1889 that it was decided to make any important additions to the American Navy, but there are now under construction seven cruisers and seven armoured ships, with considerable variety of design. In the matter of armour, guns, engines, and general plan, the most effective vessels in European navies have been carefully studied, and their best points utilised and put into a very compact form. The coast line battle-ships are the most important in the programme, and they have been designed, to use the words of Mr. Theodore Wilson, the Chief Constructor of the United States Navy, "to be able to fight vessels carrying the heaviest guns and armour," and by inference comparison with our most recent battle-ships cannot fail to be courted. Among the cruisers there is one to which we would direct special attention, and that is "No. 12." She is called a "Commerce Destroyer," and is popularly known as the "Pirate." She is intended to have a sustained sea speed of 21 knots. Mr. Secretary Tracy thinks this "vessel absolutely without parallel among the warships of the world, and that the combination there made unites a sufficient arma-

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ment with complete protection against light guns, while at the same time the vessel will have a sea speed and a coal endurance hitherto unknown in ships of war. No merchant vessel that she meets, armed or unarmed, can escape from her." From her design she seems likely to meet these expectations, as she has ample power, sufficient armour, and guns and torpedoes which would quickly dispose of any merchant ship. The vessel is well devised, and would give a good account of herself against most cruisers. She is, however, designed to avoid the enemy's cruisers, her function being to catch and destroy the merchant steamers of an enemy. She would not hesitate to fight and try to destroy any of our merchant ships fitted as cruisers. Mr. Biles remarks that the building of such a vessel is certainly an indication of American skill, both in conception and construction, and he remarks that whether vessels specially designed to meet this one, or an improved type of mail steamers, should be adopted as the best means of protection, is a question worth some consideration. There are several other very interesting vessels built, or intended to be built, for the American Navy, but into a description of these our space will not allow us to enter.

The activity and originality shown in connection with the recent development of the American Navy affords material for thought, not only to our shipbuilders, but also to our statemen. Notwithstanding this activity we sincerely hope that the two great English-speaking nations of the world will never disgrace civilisation by going to war with each other. We may say, frankly, that we should have preferred to see America content in developing her industrial and mercantile resources. Since, however, she seems determined to take a position as a naval Power, it is the evident duty of our statesmen to make themselves thoroughly acquainted with American naval progress, and to take steps to guard against possible contingencies.

INSURANCE OF SCOTCH MINERS.

Another of those signs of the times now becoming very common, and all pointing in the same direction, is the Bill introduced into the House of Commons by Mr. Baird, and other Scotch members, to provide for a national system of insurance against accidents in mines of all kinds in Scotland. The preamble of the Bill states that those employed in the mining industry in Scotland are liable to serious and fatal accidents, by which large numbers of persons or their families are often left without the means of living, except by the aid of the poor rates or by public charity, and that, therefore, it is desirable to make obligatory the practice which has prevailed among some of the largest English colliery owners and their workpeople of making provision against accidents by insurance, effected partly by payment out of wages, and partly by contributions from the mine owners. The Bill proposes the establishment in each of the two mining inspectors' districts in Scotland of an insurance fund, to be administered by a Board consisting of three representatives of each of the parties concerned—namely, the landlords or lessors of the mines, the lessees, and the miners, together with H.M. Inspector of Mines for the district. Each year the two Boards are to meet and to agree upon a scale of contributions and allowances, which shall have been previously fixed by three salaried assessors. No person is to be employed unless he is insured, and kept insured, during the continuance of his employment. If a mine owner employs men who are not insured he will be liable, in case of accident, to pay to them or their relatives the same amount he would have had to pay if the men had been insured, so that it will be to the interest of each employer to see that all his workers are insured. The employer may also deduct the landlord's contribution from the amount of his royalty. For the purposes of the insurance fund the employer and the mine owner are each to contribute ¼d. per ton per annum, while the workmen are, if employed underground, to pay 2d. per week; if on the surface, 1d. per week, with half these sums in case of persons under 16 years of age. Any contributions in arrear from the owners and lessees are to be recovered as an ordinary debt, and are to be paid into a common fund. No person can contract himself out of the Act, and no payment from the insurance fund is to be taken into account as mitigating damages recoverable under the Employers' Liability Act. In the schedule attached to the Bill the following scale of allowances and payments is given, namely:—For disablement—full members, for the first week 5s., and afterwards 10s. per week, with half the above sums to half-members. Funeral allowances—married members, £5; unmarried members, £20; half-members, £5. For a widow, during widowhood, 7s. 6d. per week; and for children, until they attain the age of 14, as follows:—For one child, 2s. 6d. per week; for the second child, 2s.; for the third and remaining children, 1s. 6d. each, while the amount to be given to dependent relatives is to be fixed by the Board.

The general principle involved in the Bill is one which will require very careful consideration, for if it once be applied to miners, there are no reasons why it, or something like it, should not be applied to other industries. Moreover, there are many of the details which will require to be very carefully examined, and we take it that they will be so examined by those who represent the interests of the three parties concerned.

MINING STATISTICS FOR 1890.

A Blue Book has just been published, giving summaries of the statistical portion of the reports of Her Majesty's Inspectors of Mines for the year 1890. From this it appears that the number employed in and about all the mines, exclusive of those employed on private branch railways and tramways, and in washing and coking coal, amounted to 655,287, of whom 5,599 were females, the aggregate increase during the year being 48,132. The total number of fatal accidents was 899, and the total number of deaths occasioned thereby 1,206, being a decrease of 13 in the number of fatal accidents and an increase of 78 in the number of lives lost, compared with the totals of the preceding year. There was one death for 543 persons employed, as compared with one for 538 in the preceding year. The total quantity of mineral wrought in the different districts was 194,605,887 tons, of which 181,614,288 was coal and 8,117,476 ironstone, the rest being fireclay, oil shale, and other minerals, making a total increase of 4,972,231 tons compared with the preceding year. There was an increase of 4,697,564 tons of coal, but a decrease of 153,066 tons of ironstone. The output of coal last year shows an increase of nearly 53 million tons over that of 1873.

Some interesting information concerning the ratios of the fatal accidents and the deaths to the number of persons employed in and about the mines under the present and former Coal Mines Acts is given for the periods covered by the first three Acts, and in detail, with averages since 1872. From these we see the great increase of safety in the occupation of miners during the operation of these Acts, the average ratio under the first Act being one death in every 233 persons employed, under the second Act one death in 258, under the third Act one death in 312, under the fourth Act one death in 466, while for the past year it is one in 528. A table of the hours of the deceased persons' shifts in which the fatal accidents happened shows that in only five cases had those to whom the accidents occurred worked more than twelve hours. The total number of persons employed under the Metalliferous Mines Regulation Act was 42,054, of whom 1,393 were females employed above ground. There were 38 fatal accidents and 46 deaths, the number of accidents being 26 less and the number of deaths 18 less than in the preceding year. There was one fatal accident for every 1,106 persons employed, and one death for every 914 persons employed, which are more favourable ratios than in any preceding year.

COST OF CENTRAL STATIONS.

A paper on this subject was read before the Institution of Civil Engineers by Mr. Crompton last Tuesday. We publish an abstract in another column. Mr. Crompton has always been a great advocate of the publicity of central station figures, and he acts up to his precepts by publishing the figures of his own stations as fully as possible. It is greatly to be wished other engineers would follow his example. A station in London cannot be the trade rival of a station in Manchester, so that the withholding of information is futile. If the two stations were to compare notes they could select what is good and reject what is bad in each, and thus they would largely increase the business of both. The electric engineering industry has been a good deal hampered by secresy. In incandescent lamp making each maker kept his processes to himself rigidly. Dynamo designing was regarded as an erudite mystery till it was popularised, chiefly by Mr. Kapp. Cable making is a profound mystery even now. Transformer design was kept back, not by secresy, but by the publication of elaborate but useless formulæ, which do not fit in with the facts. There is now, however, the greatest uncertainty as to the real first cost of various systems of distribution, and as to the efficiency and cost of running, and the sooner actual facts are made public the sooner will electric lighting be on a sounder basis.

THE LATE MR. BRYCE-DOUGLAS.

We greatly regret to have to record the death of Mr. Archibald Douglas Bryce-Douglas, which took place at his residence at Ardrossan, Ayrshire, on Sunday last, after a week's illness. He came down to the Clyde in the new steamer the "Empress of Japan," one of the fleet of vessels built by the Barrow Naval Construction and Armaments Company for the Canadian Pacific Railway Company, and on the passage was seized with illness. He was, however, able to proceed to his residence at Ardrossan, but his illness rapidly developed into peritonitis, and ended fatally. He was a man of vigorous physique, but for some months past he had not been in his usual health.

Mr. Bryce-Douglas is another notable example of what can be done by force of character and natural abilities, rather than by systematic training, for of the latter he received comparatively little. He was the son of the Rev. John Bryce, the parish minister of Ardrossan, and, having been born in the year 1840, was at the time of his death only 50 years of age. Like many other Scotch youths his father destined him for the ministry of the Scotch Church, but as he grew up it soon became evident that his vocation lay in an entirely different direction. After serving a two years' apprenticeship with a local joiner, he went to Glasgow, and entered the engineering establishment of Messrs. Randolph, Elder, & Co., then situated in Centre Street. He gained much experience there, and attracted the attention of Mr. Charles Randolph, who soon perceived the great natural abilities of the young man. But the spirit of adventure was strong within him, and after a few years in Centre Street he went as a passenger in a sailing vessel to Auckland, where he had the promise of an appointment to take charge of an important machinery plant. The carpenter died during the voyage, and Mr. Bryce was offered and accepted the position thus rendered vacant.

On arriving in New Zealand the Maori War had just broken out, and, taking the situation in at a glance, he soon found an opportunity of working his passage, with a well-known captain of one of our ocean liners, to the Pacific Coast. For about a year he was in the service of the Peruvian Navy, at the end of which time he was offered, and accepted, a situation as a sea-going engineer with the Pacific Steam Navigation Company, and thus formed a connection which may be said to have terminated only with his death. In the year 1865 he revisited Scotland, and after spending a few months with his friends, and successfully undergoing his examination for "extra first-class" engineer, he returned to Callao to become assistant engineer of the Pacific Company. This position he occupied till 1869. In that year the headquarters of the company were removed from the island of Tobogo, in the Bay of Panama, to Callao, on the establishment of a line of steamers to sail direct between Liverpool and Valparaiso. A vacancy took place at the same time in the office of the superintending engineer, through the resignation of Mr. Jamieson, and Mr. Bryce received the appointment, which he held for a period of six or seven years. On his way home an incident occurred which was an index of the character of the man. A small coal-laden vessel had stranded in the Bay of Panama. He took with him from Callao a staff of men and the necessary appliances with the view of raising her. On arriving in the bay, he learned that the "Tagus," one of the Royal Mail Company's steamers, had gone ashore near Colon. Unable, on account of the heavy sea, to accomplish the work which he had come to do, he crossed the isthmus with his staff and appliances, and successfully carried out the more difficult task of raising the "Tagus." The other vessel was also raised in due course, Mr. Bryce not only directing, but taking an active part in working in the diving bells and repairing the hulls, his fertility of resource being displayed on the occasion by the employment of a locomotive to work the pumps.

On his return to this country, Mr. Bryce resumed his connection with the firm from whom he had received his early training, the works having been removed from Centre Street to much larger premises at Fairfield. When Dr. Kirk left the firm to become senior partner with Messrs. Robert Napier & Sons, Mr. Bryce became the head of the engineering department at Fairfield, which was then carried on under the name of John Elder & Co., although Mr. John Elder had died some years previously, and Mr. (afterwards Sir) William Pearce was its leading spirit. The years that immediately followed were probably the most important in the history of the

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undertaking, for during that period there were turned out the "Arizona," the "Alaska," and the "Oregon." The great revolution which took place at that time in ocean-going steamers owed much to Mr. Pearce and Mr. Bryce-Douglas. About this time the latter had added the name Douglas to that of Bryce, on succeeding to a small landed estate in Ayrshire. Besides the engines for the Cunard liners, Mr. Bryce-Douglas constructed several sets for the Orient Line and for foreign ships of war, in addition to many for ordinary merchant steamers.

In 1888 he accepted the position of managing director of the Naval Construction and Armaments Company, which took over the works of the Barrow Shipbuilding Company, and he soon introduced new life into that concern. Important contracts were secured from the Pacific Steam Navigation Company, the British African Steam Navigation Company, the Canadian Pacific Railway Company, and the British Admiralty. The latter included three second-class cruisers, all of which have been launched, and one—the "Latona"—has been delivered. The work for the Canadian Pacific Company included three high-speed 6,000 tons steamers, for the service between Vancouver and Japan and China. The pioneer ship, the "Empress of India," is now on her first voyage; her sister ship, the "Empress of Japan," ran most successful trials last week; while the third, the "Empress of China," was launched a fortnight ago. There are at present in the yard many ships of different sizes and types. It is understood, moreover, that negotiations are well advanced for the building of four fast steamers for a new line from England to Canada, which are intended to cross the Atlantic in five days. In all these projects Mr. Bryce-Douglas was the leading spirit, and it will be very difficult to fill his place at Barrow.

It is somewhat remarkable that many of those who took active parts in the Fairfield Works should, like Mr. Bryce-Douglas, have died in the prime of life, and just when they were in a position to do their best work. Mr. John Elder, Sir William Pearce, and Mr. John Jamieson were all comparatively young men at the time of their deaths. The burden of such large concerns, falling as it generally does on the shoulders of one or two persons, would seem too great for even the strongest of men.

The funeral took place on Wednesday, and, according to the expressed wish of Mr. Bryce-Douglas before his death, was strictly private, the relatives, trustees, a few neighbours, and representatives of the Barrow firm and Canadian Pacific Railway Company comprising the funeral *cortège*.

Letters to the Editor.

ENGINEERS IN THE ROYAL NAVY.

To the Editor of "Industries."

Sir,—It is encouraging to see that the country is waking up to the fact that some improvement will have to be made in the engineering branch of the Navy, as is shown by the article in *Industries* of the 27th ult., with many of the statements in which naval engineers will agree. But it is evident that the writer has not had much practical experience of the Royal Navy, and without such experience it is almost impossible for anyone to thoroughly appreciate the conditions of that service. As it is important that the country should be in a position to pronounce an intelligent judgment on the question, I would ask for a little space in which to point out some facts which would probably somewhat modify one or two of the views expressed by the writer.

Perhaps the principal point is that referring to educational requirements. The writer states that a fault of all the Admiralty examinations is that they are conducted by men who are good mathematicians, but not as a rule engineers. Well, the person who is principally responsible for the extent of the examination is the Engineer-in-Chief—the late one, Mr. Sennett, now of Messrs. Maudslay's firm, who is referred to in the article, and the present one, Mr. Durston. If these two are not engineers, where shall we find any? But perhaps it may be thought that their responsibility is only nominal; if so, a great mistake would be made, for, though they may not have personally worked at all the details, yet these have only been entrusted to gentlemen who, it cannot be denied, are good mathematicians, but who, at the same time, are most decidedly engineers, if long training and hard work at their profession can make them so, and over the results of the whole the Engineers-in-Chief have exercised a decidedly close control.

The fundamental idea of the writer, and one which I would venture to decidedly dispute, is that the work of a naval engineer is comparable to that of an engineer of the merchant service. This appears in speaking of the "artificers" also. Now an artificer is a workman pure and simple. It is said that if he go into the merchant service he can become manager or superintending engineer, while in the Navy he remains an artificer. With regard to the first statement, perhaps my acquaintance with the merchant service is not sufficient to enable me to speak with authority, but I have a shrewd idea that to get into, say, the P. and O., the Cunard, or the White Star Companies, requires something more than a knowledge of workshop practice; this something more does not, perhaps, take the form of mathematics or physics, though such things as "extra firsts" are fairly well competed for, but there it is. At the present time I should say the chances of an ordinary workman ever becoming much above first engineer of an ocean tramp are rather limited; I am here, however, open to correction. But certainly the workman will not do for the Navy; hard experience tells us this, and we have been through the whole thing.

The original naval engineer was the man of workshop practice and little else, and necessity has driven us to our present state. In the first place, take the cream of the merchant service, the "big liners," what has the chief engineer to do? Simply to drive his engines as hard as he can from port to port. When he comes home he is at once in the hands of the superintendent. At sea his staff go below in turn to take their watch with the one object in view of keeping the engines going, and, their watch over, take their rest till the next one. On the other hand, the chief engineer of a battle-ship has delivered to him a ship, of which the actual propelling engines will probably be almost his least trouble; she is crammed from stem to stern with machinery; the very air for the men to breathe and water to drink he must supply; the hull is in his charge in conjunction with the carpenter; electric lights, as no electrician is carried; torpedoes; gun mounting, and the hydraulic gear for working them; in some cases the workshop necessary would make quite a respectable factory on shore; and, besides this, he has delivered to his care the welfare of some hundred or more men. All these he is responsible for during a period of three or four years. True, he may go to a dockyard during that time—but woe be to him if his list of defects should be considered too big!—and during that time the whole has to be kept in perfect order and readiness at every moment, *as a fighting machine*. I italicise these words because it often appears when critics, and some even belonging to the Navy, are writing, as if they forgot this fact. A good pair of legs and the ability to use them were, I believe, considered of use in the now defunct prize ring, but I do not think it was customary to cry down a pugilist because he took longer over a hundred yards than a champion sprinter, yet it has always appeared to me exactly a parallel case when certain gentlemen dilate so persistently on the speed at which the "City of Paris," &c., can run as compared with our warships.

Now it is as certain as anything can be that to be able to carry out the duties I have stated, and to carry them out in conjunction with other officers, the naval engineer must be an educated man, and it is for this reason that the Admiralty institute the examination. It will not, I suppose, be contended that a man cannot be both a mathematician and an engineer. If it be so, then I say that the present engineer officers are a direct proof to the contrary. Some few, perhaps, may consider the drudgery of their profession somewhat beneath them, and these get noticed, and so a false impression may be created; but these even are not so useless as many imagine, and instances have occurred in which such men, by the command they have obtained over their subordinates, have carried out their duties in a thoroughly efficient manner, and it is here that education often tells. I would not, however, be understood as expressing approval of this, and the instances are few, and, speaking generally, I may say that the blackest, filthiest looking figures I have at times come across in the interiors of boilers, bilges, and other secluded retreats have been the men of the highest mathematical attainments.

With regard to the approval expressed of the institution of competition, it hardly appears to agree with the remainder of the paragraph, unless it is assumed that the grievances mentioned in the commencement will be remedied, and if this is to be done the remedy lies in the hands of the profession outside by religiously ignoring these competitions until it is done. It is doubtful, however, whether this is a good step or not. The Navy is a peculiar service—how peculiar is only known to those in it—and personally I think that a really good naval officer must have been caught young; also he should have commenced as an officer. This clashes with your views as to the artificers, but, although I wish it were otherwise, it is, I am afraid, a hard fact.

The case of Mr. Sennett leaving the service is mentioned, and I may mention that his is not an isolated case, the following names coming to my mind now:—Mr. Seaton, of Earle's; Mr. Spence, of Newcastle; Mr. Milton, of Lloyd's; Mr. Morcom, of Bellis & Co.; Mr. Soper, of Humphreys and Tennant's; Mr. Hearson, of Cooper's Hill. There are others whom I cannot now remember; and I cannot resist adding, these all originally made their mark by reason of their "high mathematical attainments."

Yours, &c.,
A.E.

Portsmouth, 4th April, 1891.

THE INSTITUTION OF NAVAL ARCHITECTS.

To the Editor of "Industries."

Sir,—Referring to the letter of "M.I.N.A.," dated from Glasgow, on page 327 of your last week's issue, I shall be glad to put on record at least one East Coast member's approval of the suggested alteration of the arrangements of this Institution, so as to permit of at least two meetings being held per annum, one being held in London, the remaining one or more being held alternately in the various shipbuilding and marine engineering centres throughout the country. There must be many members who, like myself, cannot always go to the Institution, and if, therefore, the Institution were occasionally to come to us we should be kept better in sympathy with its movements than is at present the case.

I am also strongly in favour of the view expressed at the late meeting by Lord Ravensworth, that not more than one paper should be read at one sitting, as there would then be an absence of that feeling during the discussion which now exists—viz., that there is such a pressure of business coming on that the less is said in discussion the better. It is generally thought by the members of all such Institutions that, as a rule, as much or more is learnt during a good discussion as by the reading of a paper itself, and, therefore, there is the more reason for giving ample scope to those who wish to continue a discussion.

I presume the idea of permitting written remarks from absent members to be printed in the Proceedings together with the record of the verbal discussions only needs to be mentioned to be adopted, as it would appear to be difficult to find an objection thereto.

For my own part, I have only been able to attend two meetings in six years, and if my case be similar to that of many other North-country members, the force of the suggested alterations will be at once apparent.

Yours, &c.,
An East Coast M.I.N.A.

Hartlepool, 6th April, 1891.

THE BOILER REGISTRATION AND INSPECTION BILL.

To the Editor of "Industries."

Sir,—In a recent article in the *Times* (and reprinted in the *Manchester Guardian*) upon the Bill which has been prepared by the Manchester Steam Users' Association, and introduced into the House of Commons by Sir William Houldsworth and others, several statements are made which are totally incorrect, and, as the subject is an extremely important one to the steam-using community of this kingdom, I trust you will allow me to point them out.

It is stated that "the Boiler Explosions Act of 1882 is not intended for purposes either of prevention or of punishment. It provides only for an inquiry after the mischief has been done." What, then, is to be considered the object of clause 7 of that Act, which reads—"The court may order the costs and expenses of a preliminary inquiry or formal investigation, or any part thereof, including therein the remuneration of persons holding such inquiry or investigation, to be paid by any person summoned before it, or by the Board of Trade; and such order shall on the application of any party entitled to the benefit of the same be enforced by any court of summary jurisdiction as if such costs and expenses were a penalty imposed by such court"?

Since the 29th August, 1889, no less than thirty-one of these formal investigations have been made, wherein fines of various amounts from £10 to £80 have been inflicted, which is sufficient evidence of the punitive character of the Act. Its value in preventing explosions can be sufficiently gathered and is well shown by the figures given in the article, which states that "from the reports of the late Mr. Thomas Gray to the Board of Trade, in five and a half years ending December 31st, 1887, there were 176 persons killed by boiler explosions and 311 injured," or an average of 32 killed and 56 injured per annum. "From the records of the Manchester Steam Users' Association from the beginning of 1871 down to the end of 1890 there were 1,005 persons killed and 1,650 injured," or an average of 53 killed and 87 injured per annum, showing a reduction of 39⅓ per cent. in deaths and 35⅓ per cent. in persons injured owing to the beneficial operation of this Act. It must be noted that during the first seven years of the operation of the Act—viz., until August, 1889, with one exception, preliminary inquiries only were held to the number of 336, and in one solitary instance a formal investigation was made, but without putting the punitive clause in force. Mr. William Summers, M.P. for Huddersfield, then brought these facts before the House, and inquired what were the intentions of the Board of Trade. Sir Michael Hicks-Beach admitted that the Act had not hitherto been properly enforced, and stated that he was "carefully considering whether in the public interest the Act could not be more stringently enforced in future," with the result, as already stated, that since that date no less than thirty-one formal investigations have been held. At the same time Sir Michael Hicks-Beach said, after considering the question, he "did not consider that any further powers were necessary."

I would observe with regard to the comparison attempted to be instituted between the number of boiler explosions occurring on passenger steamers—viz., eleven in a period of ten years upon 1,900 vessels—that no comparison can be fairly instituted without at the same time giving the number of boilers on land, which so far as my opportunities of estimation go would appear to be about 200,000. Further, in regard to these boilers on passenger steamers and also to those under the care of the Manchester Steam Users' Association, it must be observed that they are all internally fired, and of a special class, and in fact the "very pick" of the boilers in the kingdom, which fact would alone render comparison unfair. Further, it is observed, after giving some particulars of two explosions—one at Radcliffe (which occurred nearly nine years ago) and another at Charlesworth, in which another boiler insurance company was interested:—"It is thus clear that the willingness of an insurance company to undertake a risk gives no security whatever for the trustworthiness of the thing insured; the object of the company is not to prevent accidents, but to pay dividends to the shareholders." That this is a grossly false statement can be easily proved, at any rate so far as the operations of the company which I represent are concerned, by a reference to the same documents already referred to—viz., the Board of Trade reports. Since I have been the chief engineer of this company—viz., from the 17th August, 1888—no explosion has occurred where the Board of Trade investigation has imputed any blame either to this company or to any of its officers, and during the last year upon which the present assistant secretary of the Board of Trade reported it will be seen that the Manchester Steam Users' Association have had one explosion out of about 5,000 boilers; while we had only one in over 27,000 boilers; that five boilers under the inspection of Lloyd's surveyors have exploded, and one that was also inspected by both Board of Trade and Lloyd's surveyors. My company employ quite as large a proportionate number of inspectors for the number of boilers they have under their charge as the Manchester Steam Users' Association, and they are equally competent, and are as highly paid. I scarcely think that the Steam Users' Association would for a moment pretend that their inspection is either more frequent, careful, or more reliable than that given by my company, the principal object of which is to prevent accidents, and we think we are fairly successful in so doing.

Whether such one-sided and biassed statements against insurance companies will have the desired effect in reducing their importance I cannot say, and I do not attempt to determine whether any useful purpose can be served by such statements as the following:—"The boiler owner proceeds on a like plan; he knows well that a boiler may be unsafe for a long time before it actually bursts. He dislikes accordingly to be fixed with notice of its faults or to allow them to be exhibited before his workpeople. He works his boiler to death, and he trusts that when the explosion comes, as come it must, it may not prove a specially bad job, or at least that its fatal consequences may be borne by others, not by himself."

There are one or two other sentences which I think are worth the notice of boiler owners in regard to the Bill, such as—"It goes as far as its advocates and promoters think they can go with safety for the present, and without provoking an opposition which might be fatal to the Bill. . . . It it fails on trial it can be strengthened afterwards."

Those boiler owners who think further interference with the working of their plant is undesirable will no doubt look to the

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matter, and take such steps that the Bill may be thrown out on the second reading, which is to take place on the 21st inst.

Yours, &c.,
J. F. L. Crosland,
Chief Engineer,
The Boiler Insurance and Steam Power Company, Limited.
67, King Street, Manchester, 4th April, 1891.

NOTES ON PATENT LAW.

II.

THE PATENTEES' STATUTORY RIGHTS.

(*Continued from page* 328.)

From the passage in our last article quoted from the Statute of Monopolies, it will be seen that the measure of the rights which a patentee acquires by virtue of the patent grant was not defined, but assumed, and that to ascertain what they were it was necessary to look to the language of the patent itself. So the matter stood until the year 1883, but the Patent Act passed in that year incorporated in its first schedule a form of patent which has thus acquired direct statutory force and authority. What would be the effect of a patent grant expressed in other terms than these may be a nice question for the curious, but it in no way concerns us at the present time, for the Patent Office has no power to grant any patent save in the statutory form, and for all practical purposes, therefore, this is the only monopoly of trading rights which the English law will recognise.

The privilege conferred by this grant is the "full power sole privilege and authority that the said patentee by himself his agents or licensees and no others may at all times hereafter during the term of years herein mentioned make use exercise and vend the said invention within our United Kingdom of Great Britain and Ireland and Isle of Man in such manner as to him or them may seem meet and that the said patentee shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention during the term of fourteen years from the date hereunder written of these presents." For the better corroboration of these rights the patent goes on to enjoin "all our subjects whatsoever within our United Kingdom of Great Britain and Ireland and the Isle of Man" to abstain from directly or indirectly making use of or putting in practice the said invention or any part thereof, or in anywise imitating it, or from making any addition to or subtraction from it whereby to pretend themselves the inventors thereof; and, finally, grants to the patentee that the letters patent shall be construed in the most beneficial sense for his benefit.

These clauses contain an admirable summary of patent rights, and will repay careful consideration. For this purpose it should be borne in mind that the "invention" referred to is the invention as defined by the complete specification. It is well known that a specification must accompany every application for a patent grant, and that the patent can only be sealed after the lodging in the Patent Office of a complete specification, which comprises a claim or claims in which the patentee sets forth precisely what he desires to have protected and secured to his exclusive use. Now the invention so defined may be a new product, like the incandescent electric lamp, or a new process, like the recently invented modes of treating alkali waste, or a new combination of old parts, like a patent lock. The language of the patent will cover all these varieties of invention. Thus, if the article be new in itself, no one without the patentee's licence may make, use, or vend it; if it be a new process, the public can only put it in practice subject to the same restriction, and the case of a new combination of old parts is for present purposes on all fours with the case of a completely new article. When properly secured by a suitable claim such rights may be fully effectual to confine to the patentee the entire trade, however valuable and important that may be, in the patented invention. This case is well illustrated at the present time by the well-known monopoly in the manufacture of incandescent electric lamps possessed by the Edison & Swan United Company. This monopoly rests upon a specification in which, in the year 1879, Mr. Edison disclosed the idea of a carbon filament enclosed in an exhausted receiver composed entirely of glass, and having no communication with the atmosphere outside save through the leading-in platinum wires sealed through the substance of the glass. Such a combination contains all the essential features of an incandescent lamp, and although other inventors—Swan in particular—had, before the date of Edison's patent, come exceedingly close to it, they had not actually used or described it. It will easily be believed that at this early date Edison himself did not know how to make anything approximating in serviceableness to the modern lamp. Nobody would nowadays buy, save as a matter of curiosity, a lamp constructed according to the precise directions contained in his specification. But such lamps, though quite unfitted to compete with more modern productions, were distinctly in advance of anything that had been made before, and even the latest lamp containing a filamentous carbon falls within the very comprehensive description that Edison in his specification gave of the lamp which he claimed for his invention. Hence, in spite of numerous improvements in the lamp itself, and in spite of the vast growth of the public demand for lamps of this class, the company which owns this patent has succeeded in keeping competitors out of the field and maintaining a strict monopoly of this most important industry.

It is not against competing manufacturers and vendors only that a patentee can now assert his monopoly. The Patent Act of 1883 has made his patent valid as against the Crown, going in this respect beyond the earlier legislation. But this extension of the patentee's rights is subject to the express limitation that the officers of any department of the service of the Crown may use the invention for the services of the Crown on terms to be before *or after* the use thereof agreed on with the patentee, or in default of agreement to be settled by the Treasury after hearing the parties interested.

Such, in broad outline, are the patentee's rights as laid down by statute; but for their fair appreciation it is necessary to inquire a little more nearly into what precisely is signified by the important words which prohibit the making, using, &c., of the invention by any person other than the patentee or such as have his authority. For in some circumstances the mere possession of a patented article may be in the nature of an infringement of the patent. This was shown some six years ago by a very remarkable judgment obtained by the United Telephone Company. That company complained that another company, the London and Globe Telephone Maintenance Company, had possession of some 800 telephones made in America and imported into the United Kingdom in derogation of their rights. The defendant company pleaded that the instruments in question had never been used by them and that the parts which infringed the plaintiffs' patent had been removed. They contended upon that state of facts that the mere possession of the severed parts of the instruments could not be an infringement, since it clearly was not a making, using, or vending of the plantiffs' invention. And this contention was so far recognised that the judge who tried the case refused to make an order for the delivery up or destruction of the goods, as is usual when infringement has been proved, but, on the other hand, he made an order that the defendants should be restrained from putting the parts together again and from utilising them for their intended purpose during the continuance of the patent, and, what was more important still for the litigants, he made the defendants liable for the costs of the action. This is undoubtedly a case in which the patentee's rights were put very high, but there is no ground whatever for thinking that it was wrongly decided, and it certainly shows that the courts in a proper case will give the most ample protection to a patentee against any invasion, though only threatened, of his patent rights.

On the other hand, it is by no means every possible use of a patented invention which, if unlicensed by the patentee, will amount to an infringement of the patent right. It appears from the terms of the grant that its object is to secure to the grantee that he "shall have and enjoy the whole profit and advantage from time to time accruing by reason of the said invention" during the term of the patent. Accordingly it has been held that a making or using of the invention which does not interfere with this purpose is no infringement. On this ground it has been decided that any person may use it by way of amusement or experiment. This statement needs, however, to be guarded by a reference to the object of the invention, for it cannot be supposed that the making of a patented toy, for example, for the purpose of amusement would be treated as a non-infringement on this principle. But probably it is not worth while, in a discussion such as the present, to refine upon this head. The practical importance of the principle is this—that any person is at liberty to make a patented article for the purpose of experiment with a view to improving upon it without any licence from the patentee. In such a case the object in view is all-important, for any endeavour to evade the patent right under colour of a scientific experiment would be most sternly repressed. On the other hand, the courts will never assist in restricting the facilities of invention and improvement, to cultivate which constitutes indeed the main object of the whole patent law, and hence where mere experiment is in question, made *bonâ fide* for the purpose of improving the invention, no complaint of infringement will be entertained. Whether an experiment made for the scientific purpose of ascertaining the merits of the invention would be equally protected is perhaps not quite so clear, but apparently that would on principle be so, since the only injury which any other maker or user of the invention can possibly do the patentee is that of depriving him of some part of "profit and advantage" arising from it.

There is yet another case of what may be quite intelligibly, though perhaps not quite accurately, called the use of a patented article, of which the patentee is not allowed to complain. That is the case in which the same materials may be applied to two or more totally distinct purposes, and in which one application of them may have been patented, but not the other. The case does not, indeed, often or easily arise, but an instance may be quoted in the case of soft metal packing for pistons, piston rods, and other moving parts of machinery. It was discovered that a perfectly good joint might be made for a pump, for example, by packing the piston with a soft alloy, and a patent was obtained for this invention; subsequently it was discovered that the use of such metal greatly diminished friction in an engine running at high speed, and another patentee obtained protection for soft metal bearings applied to this purpose. In an action brought by the owner of the second patent against the owner of the first, an attempt was made to set up the earlier patent as an anticipation of the later, but it was held that the object, and therefore the use, of the metal under the second patent was quite distinct from that under the first, and although the question of infringement is not the same as that of anticipation, it seems clear that in this case there could be no infringement in the use by the second patentee of what he had himself invented and patented, notwithstanding its close resemblance to what had been patented before.

We are now, perhaps, in a position to sum up in general terms the rights against the public which a patentee obtains under his grant. Without attempting fastidious accuracy, we may define them thus—They comprise the right to enjoy all the profit and advantage which can arise from the exclusive power of making, using, selling, or exercising his invention, and for this purpose to recover by way of damages the amount of any profit or the value of any advantage which may have been derived from this source by other people without his licence, and to restrain by the injunction of a court of law the repetition of any act or the commission of any threatened act which would deprive him of any part of his profit or advantage—in one word, the whole commercial benefit of a monopoly of his invention.

It is evident now that one all-important inquiry is as to how the invention is to be defined. With that topic we shall deal in our next article.

(*To be continued.*)

Books Received.

American Chemical Journal. Vol. XIII. No. 1.

The Future Situs of the Principal Iron Production of the World. By E. Atkinson. Baltimore: The Manufacturers' Record Company.

Sur la Propagation du Courant Electrique. Par A. Bandsept. Bruxelles: V. Verteneuil.

Memoir of Henry Muirhead, M.D., LL.D. By Henry Dyer, C.E., M.A., D.Sc. Glasgow: Printed by Robert Anderson.

Transactions of the American Society of Mechanical Engineers. Vol. XI. 1890.

Trade Unionism, New and Old. By George Howell, M.P. London: Methuen & Co.

Geometry of Position. By Robert H. Graham. London: Macmillan & Co.

North of England Institute of Mining and Mechanical Engineers. Report of the French Commission on the Use of Explosives in the Presence of Fire-damp in Mines.

Honest Labour versus School of Scandal. Irish Industrial Facts addressed to the Taxpayer of the British Empire. Dublin: J. Atkinson & Co.

Preliminary Survey and Estimates. By Theodore Graham Gribble. London: Longmans, Green, & Co.

Reviews.

Lockwood's Builder's and Contractor's Price Book. London: Crosby Lockwood & Sons. 1891.

The new issue of Lockwood's Price Book is not in any essential respect different from that of last year. Then it had been considerably enlarged and re-written, bringing it up to date and making it one of the most handy and reliable books upon builders' prices to be had. It must be always be borne in mind, however, in using it, that the prices given are for first-class work only, and in general practice it will be found that these are somewhat in excess of the average value of fair work. Proper attention has been drawn to this in the preface, but another equally important point, which has not been there mentioned, is that where manufacturers' prices are quoted, the catalogue prices are given, and many of these

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it is well known, are subject to heavy trade discounts. It is very noticeable, especially in the section dealing with sanitation, that appliances which are now discredited are not even mentioned, although this same care has been carried somewhat far in the exclusion also of new forms of apparatus which are undoubtably good. As these have yet to be subjected to the time test, the fault is on the right side. The addition of a few legal notes—which might well be increased in number—and of the Phœnix regulations for electric light installations, are valuable new features in this year's edition of a book which is annually being more largely used.

HAZELL'S ANNUAL FOR 1891. London: HAZELL, WATSON, & VINEY, LIMITED. 1891.

This is the sixth year of issue of this very useful annual, and it is evident that every effort has been made to maintain the position which the book has obtained for accuracy and usefulness. In order to allow room for new material and for the notice of recent events, a good many of the articles in the previous editions have been omitted from this one, but in the index there is a reference to those articles, so that the series of volumes gives a continuous record of events and of the subjects which are being discussed by the public. Among the latter, one stands paramount in importance—the Labour Movement—and this is very fully treated in the pages of the present volume. Changes in foreign politics have been duly noted, while commercial topics have received special attention, and the articles on trade, Stock Exchange movements, insurance, mercantile marine, and the McKinley tariff may be mentioned as examples. Short biographies have always formed a feature in the work, and in the present edition about two hundred of such have been added to the already large number of biographies of the notable men and women of to-day. Lawyers will find a record of the chief legal decisions of the year, and engineers will find details of the several schemes, either completed or in progress, during the last twelve months. Altogether the annual is one of the most useful productions of the present day.

WEBSTER'S INTERNATIONAL DICTIONARY OF THE ENGLISH LANGUAGE. Authorised Edition. London: GEORGE BELL & SONS. 1890.

The thoroughly revised edition of this dictionary, which comprises the issues of 1864, 1879, and 1884, has been the result of ten years' work. We are informed that more than a hundred paid editorial assistants have been engaged in the revision, and more than £60,000 has been spent upon it before the issue of a single copy. The book contains 2,118 pages and nearly 4,000 illustrations, many of which are embodied in the text, whilst others are to be found in the appendix. In addition to the dictionary of words, there are valuable appendices, which comprise a gazetteer of the world, vocabularies of proper names, a dictionary of quotations, and a bibliographical dictionary with 10,000 names. Many terms which have been lately introduced into the language through the development of electricity are found fully and fairly accurately defined, the meaning of the various units being stated with general clearness. Such electrical terms as "hysteresis," "induction," are to be found in this edition, but we notice the absence of the word "henry," which is perhaps too recent an addition to electrical nomenclature to be included. From the very complete character of the work the book is somewhat ponderous, but the illustrations are neat and clear, the letterpress is good, and, viewed as a whole, it is a remarkable example of useful literary labour. We have pleasure in commending it to our readers.

FIRST PRINCIPLES OF ELECTRICAL ENGINEERING. By C. H. W. Biggs. London: BIGGS & CO.

This little work is an elementary book for beginners, and the author has certainly hit upon a "long-felt want" which many people have attempted to fill. As anyone knowing Mr. Biggs' ideas on the subject would expect, the author has carried the notion of circuits almost as far as it will go. He deals with conductive, inductive, and magnetic circuits. We do not agree with the author in this, but, after all, it is really a matter of opinion, and Mr. Biggs is fully entitled to hold his own opinion. There is no doubt that the idea of magnetic resistance helps many students greatly, and Mr. Biggs, therefore, follows out the supposed analogy as thoroughly as possible. It is somewhat out of date to work in what are generally called Kapp lines. This method of calculation never came into general use, and we doubt if Mr. Kapp himself uses it now. There are several slips in the book, which ought to be corrected in the next edition. The book has a copious index, which is a very commendable feature.

REFLECTIONS ON THE MOTIVE POWER OF HEAT, AND ON MACHINES FITTED TO DEVELOP THAT POWER. From the original French of N. L. S. Carnot. Edited by R. H. Thurston, M.A., LL.D., &c. London: MACMILLAN & Co. 1890.

Carnot's "Réflexions sur la Puissance Motrice du Feu," which was published in 1824, and laid the foundation of the modern thermodynamical theory of heat engines was for a long time out of print, and was consequently for many years very scarce. Some years ago it was reprinted by the firm of Gauthier-Villars, Paris, and in one of our earlier volumes we gave a short notice of it. No translation of it in English, however, appeared till last year, when the one above mentioned was issued by the firm of Macmillan & Co. Possibly some critics might say that a translation of such a work was unnecessary, since every one who was likely to read it would be able to do so in the original, but this does not at all follow, for there are many who take an interest in the subject of thermodynamics who have not an easy working knowledge of French. In any case we think that such a work should be accessible to all English readers, and the publishers have done well in meeting this want. They explain that the *raison d'être* for the appearance of the work is not the usual one, and that it is published as matter of limited but most intense scientific interest, and on that score alone. The translation has been edited by Professor Thurston, of Sibley College, Cornell University, and we must say that we could have wished that a little more care had been taken in supervising it, as we have observed several rather serious slips. On the whole, however, the book will fill a want.

Appended to Carnot's work is the celebrated work of Sir William Thomson in which he gave his "Account of Carnot's Theory," and made known to the world the treasure so long concealed and unnoticed, among the scientific literature, already mainly antiquated, of the first quarter of the nineteenth century. Translated from the reprint we have mentioned there is a sketch of the life of Sadi Carnot by his brother M. H. Carnot, while the Appendix contains a number of Carnot's own notes and reflections, many of which are well worthy of study and of being remembered. The book is dedicated to the present President of the French Republic, who is a grandnephew of Carnot.

A NEW NON-CONDUCTING MATERIAL.

WE recently had an opportunity of inspecting a new non-conducting material, which we think will be found exceedingly efficacious as a covering for steam pipes. It is composed of waste cork from the Spanish cork factories, and is compressed into sheets or slabs with some glutinous material. It is then rolled between two sheets of coarsely woven canvas, and its continuity is thus secured. It can when finished be cut into strips or sheets of any desired size. Owing partly to its porous nature, the material possesses very high non-conducting properties, and, being made in several thicknesses, is readily adaptable to all sizes of pipes.

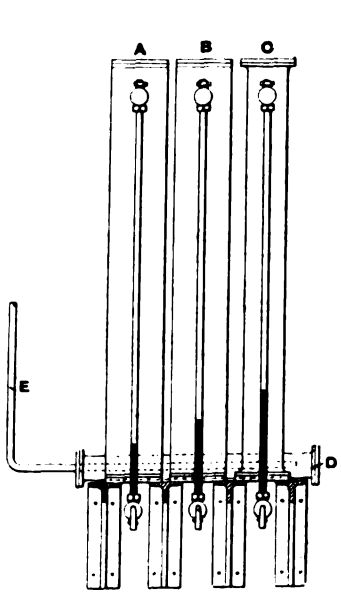


FIG. 1.

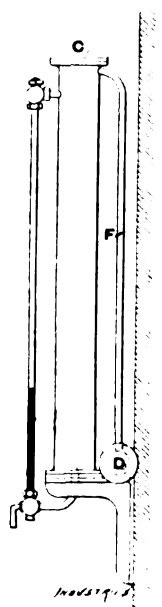


FIG. 2.

For the purpose of exhibiting the non-conducting quality of this material, Mr. Reginald Bolton, of the firm of Messrs. R. Bolton & Co., of 110, Leadenhall Street, London, E.C., who are introducing this covering into this country, has erected in the stores of Messrs. Nicholson & Jennings, electrical engineers, of 132, Horseferry Road, Westminster, an experimental apparatus which we illustrate in Figs. 1 and 2. This consists of three vertical cast-iron pipes, each 5in. diameter, and closed at both ends. One of these pipes marked A is coated with the cork material, the pipe B is covered with an equal thickness of asbestos lagging, and C is left without covering. Each of these radiators is supplied with steam by a pipe F from a receiver D, which receives steam by means of the supply pipe E. The latter extends the whole length of the receiver D, so that the supply of steam to the radiators is unaffected by any exterior circumstances. Separate water gauges are provided for A, B, and C, so that the condensation water can be accurately measured. The results of an experiment made under our supervision are given herewith—

Steam pressure, 30lb. Time of test, 30 minutes.

Weight of steam condensed from cork-covered pipe A	14¼oz.
Weight of steam condensed from asbestos-covered pipe B	23oz.
Weight of steam condensed from uncovered pipe C	35oz.

The material is made in sheets of various thicknesses—that is, from $\frac{3}{16}$in. up to $\frac{3}{4}$in. thick—and in continuous rolls from 2$\frac{3}{4}$in. to 10in. wide.

THE PRINTING, STATIONERY, AND KINDRED TRADES EXHIBITION.

(*Concluded from page* 304.)

MESSRS. BENTLEY & JACKSON, of Bury, showed their "perfecting engines" for refining pulp, which have been described at length in *Industries* (see Vol. VI., page 77), and rag and rope cutting machines. A novelty on their stand was a small indicator, which is intended for attachment to the hopper of the "perfecting engine." This is the invention of Mr. Richardson, and indicates the output of the machine. Messrs. Fielding & Platt, of Gloucester, had on exhibition a 2 h.p. nominal horizontal gas engine, which is too well known to require any special description.

Mr. E. S. Hindley, of 11, Queen Victoria Street, London, E.C., who provided the engines for driving the shafting for the Exhibition, showed a collection of steam engines with and without boilers. The Blackman Ventilating Company, of 63, Fore Street, London, E.C., exhibited their fans, and the Linotype composing machines were also to be seen at work. Messrs. Crossley Brothers exhibited various sizes of their well-known "Otto" gas engines.

Mr. W. C. Horne, of 6, Dowgate Hill, London, E.C., had on view several useful machines. The "Universal" ruling machine, which we illustrate herewith, is a German invention, and is made by the firm of Messrs. Förste & Tromm, Leipzig. Fig. 3, on page 354, shows a general view of this machine, which is strong and compact, and Figs. 1 and 2 represent detail views of the ruling device. The principal feature in the machine is that it rules both sides of the paper at one operation. For this purpose there are two ruling cylinders which are geared together by toothed wheels. The paper when passing through the machine is carried rigidly from the first to the second ruling cylinder, thus ensuring perfect register. On each ruling cylinder there are three ruling spindles (see Fig. 1)

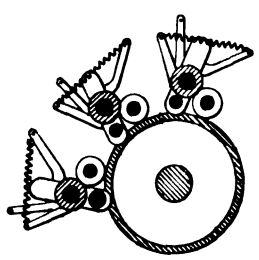


FIG. 1.

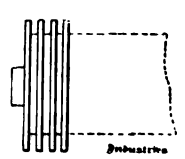


FIG. 2.

and three troughs for ink, which may be of different colours, consequently three colours may be used together. The "striking" gear for "stop-at-head" work is very complete. The end of the ruling cylinder has three grooves (Fig. 2), allowing for the insertion of three different sets of cams, which may be all used together upon one sheet, or kept in position for different sets of headings—as, for instance, one set may be kept in the machine for "foolscap," another for "demy," and one for "post," &c. In the smaller sizes of papers, such as "post" and "foolscap," there is an arrangement, easily adjustable, by means of which two sheets can be ruled by one

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THE "UNIVERSAL" RULING MACHINE.

EXHIBITED BY MR. W. C. HORNE, 6, DOWGATE STREET, LONDON, E.C.

(*For description see page* 353.)

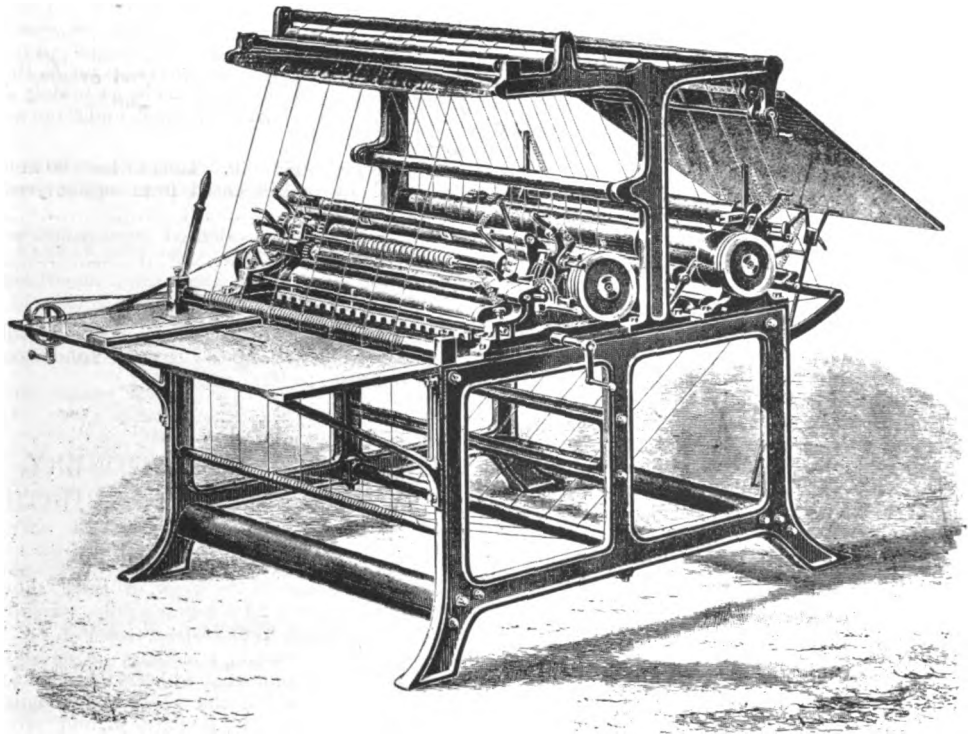


FIG. 3.

revolution of the ruling cylinder. If, when ruling a complicated stop-at-head pattern, it is desirable to stop and do a "run through" job, the only alteration necessary is to loosen one screw, thus avoiding the necessity of removing any wheels or cams. By simply replacing the screw, the stop-at-head job can be again taken up at any moment.

The ruling is done by means of discs of hardened brass, which have many advantages over pens. They will, with care, wear for a very considerable time, and are more quickly placed upon the spindle than pens are as set up in the old wooden frame. It is possible to have four separate jobs on the machine at the same time, any one of which can be worked without disturbing the other. The speed of the machine is entirely dependent upon the feeder. The most complicated patterns can be ruled with a speed equal to ordinary run-through work, and 80 reams per day can be run off complete on both sides. With the discs it is almost impossible to run "blind" lines, and if the pressure be properly regulated at starting and the ink kept well supplied to the troughs there is an absence of broken lines.

ELECTRIC LIGHTING IN HAMPSTEAD.

AT a meeting of the Hampstead Vestry, on the 31st ult., a report was presented by the special committee recently appointed to consider the question as to whether the vestry should undertake the supply of electricity in the parish or permit the Tottenham and Stamford Hill Company to include Hampstead within the area of its operations. Mr. W. H. Preece, F.R.S., had recommended the vestry to undertake the installation of electric lighting, both for street illumination and for the supply of private houses, &c., at an estimated capital outlay of £81,000. With respect to carrying out a portion of the scheme at an outlay of £20,000 or £25,000, or completing the system for the whole parish at once, the committee recommended the latter method, as being likely to be the most agreeable to all residents in the parish.

Mr. Preece estimated that from the private and public lighting an annual revenue would be derived, when the system was in full working order, of £19,500, collected at working charges of £15,800 a year. It is right to explain that in Mr. Preece's estimate of revenue he included £1,400, the increased cost of electric light over gas for public lighting, for which extra outlay about three times the amount of light would be obtained. Even deducting this item there would still remain a profit of £2,300 available towards payment of interest and repayment of capital. The balance of gross profit—viz., £3,700—he showed would be equal to 4·6 per cent. on the capital proposed to be extended. Mr. Preece has calculated that ultimately about 24,000 16 c.p. lamps would be in use, and that the bulk of houses yet to be built would be wired. The cost of wiring and fitting up he put at 25s. per lamp, and the total charge for light 12s. 6d. per lamp, making £12 per annum for twenty lamps, *plus* £25 as the initial cost of fittings, &c. The present cost of gas was, he stated, probably about £10 or £12 a year for the same number of burners, with the addition of charges for plumbing, recolouring of ceilings, &c., so that there would be no material difference between the costs of the two systems. These figures were calculated on the charge for the supply being 6d. per Board of Trade unit.

The report was, after some discussion, received, but the final decision of the vestry was postponed to the 7th prox.

NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.*

PREVENTION OF SPARKING IN MACHINES GENERALLY.

FROM the data furnished by a large number of examples, some of which were given in the paper which I submitted for your consideration twelve months ago, an expression for the load which could be safely carried by armatures without causing sparking was obtained; this expression, though admittedly of an arbitrary character, having been proved by my own experience, and that of my colleagues, to have been of some service. In that paper the term "ampere-turns" was employed to denote the product of the number of conductors on the exterior of the armature and the current carried by each, and I am afraid this may have led to some confusion; at least, so it appears from the discussion. In order that there shall be no misunderstanding in the present case, I shall call this product, quite irrespectively of the number of poles, the *volume* of current carried. The volume is therefore the total current flowing parallel to the armature shaft, independently of direction and whatever the number of poles, and it is obtained by multiplying the conductors on the exterior of the armature by the current flowing in each; or, considering the exterior winding as a copper cylinder, it is the total current flowing in its parallel to the axis.

In his paper on "Armature Reactions," read here last year, Mr. Swinburne had worked out the limiting load from a theoretical point of view, and those who were present will remember that to obtain the results given in his paper the author assumed that the brushes were placed almost close to the polar tips. For the moment, however, it will be assumed that the brushes are somewhere near the pole-tips—in their vicinity, let us say—and that the only conductors concerned in producing the cross field are those covered by the pole-pieces. This is sufficiently near the truth for our purpose. Under these circumstances the magnetising force in ampere-turns producing a cross field is, of course, $v\phi/360$, where v is the volume, and ϕ the angle embraced by each pole-piece in degrees. Call l the length of the air gap, measured from the surface of the armature core to the polar surface, and I the induction per square centimetre which would be produced in the gap due to the field magnets alone. When a current flows in the armature the field is weakened at the pole-tips nearer the brushes, and strengthened at those farther from them. Imagine that the armature is loaded so that the forward induction under the nearer pole-tips is just balanced by the cross induction, and we have $v\phi/360 = 2l \times \cdot 8\,\mathrm{I}$, assuming that the components of the cross circuit, other than the air gap, have no resistance. According to this equation, with a value $v = 576\,l\mathrm{I}/\phi$, the forward and cross induction at the pole-tips would be equal, the field would be *nil* at the brushes, and, the machine being unstable, any increase of current would at once cause great sparking.

THE RELATION OF v TO THE DIAMETER OF THE ARMATURE.

But besides taking care that the armature load does not approach the sparking limit, we must provide ample surface for getting rid of the heat generated in the conductors. The first thing to be settled in designing a new machine is what this amount of heat shall be; or, in other words, we must fix the ratio which the energy appearing at the terminals shall bear to the total electrical energy produced. Having settled this, sufficient radiating surface must be allowed to prevent too great a rise in temperature—a point to which due consideration has already been given.

The principal factors which determine the relation of the volume to the diameter of the armature are efficiency and temperature. To carry a given volume we must have, consistent with the waste of power permissible, a certain section of copper; and this copper should be disposed so that a cooling surface is provided sufficient to keep the rise in temperature within the specified limit, while the gap, being of sufficient length to prevent sparking, should have only the dimensions necessary for accommodating the conductors and allowing of proper clearance.

Though the relation lacks definiteness to some extent, I find in the data of a large number of machines indications sufficiently pronounced to justify us in regarding the volume carried by the armatures of two-pole dynamos as proportional to the diameter for all sizes. In designing cylinder machines the value of v may be taken as 400 times the diameter of the armature in centimetres, while for drum armatures the volume is obtained by multiplying the diameter by 600. The cylinder armature has for a given volume a larger diameter, because of the influence of the interior wires. These being heaped inside to one and a half or twice the depth of the exterior winding, also being longer, a larger diameter is required for a given volume, both from efficiency and temperature considerations. Necessarily, the relations here given are not of a hard and fast character, and may be varied considerably. But whatever the proportion adopted, it is absolutely essential that the sparking limit already considered be not too closely approached.

OUTPUT OF DIRECT-CURRENT ARMATURES.

If we call N the total number of lines of force entering the armature from all the poles, however many, and n the number of revolutions per second, the average e.m.f. generated in each conductor is, of course, $\mathrm{N}n\,10^{-8}$. If C be the total current flowing, each conductor will carry, with the sections coupled in the ordinary way, C/p amperes, p being the number of poles. The electrical work due to each conductor is $\mathrm{C}/p \times \mathrm{N}n/10^8$; and the total work, $w\mathrm{C}/p \times \mathrm{N}n/10^8$, where w is the number of conductors, counted all round the exterior of the armature. The quantity $w\mathrm{C}/p$ is what we have called the *volume*, and we get for the total electrical output, in watts, the expression

$$\mathrm{W} = \mathrm{N}nv\,10^{-8},$$

which is quite independent of the manner of coupling up the armature sections. It will be evident, I think, that, with the same relation existing between v and d for two, four, and six poles, the output of an armature of given diameter and length, running at the same speed, is quite independent of the number of poles. It matters not whether N be furnished by two poles only, or by four poles of half the angular width, provided its value remains unaltered.

The volume, then, may be expressed in terms of the diameter. The quantity N may be expressed in terms of the diameter × length of the armature. Taking an induction of 5,000 C.G.S. units per square centimetre in the air gap—a very usual figure—and assuming that the fraction of the armature circumference covered by the pole-pieces = $2{\cdot}25\,d$, we get, calling L the length of the armature in centimetres, 11,250 dL as the total number of lines of force entering the core. Call this, in round numbers, 12,000 dL. Substituting for N and v their values, the output becomes for cylinder armatures

$$\mathrm{W} = {\cdot}048\,d^2Ln$$

and for drum armatures

$$\mathrm{W} = {\cdot}072\,d^2Ln.$$

This applies to all direct-current machines, whether bi-polar or multipolar; though it will be understood, of course, that the induction in the gap may be greater or less than what has been assumed. In that case the coefficients ·048 and ·072 would be altered, without changing, however, the form of the expression.

(*To be continued.*)

* Abstract of a paper read by Mr. W. B. Esson before the Institution of Electrical Engineers on the 9th inst.

THE MANUFACTURE OF SOAP.

BY W. LAWRENCE GADD, F.I.C., F.C.S.

(*Continued from page* 332.)

III.

BEFORE commencing a "boil" of soap the pan should be perfectly clean and free from dirt. A little weak lye is allowed to run into it, and the steam turned into the coils. As soon as the lye is set boiling, a portion of the fat

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or oil to be used is pumped up from the melting-out tanks into the pan, and more weak lye gradually added while the boiling is continued. At first the contents of the pan appear merely as a light, opaque, and frothy emulsion, a small portion of which when taken out of the pan immediately separates into fat and lye; but after a certain time, depending principally on the strength of the lye, the pressure of the steam, and the amount of material boiling, the mixture becomes heavy and semi-transparent, showing that the combination of alkali and fat has taken place. A further quantity of oil or fat may now be added, and, owing to the presence of the soap already formed, this will be more easily saponified, and stronger lye may be used. It sometimes happens that there is some difficulty in getting the fat at once to combine with the lye in a clean pan, in which case the addition of a few bars or scraps of soap materially hastens saponification. In this way the fat and lye are gradually added to the boiling contents of the pan until all the former intended for the charge is pumped in. The boiling is then continued for some time, and stronger caustic lye very gradually added, until there remains, after prolonged boiling, a very slight taste of caustic in the lye, which is separated from a small portion of soap by shaking or stirring, on a shovel, with a handful of common salt.

During this first operation, it is essential that the soap be vigorously beaten or paddled to break up the surface, and so prevent the accumulation of steam in the mass, which would be liable to cause it to "bump" or to froth up and overflow the pan, and also to assist in hastening the saponification. This is sometimes effected by a kind of rotating fan, the blades of which can be adjusted so as



Fig. 3.

to just dip below the surface of the soap, but the common method is to beat it by hand, the spades used being similar to ordinary square light shovels, fitted with long wooden handles, and they are used with a peculiar sculling action, with the handle resting on the pan side. Another form of hand spade is a circular flat iron paddle, as shown in Fig. 3, but the shovel form is perhaps the more useful.

When the saponification of the fat is judged to be complete common salt is thrown into the pan, to throw the soap out of solution, and to separate it from the glycerine, excess of water, and impurities present in the materials used. Before the addition of salt the soap presents the appearance of a uniformly smooth, glossy, and semi-transparent mass, which contains an indefinitely large quantity of water, besides the glycerine formed by the saponification and the impurities of the original fat. On adding salt, however, the appearance and character of the mass undergoes an entire change. The smooth paste becomes opaque and granular, and the ebullition of the boiling soap has a tendency to confine itself to certain points, producing crater-like openings in the curface, and, as a rule, the mass contracts in volume. In this state it is called "grain soap," and is said to be "cut open." This granular form of soap, which contains from 30 per cent. to 40 per cent. of water, and none of the glycerine, separates from the spent lye, and when pressed between the finger and thumb has a dry and flakey feel.

When sufficient salt has been added and dissolved in the lye, the soap should entirely separate from the latter, when a shovelful is withdrawn from the pan, leaving the brown-coloured lye perfectly clear. At this stage the steam is shut off, and the contents of the pan allowed to remain at rest for some hours, during which the grain soap collects in a layer on the surface, and the spent lye and impurities fall to the bottom of the vessel. Excess of salt is to be avoided, both on the ground of economy and also because such an excess causes the mass to froth, and prevents the amalgamation or partial fusion of the grain soap on the surface, which is desirable in order to ensure complete separation; but, on the other hand, an insufficiency of salt will fail to properly cut the soap.

The subsequent quality of the soap depends largely on the first operation being properly performed throughout, and it is without doubt the one requiring the greatest attention from the soapboiler, and demanding the most skill and experience in working it. If the strength of the caustic lye used be too high, there may be difficulty in commencing the saponification of the fat, especially if it be principally composed of tallow, whilst, on the other hand, an insufficiency of caustic, either in quantity or strength of lye, may cause the whole contents of the pan to become a thick, pasty, and heavy mass, which is only remedied with much difficulty and trouble. There is the greatest danger of this when using palm-kernel or cocoanut oil, as these oils are readily saponified, and require a greater quantity of caustic lye than do tallow and most other oils and fats, and on this account it is common, when using these oils in conjunction with other fats, to first saponify the tallow, &c., and to partially or even wholly cut open the soap so formed, with salt, before adding and saponifying the oils. Although the salt may, and probably does, to some extent hinder the saponification of the oil, this method entirely obviates all chance of the mass becoming thick. During the early stages of this operation the steam must be carefully managed, as the light frothy emulsion of fat and lye is liable to boil up suddenly and, if not checked, to overflow the pan.

In addition to the speed at which the lye is admitted to the boiling pan, the quantity of caustic added requires considerable judgment. It is easy to waste a comparatively large amount of alkali by running in more lye than is needed for the complete saponification of the fat, and I have occasionally found samples of spent lye to contain considerable amounts of caustic, in one case as much as 4oz. of caustic soda per gallon of lye, which, on the whole volume run out of the pan, represented a waste of 160lb. weight of real alkali. Many soapboilers avoid waste of caustic by reserving a portion of the oil or fat, and adding this small portion when the main bulk of soap has received a slight excess of alkali; but, by this method, there is the liability of some fat remaining unsaponified, and the best plan is to determine in the laboratory the exact amount of caustic necessary for the complete saponification of the materials, which amount is calculated to volume of lye, the strength of the latter being known, and as the lye tanks are fitted with gauges marked in gallons and parts of a gallon, it can be seen at a glance whether the requisite amount has been run into the pan.

(*To be continued.*)

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

On the 6th inst. Professor V. B. Lewes read two papers before this Section. The first paper was entitled, "The Analysis of Illuminating Gases," and in it the author gave a detailed account of the method which he has been led to adopt for the analysis of coal gas and illuminating carburetted gases. This method has already been described by us (see *Industries*, Vol. IX., page 264), and we refer our readers to our previous account for details of the process. The author observed that he had found that besides paraffin, olive oil and alcohol were also good absorbents of the marsh gas hydrocarbons, and that the method which he described had been shown to be trustworthy by examining mixtures of gases of definite composition. He recommended ammoniacal silver nitrate for absorbing sulphuretted hydrogen and acetylene. The precipitate formed by aspirating a known volume of the gas was then treated with dilute hydrochloric acid, when the silver acetylide was decomposed, and the silver chloride formed was then dissolved away by ammonia, reprecipitated by nitric acid, and weighed. The residual silver sulphide was reduced in a current of hydrogen, and weighed as metallic silver. After the removal of the sulphuretted hydrogen, the total sulphur left in the gas was ascertained by passing it over heated platinised pumice, and absorbing the sulphuretted hydrogen formed by ammoniacal silver nitrate as above.

In the discussion which followed Mr. Lacy bore testimony to the obvious merits of the new process, and Mr. Foster described the process which he had adopted to overcome some of the difficulties which the author had referred to, and advocated the use of mercuric chloride as an absorbent for sulphuretted hydrogen. He expressed the hope that he would shortly be in a position to substitute a new absorbent in the place of the unpleasant Nordhausen sulphuric acid.

Professor Lewes' second paper was entitled "The Products of Checked Combustion," in which he described in detail the process he had adopted for investigating the products of combustion of a Bunsen burner as it played on the surface of a copper vessel containing water. These experiments were referred to in the author's recent lectures on gaseous illuminants before the Society of Arts (see *Industries*, Vol. IX., p. 624). The products of combustion were aspirated from the false bottom of the copper vessel, through a series of absorbent vessels arranged as follows:—(1) Tubes containing calcium chloride and caustic potash to remove moisture and carbonic acid; (2) two Volhard tubes, containing ammoniacal silver nitrate to absorb acetylene; (3) a trap tube; (4) a V tube, containing palladised asbestos, followed by calcium chloride and potash bulbs to give the carbonic acid and water formed from the free hydrogen and carbon monoxide; (5) a tube containing platinised asbestos, followed by calcium chloride and potash bulbs to absorb the carbonic acid and water formed from the marsh gas; and, lastly, after passing through a trap tube, the gases were measured by the aspirator. As the quantity of oxygen present in the gases drawn off in this way was insufficient to completely burn the gases, analysed oxygen was introduced by a side tube to the second Volhard tube. The V tube, containing the palladised asbestos, was heated in a bath to 120° C., at which temperature the combustion of the hydrogen and carbon monoxide is rapid, and none of the marsh gas is oxidised. The volume of the gas is obtained by adding the calculated volumes of the gases weighed to those measured in the aspirator, less the known amount of oxygen introduced.

The following table summarises the results obtained with the gases drawn from various heights from above a Bunsen flame:—

Combustion of Coal Gas Flame.

Height from Bunsen in inches	0	0·39	0·79	1·18	1·58	1·99
Composition—						
Hydrogen ...	22·66	14·95	15·49	15·54	14·50	11·95
Methane	33·77	30·20	28·34	21·55	11·92	3·64
Carbon monoxide	7·34	14·07	14·05	14·58	22·24	25·14
Olefines	7·29	7·49	7·87	7·94	7·05	5·45
Oxygen	0·66	0·78	0·47	—	—	—
Nitrogen.....	29·41	38·66	140·78	184·23	270·45	307·10
Carbonic acid	1·94	2·34	10·11	14·98	23·76	32·34
Water	8·34	11·60	38·85	52·55	72·67	75·61
	111·41	120·09	255·96	311·37	422·59	461·23

A discussion followed the reading of the paper.

MANCHESTER SECTION.

At a meeting of this section, held on the 3rd inst., Dr. Bowman being in the chair, Mr. William Thomson read a paper entitled "Notes on Effluent Water Analyses and on the Methods for Determining the Value of Rival Sewage Processes." The paper was mainly a critical one, and had special reference to the trials recently carried out at Salford by a committee of engineers and chemists. He contended that it was extremely difficult to get really comparable results unless the different processes were tried side by side with the same sewage. The method of mixing a large number of samples taken at different times did not always produce the same strength of sewage, and was, therefore, not a good one. The author laid special stress on the removal of the suspended matters and the organic matters in solution. He recommended the following as a satisfactory method of working:—A tank about five yards square containing an agitator should be filled with the sewage, and a sample of the agitated fluid taken for analysis. If four processes were to be tested the tank should have four taps, and a certain quantity of sewage should be run off for treatment by the different processes ranged alongside. After treatment with the chemicals the sewage should be filtered through canvas bags, the time taken for filtration being noted. The sediment and filtrate were then to be analysed in the usual manner, and the degree of acidity or alkalinity determined with lackmoid or an indicator. The figures thus obtained would, he said, be of great value. He drew attention to the fact that, when raw sewage was allowed to stand, a great deal of the impurities were precipitated, and that frequently the good effects claimed by the promoters of a process were but slightly brought about by the chemicals used. About 3,000 gallons were recommended for each test. Mr. Thomson described the analysis of the effluents, but the methods proposed did not possess any features of novelty except where he drew attention to the mistake of recording the loss on ignition as organic matter. This loss, of course, included combined water, chlorine, &c., and erroneous opinions as to the value of a process were likely to result if the figures were so expressed. The rest of the paper was confined to a criticism of the report recently drawn up by the engineers and chemists of the Salford trials. This report has been printed for private circulation only, and its contents are not therefore generally known. Mr. Thomson contended that the results were not strictly comparable, as no such arrangement as he had just described had been used. He criticised Dr. Burghardt's figures and report, and stated that the report was in direct opposition to the figures given. The processes tried were the "International," "Electric," and Spencer and Barry's. Dr. Burghardt had put down the loss on ignition as "soluble organic matter, &c.," but the author thought that it was mostly "&c." in many of the cases. The figures, therefore, were not trustworthy, nor could he understand how Dr. Burghardt came to report in favour of the Electric process while his figures showed distinctly that the International process was the best.

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After a short animated discussion, it was agreed to defer further comment till the next meeting, in order to give Dr. Burghardt an opportunity of being present.

Mr. Thomson then described a process for cutting glass tubes and bottles, which, he thought, was not much known, although he claimed no originality for it himself. If two strips of moist blotting paper are wrapped round the glass about ¼in. apart, and the enclosed part heated for a short time with a blowpipe flame, on touching the heated part with water a clean fracture is obtained. Mr. Thomson illustrated this by dividing a Winchester quart into two parts, using only a mouth blowpipe.

A description was then given by Mr. J. C. Cain of a simple method of gravimetric analysis, worked out by Dr. Bailey and himself on the suggestion of Dr. Grossman. The process consisted of calculating the amount of a precipitate, by precipitating in a specific gravity bottle, filling up with water, and weighing. The specific gravity of the precipitate had, of course, to be accurately known. The theory of the method and the corrections to be employed were mathematically demonstrated by Dr. Grossman. It was claimed that the process would prove of special service in cases where the precipitate altered on drying as was the case with sulphides. A series of results obtained by this method when used for the estimation of chlorine as silver chloride, sulphur as barium sulphate, and copper as oxide, agreed remarkably well with those obtained by the ordinary gravimetric methods. The time occupied in a determination is not more than half an hour. No doubt the process will be of service to those who are not frightened by the mathematical corrections involved.

LIVERPOOL SECTION.

At the last meeting of this Section, Mr. A. Norman Tate being in the chair, a paper was read by Dr. G. Schack-Sommer, on the "Introduction of Home Grown Sugar," being a continuation of experiments on the growth of beetroot for the manufacture of sugar in this country. In a previous paper Dr. Schack-Sommer had described the success attained in the growth of beet for this purpose, and his further experiments, which had been conducted both in the neighbourhood of Liverpool and in Ireland, fully confirmed his previous results, and left no doubt in his mind that the industry could be as successfully followed up here as in France and in Germany. The author referred with regret to the apathy shown in the subject by the farmers, who failed to grasp the profitable nature of this new branch of agricultural industry. The author thought the farmers were content to follow on the lines laid down by their fathers, and it seemed as if the raising of a really profitable new crop was to them a matter of perfect indifference. Dr. Schack-Sommer stated that, according to the best authorities abroad, the immediate result of opening a beetroot factory in convenient proximity to the growers would be to increase the value of land by one-third. The choice of suitable seed merited much attention, and the care that had been given to this subject had enabled the agricultural chemist to bring the saccharine strength of beetroot as high as that of the best cane sugar. In France the average quantity of beetroot required to make 1 ton of sugar was in 1881–2 17 tons $3\frac{4}{10}$ cwt., whilst in 1889–90 it had been reduced to 8 tons $11\frac{1}{5}$ cwt.; on the other hand, the average production of sugar per hectare was, on the former occasion, 1 ton $14\frac{1}{6}$ cwt., and on the latter, 3 tons $1\frac{9}{10}$ cwt. The lines on which this remarkable result had been reached were then explained—namely, by a process of very careful selection, and attention to the best methods of growth and of manuring. The process of manufacture of the sugar from the beet was then described, the description being elucidated by diagrams. The root is first sliced into pieces corkscrew-like in form, which are then extracted in a "diffusion battery," consisting of twelve vessels, by lukewarm liquor. The saccharine extract thus obtained is treated three times with lime and carbonic acid and once with lime and sulphuric acid, in order to remove salts and colouring matter, whence it passes through a filter press before being finally concentrated in a vacuum pan. The cost of a beetroot sugar factory capable of treating 30,000 tons was estimated at £58,000, from which a profit of 7¾ per cent. on the invested capital would be realised, and this quite apart from the profit that would accrue to the farmer from the growth of the beet.

An interesting discussion followed, during which the question of the profit likely to be derived from the growth of beet apart from the manufacture of sugar therefrom, was touched upon. This was a point of special interest to the farmer during the tentative stages of the industry, and it did not appear that the utilisation of the soil for this purpose was likely to be a lucrative one compared with other crops. The difficulty at present seemed to be that the farmers were indisposed to foster this new industry until they saw the establishment of beetroot sugar works, whilst the works were not likely to be erected until the growth of beet had been more widely and generally adopted. To meet this deadlock the formation of some sort of syndicate or the taking up of the subject by the Royal Agricultural Society was suggested.

Afterwards a paper was read by Dr. Charles A. Kohn, on the "Application of Electrolysis to Qualitative Analysis." After pointing out that the early attempts to apply electrolysis to chemical analysis were in this direction, Dr. Kohn described a series of experiments he had made on the detection of small quantities of the mineral poisons, antimony, lead, mercury, and copper, taking advantage of the quantitative electrolytic methods of analysis, an account of which he had given to the Society on a previous occasion. The methods were very delicate, clean, and decisive, and likely to be of value in cases of medical and of medico-legal inquiry. These poisons could be detected in the urine directly by means of the electric current, but in the case of the contents of a stomach, &c., the previous destruction of the organic matter by the usual methods was desirable. Very small quantities of silver and of gold could also be detected electrolytically with ease, and the methods had the further advantage of being made approximately quantitative when desirable.

A short discussion followed the reading of the paper.

Notes.

PROJECTED CANAL BETWEEN THE BLACK SEA AND THE SEA OF AZOV.

It is reported that a company has been formed for the construction of a ship canal which will join the Black Sea with the Sea of Azov. The canal will have a length of about 75 miles; breadth, about 73ft.; depth, about 13½ft., which will be increased at the two ends of the canal to about 16ft. Six years are to be allowed for the construction of the canal.

THOMSON-HOUSTON STATIONS IN AMERICA.

According to an electric lighting atlas which the Thomson-Houston Company has issued, the number of their stations in America is astonishingly large. We turned over map after map of the atlas, and found red dots, representing Thomson-Houston stations, in every district. In all the States in which there is much electric lighting the Thomson-Houston system heads the list. The Westinghouse system makes a good second. The atlas in question is a very valuable compilation, as it shows what system is used in every central station in the United States.

THE CORINTH CANAL WORKS.

These works, which had been suspended in 1889 on account of financial difficulties of the Comptoir d'Escompte, were resumed on June 22nd, 1890. When the work was recommenced it was estimated that 3,358,000 cubic metres of earth had to be removed. It is hoped eventually to employ 2,000 men, and raise the monthly removal to 130,000 cubic metres; at present, however, there are less than 1,000 navvies employed, and the monthly result does not come anything near the above-mentioned quantity. Nevertheless March 22, 1893, has been fixed for the opening, yet it is highly improbable that it will be finished by that date. It is generally considered, however, that the present company will be able to carry the work through. Whether the canal, even when completed, will be used for anything but coasting or Adriatic navigation is still to be seen, as, apart from dues, which will of necessity be levied in order to pay interest on capital, the difficulties which attend navigation for larger vessels on either side of the isthmus must not be lost sight of.

NEW RAILWAY STATION FOR ADELAIDE.

The Commissioner of Public Works has laid on the table of the South Australian House of Assembly preliminary sketch plans of a proposed new railway station at Adelaide, estimated to cost about £175,000. The scheme, which is for a building at the back of the present structure, consists of two main divisions; a series of covered roads and platforms, and a suite of offices. The main shed, states *Indian Engineering*, is of the simplest construction, transverse girders 40ft. apart being erected on cast-iron columns and connected by small roof trusses, the whole roof and sides being of galvanised iron. The details of the expenditure involved are as follows:—Permanent-way, £11,200; filling, &c., £11,500; road approaches, footpath, fencing, drain pipes, &c., £3,800; retaining wall, £4,700; main station building, £43,000; parcels and luggage offices, &c., £15,500; customs and resident engineer's offices, &c., £6,700; refrigerating chambers and machinery, £4,000; platform walls and tar-paving, £4,370; main roof, £42,300; verandahs, £3,700; gas, water, and sewerage, £1,700; electric lighting, £4,600; alterations to goods platforms, engine pits, &c., £1,070; signals and interlocking, £6,350; coal gears and sidings to ditto, £9,000; total, £173,540.

TASMANIAN EXHIBITION.

An Exhibition is to opened at Launceston, Tasmania, on the 14th of October next, and it will be carried out under the patronage and with the aid of the Governor and the Government. The scope of the Exhibition embraces every branch of manufacture, but special attention will be given to all classes of mining plant, and the Exhibition thus offers a favourable opportunity to the manufacturers of such machinery in view of the large development of Tasmanian mineral resources now going on. As the Exhibition will take place at a period of the year when Launceston is crowded with visitors, it will afford an excellent opportunity to exhibitors of bringing their goods under the notice of a very large number of colonists. Special arrangements have been made for the carriage of exhibits at greatly reduced rates. It is proposed to supply motive power for machinery in motion free of charge, and medals and certificates will be awarded. Applications for space should be made at the earliest possible date to the honorary secretary of the Tasmanian Exhibition, 5, Victoria Street, Westminster, S.W., from whom all information can be obtained.

EDUCATION IN TEXAS.

The public schools of Texas are rapidly attaining a degree of perfection that will make them compare favourably with those of New England. The permanent free school fund, invested in State and county bonds, is $5,873,174, together with 40,000,000 acres of land controlled by the State, and 17,712 acres, to each county organised and unorganised, controlled by the counties, making a total of 47,288,676 acres, which at $3 per acre would give $141,866,028, and added to the above makes a grand total of $147,739,202. The State University at Austin is one of the best endowed educational institutions in the United States, and is free to students of both sexes. The University Permanent Fund is $523,411 invested in bonds, with an available fund of $21,680, and cash on hand of $10,825, making a total university fund of $555,916, besides which it has 2,221,400 acres of land, most of which was located in early times, and is very valuable, say worth $6 per acre at least, or $13,328,400, making a grand total of 13,884,316 for university purposes. The State Agricultural and Mechanical College, near Bryan, Brazos County, is endowed with $209,000 invested in bonds, and has also a large endowment from the United States Government. Here ninety-four students, half of whom take a mechanical and half an agricultural course, receive free board and tuition.

DECIMAL MEASUREMENTS.

There is quite a movement in favour of the decimal system of measurement just now. When decimal measurements do come in it is to be hoped that they will not be confined to money and length, and such derivatives as volume and weight. There are various other measurements that demand reform—for instance, those of angles. It is absurd to divide the circle into degrees, minutes, and seconds. Even to divide the degrees into decimal parts is only a compromise. What is wanted is to give angles in circular measure, with decimal values. Many calculations involve circular measure. Then thermometers should not be graduated in the present arbitrary manner. They should be graduated according to Sir W. Thomson's scale, and in consonance with the C.G.S. system. The present hydrometer scales should be swept away, and nothing more should be heard of degrees, Twaddel or Beaumé. It would certainly be better to begin by altering weights and measures that are used chiefly by technical and educated men, than to make changes in such customs as selling old and new potatoes by the "sack" and "dozen" respectively in one county and by the "gallon" and local "stone" in another. A county with a local stone may think itself the centre of the universe, and never alter without outside pressure. Again, sizes of books, paper measure, involving as it does various conventionalities, measurements of ropes, sheet lead, gas screw threads, wires, hay and straw, wine, drugs, precious metals, stature of horses, area of fields, and the thousand and one idiotic systems of measurement now in use, will probably take a couple of generations to replace by a system having a rational basis.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

23rd March, 1891.

5136. Wilson & Middleton ... Traverse motion of card-setting machines.
5138. Bagueley, E. E. ..... Steam engine valve gear.
5142. Bowker, Butterworth, & Farrow ..... Strap relieving motion for self-acting mules.
5143. Lewis, G. A. ..... Lock action of magazine rifles.
5158. Vanduzen, B. C. ..... Gas and gasoline engines.
5162. Mills, B. J. B. ..... Devices for transmitting power (*Johnson*).
5163. Lake, H. H. ..... Apparatus for the production of printing surfaces (*Sarigny*).
5164. Parry, W. A. ..... Pug mills.
5177. Grimes, W. ..... Railway signalling apparatus.
5178. Edge, J. ..... Preparing and spinning machines.
5189. Sandino, A. ..... Apparatus for feeding water to steam boilers.

24th March, 1891.

5198. Davies, E. ..... Apparatus for delivering or transferring mail bags from or to trains in motion.
5204. Williams, M. ..... Railway and other signals.
5208. Carter, Carter, Carter, & Carter ..... Valves for steam engines.
5213. Fielding, J. ..... Gas motor valve apparatus
5217. Key, J. T. ..... Apparatus for the manufacture of illuminating gas.
5226. Lanchester, F. W. ..... Gas engines.
5229. Bradbury, J. F. ..... Carding engines.
5234. Jones, T. ..... Machinery for galvanising wrought, cast iron, or steel pipes, bars, and hoops.
5248. Baldinger, W. H. ..... Bottle-filling machine.
5244. Coy, H. E. ..... Screw-cutting machines.
5248. Cottrell, C. B. ..... Printing machines.
5250. Love & Priestman Brothers, Ld. ..... Hydrocarbon and gas engines.
5251. Newton, H. E. ..... Direct-acting engines (*Worthington*).
5253. Lake, H. H. ..... Die rolls for making horseshoe blank bars (*Perkins*).
5254. Lake, H. H. ..... Air compressors (*Hill*).
5256. Lake, H. H. ..... Balanced valves for steam engines (*Canfield*).
5268. Fales, E. ..... Method of and apparatus for generating steam.
5271. Thompson, W. P. ..... Stamping machines for printing (*Alexander*).
5272. Trost, H. ..... Polishing machines.
5274. Standiford & Hyers ... Type-setting machines.
5277. Barrett, T. ..... Punching machines.
5278. Connelly, J. T. ..... Devices for tapping holes. (15th October, 1890.)
5279. Barrett, T. ..... Multiple metal saw apparatus.

25th March, 1891.

5301. Rowbotham & Rowbotham ..... Multiple boring and drilling machine.
5302. Robertshaw & Kaye ... Hard waste breaking machines.
5303. Roots & Seal ..... Gas engines.
5307. Ward & Luck ..... Dredger.
5308. Proctor, J. ..... Mechanical stokers.
5314. Holden, J. ..... Paper-making machines.
5328. Blezard, R. ..... Machines for cutting up rags, &c.
5333. Silvester, F. ..... Mechanism for tipping, screening, and loading coal.
5334. Parmiter, P. J. ..... Machine for breaking up roads.
5344. Reynolds, E. ..... Apparatus for turning heavy forgings.
5349. Seebeck, F. ..... Vertical steam boilers.

26th March, 1891.

5367. Perry, J. ..... Steam engines.
5373. Wheelwright, F. C. ... Loom stopping mechanism.
5374. Holdsworth, W. ..... Spinning and twisting machinery (*Greenwood*).
5395. Norman & Cochrane ... Apparatus for hulling and cleaning grain.
5397. McMullen, J. B. ..... Steel taps and dies.
5399. Middleton, H. ..... Submarine ships.
5415. Bowron, S. ..... Machinery for splitting hides.
5429. Riedler, A. ..... Valves for pumps.

28th March, 1891.

5440. Boulton, I. W. ..... Steam boilers.
5447. Houlden, H. W. ..... Steam engine.
5453. Ashberry & Barnes ... Flexible driving shafts.
5463. Kulage, J. J. ..... Brick-making machines.
5478. Anderson, R. W. ..... Valves.
5481. Eadie & Tannahill ..... Pipe joints and apparatus for making same.
5482. Ivatt, H. A. ..... Railway signalling apparatus.
5488. Burgess, C. T. ..... Chain pumps.
5489. Mackay, M. ..... Apparatus for purifying gas.
5490. Higginson, J., Jun. ..... Gas engines.
5498. Wren & Wren ..... Self-acting balling machine.
5499. Lister, Rodgers, Crosland, & Bannister ... Healds of looms for weaving.

ELECTRICITY.

23rd March, 1891.

5135. Southard, B. D. ..... Armatures for dynamos or motors.
5167. Elmore & Elmore ..... Manufacture of tubes by electrolysis.

24th March, 1891.

5247. Dewey, M. W. ..... Electric heating apparatus.
5252. Graff, E. D. ..... Railway signal apparatus.
5280. Thompson, W. P. ..... Switches (*Willing & Violet*).

25th March, 1891.

5313. Aylesbury, H. ..... Driving electrical machinery.
5318. Boardman & Fairfax ... Arc lamps.
5329. Bristol, L. ..... Portable safety lamps.
5338. Crampton & Essinger ... Carbons for arc lamps.
5341. Poleschko, A. ..... Transformers.
5343. Brockie, J. ..... Arc lamps.

26th March, 1891.

5370. Williams, P. H. ..... Dynamos, motors, and accumulators.
5371. Williams, P. H. ..... Telephones and telegraphs and apparatus therefor.
5412. Parker, T. ..... Means for supplying electricity to electric tramways.

28th March, 1891.

5485. Massin, E. ..... Means for telephonic communication.

CHEMISTRY.

23rd March, 1891.

5169. Duke, Bishop, & Symons Production of aluminium.
5170. Duke, Bishop, & Symons Production of aluminium bronze.
5171. Duke, Bishop, & Symons Metallic alloy.
5184. Johnson, J. Y. ..... Production of monobromo and dibromoparaoxybenzoic acid (*Von Heyden*).

24th March, 1891.

5222. Schneller & Wisse ..... Formation of ozone in presence of air or oxygen and apparatus therefor.
5263. Johnson, J. Y. ..... Production of salicylic acid derivatives containing chlorine and sulphur (*Von Heyden*).

25th March, 1891.

5299. Thwaite, B. H. ..... Method of and apparatus for the production of combustible gases.
5352. Lyte, F. M. ..... Production of alkaline carbonates and chlorine and their derivatives.

MISCELLANEOUS.

23rd March, 1891.

5149. Bengall, J. R. ..... Chamfer plane.
5181. Nunan, E. ..... Flexible hose couplings.

24th March, 1891.

5212. Munns, W. H. ..... Method of manufacturing illuminating gas (*De Beauharnais*).
5242. Hinsdale, W. R. ..... Process of casting ingots.
5246. Clauser & Paterson ... Nut locks.

26th March, 1891.

5431. Hopkins, M. O. ..... Telemeters.

28th March, 1891.

5439. Phillipson, B. R. ..... System of sewage disposal.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

2229. Wise (*Robinson*, Executor of *Ericsson*, & *Reynolds*).
4503. Thomas.
4630. Rickards.
4791. Douglas.
4803. Honeysett & Stanley.
4879. Rodd.
5091. Pitt (*The Engelberg Huller Company*).
5282. Redfern (*Weinrich*).
5403. Smeaton.
5734. Imray (*Hogan Engineering Company*).
5902. Healey.
8099. Hurrell.
4490. Street.
4501. Silcock.
4622. William Frisse Greene & Frederick Henry Varley.
4804. Jacobus.
4990. Booth.
5129. Plumridge, Sen., Plumridge, Jun., & Jackson.
5540. Higgins.
5742. Fairweather.
5754. Collins, Fleming & Frazer.
5916. Bonne (*Actien Gesellschaft Mix & Genest*).
6102. Simpson.
6270. Aytoun.
6318. Lacy.
6503. Horton & Levison. (26th October, 1889.)
6614. Hurst.
6645. Lancaster & Conley.
6780. Hemart.
6825. Parkinson, Fawcett, & Parkinson.
7083. Fairbairn.
7101. Gregory & Gregory.
7174. Pearson.
7351. Hutchinson.
7456. De Brouchere & Anspach.
7511. Immisch.
7518. Wise (*Schoop*).
7534. Clarke.
7689. Anderson (*Singer Manufacturing Company*).
7880. Brown, Morris, & Moritz.
8013. Chulow, Musto, Sen., & Musto, Jun.
8040. Scott.
8094. Fritzsch.
8134. Sykes & Sykes.
8153. Holmes.
8155. Livesey & Gill.
8168. Moffatt & Stuttaford.
8174. Richard & Richard.
8196. Leyland.
8232. Dickson & Hurdle.
8234. Birch.
8251. Redfern (*Sculier*).
8258. Varilla. (23rd May, 1890.)
8328. Haslam.
8338. Mitchell.
8347. Gonsalves.
8380. Wilson, Cook, & Winter.
8412. Strawson, Sen., & Strawson, Jun.
8414. Buckney.
8431. Seage & Seage.
8435. Bayly (*Dattlebaum*).
8443. Fielden.
8462. Cook (*Ward*).
8475. Lawson, Lawson, & Dear.
8478. Nickau.
8628. Whytlaw & Kincaid.
8854. Desruelles & Chauvin.
9321. De la Sala.
9520. Phillips.
10105. Smyth.
10106. Reynolds & Jacobs.
10117. Krnka.
11171. Hardinge.
12739. Kirk & Lee.
13486. Schneller & Astfalck.
13547. Heginbotham.
15431. Chappel.
16896. Aird.
17778. Gardner.
18818. Steele.
19037. Gisborne.
19602. Fletcher.
20767. McGlinchey.
21223. Meyer.
21299. Lake (*Muhlenbananstalt & Maschinenfabrik vormals Gebruder Seck*).
5926. Pitt (*Atherton*).
5957. Pride.
6266. Marx.
6281. Redgate.
6430. Pollock.
6590. James Dixon Churchill.
6631. Aird.
6667. Frager.
6805. Thompson (*Von Pereira*).
7064. Drummond.
7098. Boult (*La Société Générale de Maltose*).
7202. Cavailles.
7352. Hutchinson.
7501. The London Necropolis and National Mausoleum Company & Austin.
7631. Towler.
7749. Howat.
7823. Sagar & Sagar.
7921. Slim.
7925. Hollis.
8015. Bartlett.
8031. Radcliffe.
8041. McGregor.
8116. Binswanger & Franke.
8152. Thompson (*Kellogg*).
8154. Livesey & Gill.
8167. Moffatt & Stuttaford.
8173. Walker.
8183. Campbell.
8221. Tuquet, Boudard, & Crawley.
8249. Manchester.
8256. Lake (*Hopfer*).
8270. Sutcliffe & Sutcliffe.
8326. Jones.
8343. Nightingale.
8352. McDermott.
8390. Fisher, Lees, & Ross.
8400. Mills (*Grayjon & De Morsier*).
8418. Hartnell.
8429. Hurtley.
8432. Pagnt.
8437. Bayly (*Morrison & Sindlinger*).
8473. Lake (*Vuitton*).
8476. Kendrick.
8477. Benvor.
8543. Pearson & Jones.
8729. Utley.
9233. Joyce.
9366. Bailey.
10047. Imray (*The Society of Chemical Industry in Basle*).
10924. Turner & Croker.
12442. Thompson (*The Bausch and Lomb Optical Company*).
14203. Smith.
15553. Göbel.
17674. Lungren.
18525. Brayn, Field, Field, Jun., Spittal, & Timms.
19866. Wood.
21219. Haughawout.
21227. Ruud.

1891.

85. Mayer.
450. Heymann & Cox.
720. Haddan (*Grube*).
959. Thompson (*Gouldberg*).
1058. Richards.
1279. Wiley, Dickey, & Ainesworth.
1425. Boult (*Roberts*).
1919. Lindahl.
2096. Mitchell.
2349. Juel & Ryan.
2449. Myers.
2539. Eggington.
2599. Eggington.
2900. Lake (*Purbeck*).
2986. Haddan (*Battallé*).
3033. Spencer & Ralston.
3122. Bohl.
3224. Heywood & Holland.
3261. Weiss.
3325. Thompson (*Sweet*).
3329. Spencer.
3333. Hallowell.
3350. Coffey.
3365. Lake (*Sochaczewski*).
3369. Moore.
3432. Crisp.
3436. Benners & Leach.
3447. Mitchell.
3495. Dorman & Smith.
3504. Höfle.
3522. Krumbacher.
3607. Hunt.
3673. Seibold.
3679. Rosenkötter.
115. Link & Avenarius.
620. Linton.
745. Brierley (*Wolpert*).
1007. Ferraris.
1218. Schmidt.
1314. Hobson.
1411. Dawson (*Allen*).
1899. Steinberg.
1962. Hiller & Czvetkovics.
2300. Sutcliffe.
2440. Lake (*Richardson*).
2503. Haas.
2566. Ososki.
2697. Greener.
2907. Johnson.
2997. Thompson (*Collins*).
3116. Ehrhardt.
3150. Giles & Giles.
3232. Emdin.
3320. Steffenson.
3327. Thompson (*Fletcher & Emmert*).
3386. Lake (*Lemp & Schmidt*).
3352. Lake (*Berrenberg & Nickerson*).
3377. Clark (*Bornholdt & Glatz*).
3442. Stevens, Dana, & Beers.
3501. Stone.
3506. Rowe.
3598. Canary.
3609. Hartmann & Braun.
3674. Edwards (*The St. Blasien Spinning Mill Company*).

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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

DRILLING MACHINES.—*J. Brindle, Failsworth, Lancashire, R. L. Reade & J. Taylor, both of Sale, Cheshire.*—The invention embraces a machine adapted for drilling a number of holes simultaneously in the hub or felloe of a wheel. Referring to the accompanying illustrations, Fig. 1 is a vertical section of the improved drilling machine, and Fig. 2 a partial plan showing one of the drills and its adjuncts. Upon a suitable frame A of a circular form are mounted in bearings B the required number of

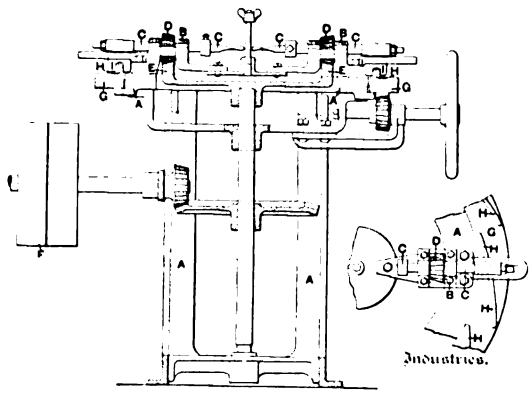


FIG. 1. FIG. 2.

drills C arranged radially at any required angle and at equal distances apart, the bearings B being so arranged that the drills can revolve in them, and are also capable of sliding to and from the centre of the plate or frame. Upon each drill C is mounted on a long key or feather a bevel pinion D between two bearings B. These pinions are all caused to revolve simultaneously by means of a crown wheel E, driven, as shown, from pulleys F. At or near the outer ends of the drills is arranged a circular plate G capable of revolving and provided with inclined curved projections H so formed that when G is revolved by the hand-wheel the projections H acting in the forks I will force the drills all gradually inwards simultaneously. Claims: The construction of improved multiple radial drilling machines substantially as and for the purpose described.—No. 5548. April 12th, 1890. 6*d.*

SELF-ACTING LUBRICATOR.—*G. C. Downing, London.* (*A. Lalance & J. Elsner, both of Paris, France*).—The lubricator embraced by this patent is for the purpose of supplying the cylinders of air compressors with the requisite quantities of petroleum or naphtha, the vacuum produced in the top of the cylinder during the period of exhaustion being utilised for operating said lubricator. A lubricator of this description is shown in the accompanying illustrations, of which Fig. 1 is a sectional elevation and Fig. 2 is a transverse section. A is the oil cup formed in two parts, as shown in Fig. 1; G is an annular reservoir for receiving the oil. C is the lower reservoir, which receives oil from the upper reservoir B by means of the vertical tube B provided with a wick of

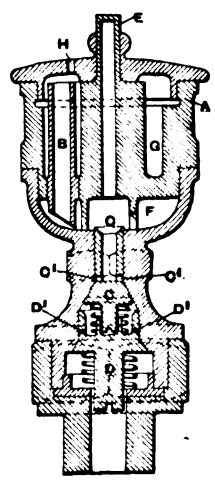


FIG. 1.

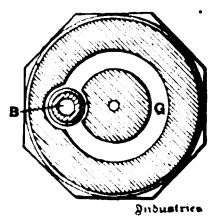


FIG. 2.

cotton or wool. A hole H is formed in the cover to admit the atmosphere to the upper chamber, and holes in the tube F admit the air to the lower chamber. C and D are inverted bronze valves, fitted as shown, and held to their seats by coiled springs. The valves have cylindrical stems, bored out to receive the oil, and small holes C^1 and D^1 to allow the oil to escape when the valves are opened. The action of the apparatus is as follows:—Before the pump is set in motion, oil is poured into the upper chamber and into the tube containing the cotton or wool, also partly filling the lower chamber and shutting off the escape of air therefrom. When the pump is set in motion, the vacuum formed in the cylinder causes the valves to open, and to eject the quantity of oil accumulated in the lower reservoir. The lubrication is effected by drops of oil following each other while the compressor is working, and the quantity is regulated by varying the thickness of the wick in the tube. Claims: (1) The improved construction of apparatus for purposes of lubrication, as described; (2) the general arrangement, construction, and combination of the several parts of an improved self-acting lubricator for air compressors, substantially as described.—No. 4531. March 22nd, 1890. 6*d.*

GAS ENGINE GOVERNORS.—*H. N. Bickerton, Ashton-under-Lyne.*—Pivoted underneath the end of the crank shaft of the engine is a bell-crank lever, one end of which carries an anti-friction roller and is acted upon by means of a cam on the said crank shaft. This motion is transmitted to the engine supply valve by means of the bell-crank lever and a rod pivoted on the other end thereof, the end of which rod is adapted to normally engage a notch in the end of the rod of the supply valve of the engine. Pivoted on the same pivot as the bell-crank lever is a weighted lever, which is caused normally to follow the motion of the former by means of a helical spring, one end of which presses upon a lug on the bell-crank lever, whilst the other end presses upon a nut on a screwed rod pivoted in a short arm or lug on the weighted lever. The other end of the weighted lever normally rests on a projecting lug on the valve-actuating rod on the end of the bell-crank lever. The action is as follows:—When the engine commences to run beyond its normal speed, the weighted lever, not being able to move as quickly as the bell-crank lever is actuated, will overcome the resistance of the helical spring, and will act upon the lug or the valve-actuating rod, so forcing the latter to one side and preventing it engaging the notch in the supply valve spindle. When, however, the engine has regained its normal speed, the bell-crank and weighted levers will be caused to work together by means of the helical spring, and the valve-actuating rod will be forced into its normal position so as to operate the valve spindle by means of a light spring carried by the bell-crank lever and pressing on the opposite side of the lug on said valve-operating rod. The tension of the helical spring is made adjustable, so that the speed of the engine may be regulated. The inventor also describes another form of the above, in which the weighted lever revolves. Two claims are made.—No. 297. January 7th, 1891. 6*d.*

PRINTING MACHINE.—*S. Barnes, Clifton-with-Norwood, near Otley, Yorkshire.*—The object of the inventor is to facilitate the removal of the flyer used in printing machines, for taking the paper from the cylinder when not required and bringing it again into position when required. For this purpose is employed a circular balance disc to which a weight is attached on one side, and the opposite side of the balance is attached to a lever connected to the upright rod carrying the flyer; the balance disc is suspended by a stud having an anti-friction bowl which works within slots provided in the disc. On moving the disc round, it lifts the rod upon which the flyer is fixed out of the way, at the same time it is balanced; on moving it in the opposite direction it brings the flyer into position again and is again balanced. Claims: (1) The use and employment in printing machines of a balance disc with adjustable balance weight, lever, and spring, actuated by the slide carrying the flyer, as and for the purpose described; (2) the use and employment in printing machines of a balanced disc, with adjustable balance weight, weight and lever, actuated by the slide carrying the flyer, as and for the purpose described.—No. 6759. May 2nd, 1890. 6*d.*

STOP VALVES.—*A. Jeffrey & D. Cockburn, both of Shore, Alloa, Clackmannan, N.B.*—The valve box and valve seating are of the usual form. The valve is of the disc pattern, guided by means of a spindle, and is closed or opened by means of a spindle extending through a stuffing box in the cover of the valve box, the outer end of the spindle being screwed and working in a yoke fixed to the cover. The spindle is not fixed to the valve, but enters down through a tubular part connected to the disc of the valve by two side bars. Below the tubular part a collar is fixed on the spindle for lifting the valve. The valve thus has a certain amount of play between its seat and a second seat fixed in the valve casing above it when open. The tubular part on the valve is made with an external groove, in which engage the forked ends of a short lever pivoted on a horizontal spindle in a recess in one side of the valve box. One end of this horizontal spindle, which passes out of the valve box through a suitable stuffing box, carries a weighted lever, which tends to so revolve the spindle as to raise the valve against the upper seating. This action is prevented by a helical spring, one end of which is attached to the weighted lever, whilst the other end is carried by a projection on the valve cover. This upper end can, however, when necessary, be disengaged from said projection by means of a catch pivoted thereon and operated by a cord. The weighted lever is thus allowed to fall, so raising the valve against the upper seat. Claims: (1) Combining the parts of and connected with stop valves for steam and other fluids, as described; (2) in connection with a stop valve capable of being closed on one seat by means of a screw spindle against the current, and of closing against another seat by the action of excess current, arranging a lever to act on the valve, such lever being operated by means of a cord or wire substantially as described.—No. 6703. May 1st, 1890. 8*d.*

LOCOMOTIVE ENGINES.—*G. Simpson, London.*—The inventor's object is to prevent the escape of sparks of fire from the funnels of locomotive engines. Within the ordinary funnel is fixed an inner tube or funnel equi-distant from the outer funnel and resting upon proper grids or supports. This inner tube is preferably about 6in. less in diameter than the outer funnel and is held upright by suitable stays and does not reach the top of the outer funnel, but carries upon a transverse grill a vertical rod which supports a curved and perforated iron plate extending slightly over but not touching the top of the inner funnel, and acting as a hood. Connected to the bottom of the outer funnel is a tank of water. The exhaust steam pipe from the engine is taken into the centre of the inner funnel. The sparks from the boiler fire are thrown against the perforated hood and rebound into the tank of water below. Two claims are made embracing the arrangement as described, with modifications.—No. 7798. May 19th, 1890. 6*d.*

SLIDE VALVES.—*J. T. Jameson, Sunderland.*—The object of the inventor is to diminish the pressure and friction on slide valves exposed to high pressure steam. For this purpose the slide is constructed of the ordinary hollow form, but with a bar arranged in the centre of the hollow part, so as to form a port at each end of the bar, said ports being of a similar size to the central steam admission port on the cylinder face, and serving to admit fresh steam to the interior of the slide valve, whence it is distributed to a port at each end of the cylinder face and leading to each end of the cylinder. The exhaust is released directly past the ends of the valve into the valve box. In order to counteract the tendency of the valve to lift when the steam is first admitted to the interior thereof, a plate is provided which, by means of a bent spring, is made to bear on the back of the slide valve. Claims: (1) A slide valve, of D form, provided with a central bar in the hollow, and ports at each end of said bar, and working in a chamber which receives the exhaust fluid, in combination with a central steam admission port on the cylinder face, as and for the purpose set forth; (2) the application of the slide valves to triple and quadruple cylinder expansion engines; (3) the slide valve as described.—No. 3766. March 10th, 1890. 6*d.*

CARDING ENGINE FLATS.—*W. H. Richardson, Oldham, Lancashire.*—The invention consists of an arrangement for facilitating the adjustment of the travelling flats to the cylinders of revolving flat carding engines. Referring to the accompanying illustrations, of which Fig. 1 is a side elevation and Fig. 2 a cross section, the

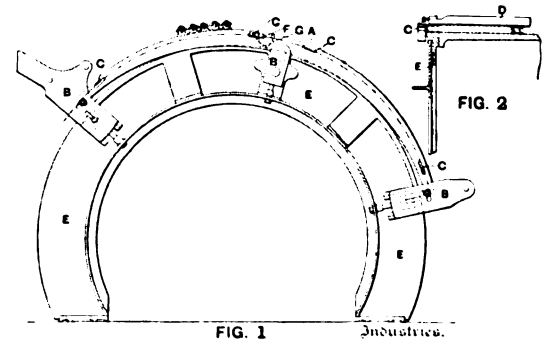


FIG. 2

FIG. 1

flexible bend A is supported by means of the ordinary brackets B, and has formed in it four slots C. These slots are made in such a position that they come exactly opposite the points of the teeth or wire of the flats D on A, and the points of the teeth or wire of the cylinder E. It will thus be seen that, by inserting a strip of metal in said slots, the position of the flats can be adjusted. Suitable plugs or covers F attached to the machine by means of a chain G are provided for closing the slots C when the engine is in operation. Claims: (1) In a revolving flat carding engine, flexible bends or other appliances provided with slits or openings by means of which the position of the points of the teeth or wire upon the flats in relation to the teeth or wire of the cylinder may be ascertained or tested as described; (2) for use in conjunction with slits or openings formed in the flexible bends or other appliances of a revolving flat carding engine, plugs such as F employed to prevent dust, "fly," or cotton from being blown out through the slits or openings.—No. 6684. May 1st, 1890. 8*d.*

GAS PRODUCER.—*S. Griffin, Bath, Somerset.*—The present invention embraces an apparatus for producing combustible gas for gas engines by the admixture of any suitable liquid hydrocarbon in a finely divided state with ordinary atmospheric air. Fig. 1 in the annexed illustrations is a vertical section of an apparatus for the above purpose, Fig. 2 being a horizontal section of the carburetter. Fixed to a suitable base are the two cylindrical vessels A B, one inside the other. The smaller vessel B contains the liquid hydrocarbon supplied through pipe B^1, and is connected by a passage C governed by a float valve, float chamber D, and passage E, with the carburetter F, the upper end of which is connected by pipe G with the interior of a bell or gas container H arranged to slide over B but contained in A. The interior of F is also connected with the air supply pipe I by means of valve J, cover J^1, and finely perforated radial pipes J^2. K is the air superheater, L the gas delivery pipe, and M an air relief pipe

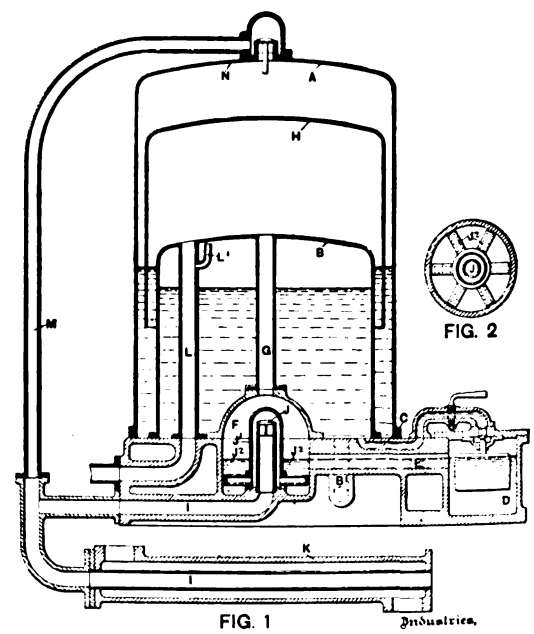


FIG. 2

FIG. 1

connecting the interior of A with I. L^1 is an equilibrium pipe, and N equilibrium holes. The action is as follows:—As the air passes through the perforations in the pipes J^2 and through the liquid hydrocarbon in F, the former absorbs the latter, and the mixture so formed passes into H and is ready for use. In seven claims the inventor embraces the general construction of an apparatus as described and for the purpose set forth.—No. 6217. April 23rd, 1890. 8*d.*

GAS ENGINES.—*A. A. Domington, Longsight, near Manchester, & H. Coates, Manchester.*—The improvements embraced by this invention consist in having two cylinders, one placed above the other, the top cylinder being in a horizontal position and the lower cylinder at an angle, or the lower cylinder may be placed

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horizontally and the top one at an angle, or both cylinders may be placed at an angle, the connecting rods of each engine being coupled to the same crank-shaft. This arrangement may be adapted in using several cylinders in the positions and angles as described. Claims: The position and angles of the cylinders as mentioned.—No. 6910. May 5th, 1890. 4*d.*

STEAM ENGINE REVERSING GEAR.—*W. Thompson, Clouds Hill, St. George, near Bristol.*—Fig. 1 in the annexed illustrations is a side elevation partly in section, and Fig. 2 a part sectional plan of a reversing arrangement embraced by this invention. Fixed to one side of the eccentric A is a bevel wheel B loose on the driving shaft C and gearing with a second bevel wheel D loosely centred on the reversing lever E which is screwed into a socket F loosely encircling the driving shaft C. A third bevel wheel G

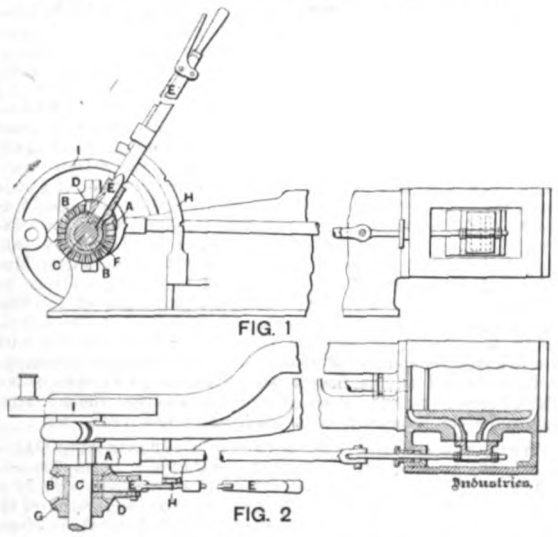


FIG. 1

FIG. 2

fixed on the shaft C also gears with the wheel D. When the reversing lever E, which works in a notched quadrant H, is moved about the driving shaft C, whether the engine be stationary or in motion, the eccentric A is moved round on the shaft through the train of bevel gearing B D C, and the direction of motion of the crank I determined accordingly. The inventor also describes a modification of the above, and both of such arrangements are embraced in three claims.—No. 19305. November 27th, 1890. 8*d.*

SECTIONAL WARPING AND BEAMING MACHINES.—*J. H. Stott, Rochdale, Lancashire.*—A machine such as is embraced by the invention is shown in the annexed illustrations, of which Fig. 1 is a side elevation and Fig. 2 an end view. In suitable framework A is carried the horizontal driving shaft B, on which is fixed, by means of a feather, so that it revolves with but can be moved longitudinally along said shaft, a sleeve, carrying two bevel wheels C, either of which may be thrown into gear with bevel gear D^1 on a shaft D by means of a lever E The shaft D carries a frictional disc F, which can be moved into or out of gear with a frictional disc G on the shaft H carrying the "section block" I by revolving a hand-wheel J. In the upper part of the framework are journaled three rollers K, one of which receives motion by means of suitable gearing from B. The bearing of the upper roller is adapted to slide vertically in slots in the framework, and the roller itself may be pressed down upon the other two by means of weights L carried by a frame supported on the said spindle. The yarns as they pass from the creel first pass through a "vee reed" M, then under the first of the lower two of the three rollers, over the upper one, and again under the second of the lower two. From thence it passes around a roller N to the "section" roller. The roller N, which

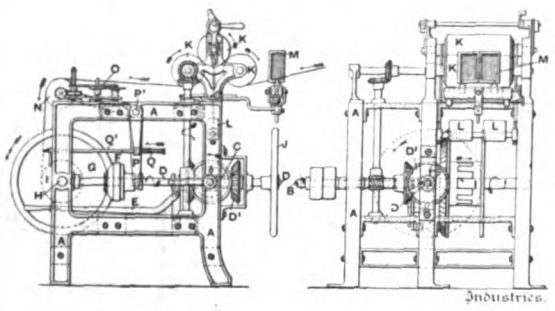


FIG. 1. FIG. 2.

is in gear with a measuring device O, is journaled in the end of the bell-crank lever P pivoted at P^1, the other arm of which carries a stud which projects into a groove in F. A helical spring Q carried on a rod Q^1 tends, by pressing against one arm of P, to hold said lever in the position shown, but should the pressure of the yarn upon N become sufficient to overcome the resistance of said spring the lever P will be moved sufficiently to throw F out of gear with G. In three claims the inventor embraces the general construction of a sectional warping and beaming machine as described.—No. 2850. February 22nd, 1890. 8*d.*

MACHINERY FOR THE MANUFACTURE OF PROJECTILES.—*T. Davage & S. Taylor, both of Sheffield.*—The invention relates to a method of and apparatus for rolling hollow or solid elongated projectiles and to improvements in forging same. In carrying out the first part of the invention a pair of disc rollers fixed upon the end of two horizontal shafts, and driven in the opposite direction, are used. The opposite faces of these discs have formed on them concentric circular projections, which projections are so bevelled off at their peripheries that the two edges together correspond to the radius of the point of the required projectile. The point of a bar of metal may thus be pointed by placing it between said rollers. This partly formed projectile has then a hole drilled or otherwise formed in its base. It is then placed on a suitable mandrel and by hydraulic power advanced between the faces of two other finishing rollers of a similar construction to the last named, the mandrel being capable of rotating with the shell. According to the second part of the invention, a bar of steel is either pressed or forged in suitable dies into a blunt conical form, the base of which is larger than that of the required shell. A hole is then formed in the base and a mandrel inserted. The whole is then placed between a pair of dies approximating to the required shape of the shell, and which also have recesses to receive a collar upon the mandrel. The operation of the dies, which are fixed in a steam hammer, reduces the forging in diameter and elongates it upon the mandrel. Four claims are made.—No. 6963. May 6th, 1890. 8*d.*

COTTON-OPENING MACHINES.—*J. Dunn, J. W. Pateson, W. Riley, & J. Wilding, all of Preston, Lancashire.*—The invention has for its object to increase the means of cleaning the cotton during its passage through the suction tube or trunk of a cotton-opening machine or "porcupine." To effect this the interior of the upper arched part of the tube, and in some cases its two perpendicular sides, are provided with short projecting teeth or pins, against which the flying cotton, as it is drawn through the tube, strikes, so more effectually liberating the dust contained in it. The flat metal bars forming the grate or grid below are arranged longitudinally or in the same direction as the length of the tube. Claims: The application to the suction tubes or trunks of cotton-opening machines of internal projecting teeth, pins, fingers, or other equivalent obstructing media, substantially as and for the purpose set forth.—No. 6991. May 6th, 1890. 6*d.*

SALT WATER EVAPORATOR.—*J. Kerr, Waterloo, near Liverpool.*—The evaporator embraced by the present invention is to supply extra feed for marine boilers which are used in conjunction with surface condensers. Such an apparatus is shown in vertical section at Fig. 1 in the accompanying illustrations, Fig. 2 being a plan of the heating coil. A cylindrical vessel A is bolted on to the top of the main condenser, and has secured to its upper end and projecting into it the second or inner vessel B. Within this

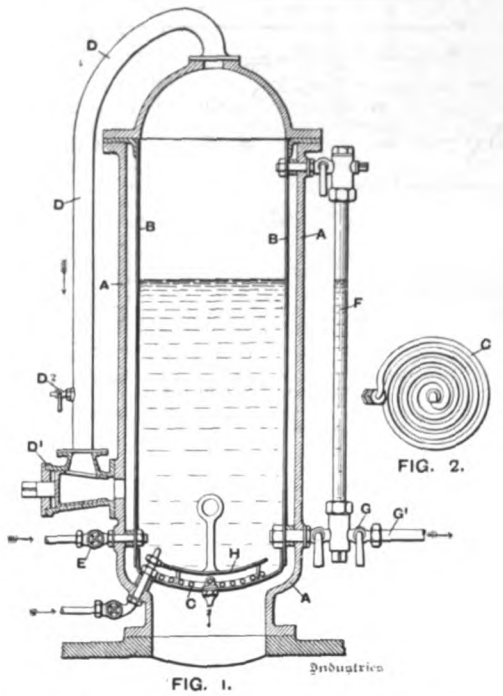


FIG. 1.

FIG. 2.

inner vessel, and resting on the bottom thereof, is a flat spiral coil C (Figs. 1 and 2) of thin metal tubing. One end of this coil is passed through the inner and outer vessel, and is connected to the boiler. The inner end passes through the inner vessel and opens, in the form of a contracted nozzle, into the condenser. The inner vessel contains the water to be evaporated, the vapour from which escapes, through a pipe D, from the top thereof to the main condenser, the passage of the vapour through said pipes being governed by a cock D^1. The water to be evaporated is supplied through pipe E. As the water in B becomes concentrated, it is drained out by cutting off communication between A and B, opening a small cock D^2 in D, and allowing the water to escape through the lower cock of the gauge glass F, cock G, and pipe G^1. A deposit-collecting pan H is also placed in the lower part of B to prevent deposition of scale upon the bottom of the inner vessel. Six claims are made.—No. 5891. April 18th, 1890. 8*d.*

BENCH VICES.—*D. Bateman & R. Sellers, both of Bradford, Yorkshire.*—The invention embraces a simple method of disconnecting and connecting the movable jaw with the screw of instantaneous grip vices. For this purpose a half-nut is rigidly attached to the fixed jaw, and is cut with a "buttress" screw thread. The said nut is fixed below the screw carried in the movable jaw, the thread on which is of a similar type to that on the half-nut. The screw is so mounted and arranged that it may be lifted out of engagement with the nut, and allow the movable jaw to be rapidly adjusted. The face on the movable jaw, against which the shoulder on the screw bears, is inclined towards the nut, and thus tends to press the screw against the nut. A spiral spring is placed on the rear end of the screw to prevent "back lash." To regulate the angle of the jaws and adapt them to uniformly grip a tapered object, the guide in the fixed jaw is formed wider in front, so that the slide of the movable jaw is free to move to either side. Claims: (1) In a vice, mounting or arranging the screw so that it is capable of being disengaged by hand from the nut, as described; (2) the construction and arrangement adapting the angle of the sliding jaw to be adjusted, as described.—No. 4932. March 29th, 1890. 6*d.*

DOUBLE-ACTING STEAM ENGINES.—*C. A. Tower, Cleveland, Ohio State, U.S.A.*—Referring to the annexed illustrations, Fig. 1 is a side sectional elevation, Fig. 2 a horizontal section, and Fig. 3 an end sectional elevation of a machine constructed on the principle of this invention. Journaled centrally in a suitable casing A is the main crank-shaft B, the crank of which is embraced by the piston C of the vertical cylinder D, which latter is adapted to slide horizontally in the casing between the ends of the two horizontal cylinders E, the pistons F of which are connected by screws F^1 to the cylinder D (Fig. 1). At each side of

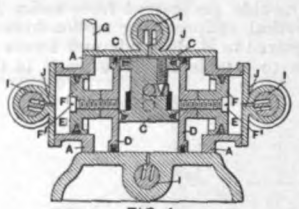


FIG. 1

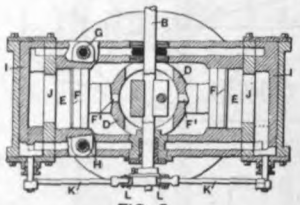


FIG. 2

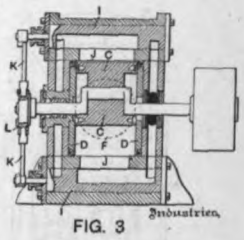


FIG. 3

A are provided a set of channels connected respectively with the supply and exhaust pipes G H, the opposite ends of each set of channels being connected with the interior of the casing of four valves I, in each of which are formed two ports extending respectively sufficiently far to the opposite ends to form communication between the exhaust or supply channels and that end of the cylinder above which it is placed through ports J. The valves I are all connected by rods K to a ring L embracing an eccentric in the shaft B, and are so operated as to cause the pistons of the three cylinders to work together and give B a continuous rotary motion. Nine claims are made, embracing the general features of an engine as described.—No. 225. January 6th, 1891. 8*d.*

SHIPS' STEERING GEAR.—*R. Roger, Egglescliffe, Yarm, Yorkshire.*—This invention has for its object the improvement of the method of safely controlling the movement of the uncoupled ends of the connecting rods of ships' steering gears of the "right and left hand screw" type when such gears are disconnected, to allow of the use of other means of steering. For this purpose the nuts (which travel on the right and left hand screwed spindle and actuate the rudder through the connecting rods and cross-head) are so formed that, when the rods are disconnected from the nuts by the withdrawal of the joint pins, the rods are only moved within guides connected to or forming part of the nuts, and in the form of tubes of a size sufficiently large to allow the ends of the rods moving inside them. Claims: The application to "right and left hand" screw steering gear of nuts having guides attached to them or forming part of them, which guides control the motion of the disconnected rod ends, as described.—No. 14860. September 20th, 1890. 6*d.*

BOLT CUTTER.—*H. J. Haddan, London.* (*J. Helwig, Dubuque, Iowa State, U.S.A.*)—The cutter forming the object of this invention is adapted for heavy cutting, such as cutting stay bolts of locomotive boilers, &c. A front and side elevation of such a cutter is shown respectively in Figs. 1 and 2 of the annexed illustrations. The two levers A, carrying in their upper ends the cutting knives and the actuating lever B, are pivoted at C C^1 to

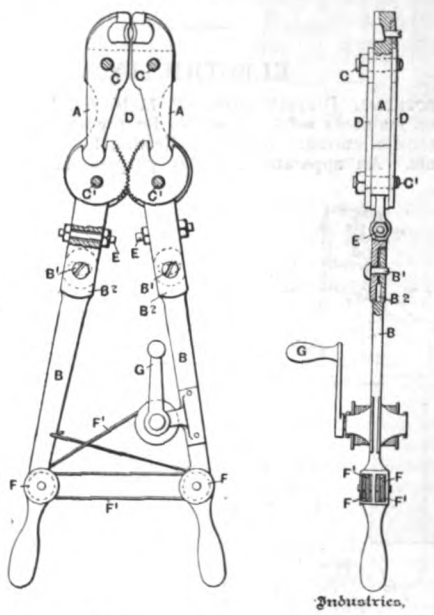


FIG. 1. FIG. 2.

plates D. The lower ends of A are provided with knuckles, which enter recesses in the upper ends of B, the inner faces of the upper ends of which are formed with teeth as shown. Suitable stops E are provided for preventing B coming too close together, and pulleys F are held in the lower part of said levers, around which passes the actuating cord F^1 operated from handle G as shown. The levers B are formed in two parts fixed together by means of screws B^1 and engaging teeth B^2. Four claims are made.—No. 892. January 17th, 1891. 6*d.*

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BRICK MACHINES.—*J. S. Pullan, W. H. Mann, & J. Gill, all of Leeds, Yorkshire.*—A machine such as embraced by this invention is shown in the annexed illustrations, of which Fig. 1 is a side elevation and Fig. 2 an end elevation, Fig. 3 being an enlarged detail thereof. The clay, in a plastic condition, is fed into the hopper A, and by means of a screw B, operated from B^1, is forced downward and into one of the two openings in the slide C (Fig. 3). This slide receives a reciprocating motion, so as to bring the two openings therein alternately under the mouth of the hopper by means of a rod D operated by a crank in the spindle of the gear wheel E, which wheel is geared to the driving shaft F. As the moulds are moved from under A a pusher, which receives a vertical reciprocating motion from the shaft G (Fig. 2), which is geared to E, descends and forces the brick out of the mould on to a table H. The brick is then

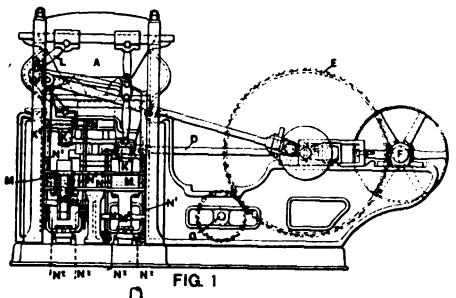


FIG. 1

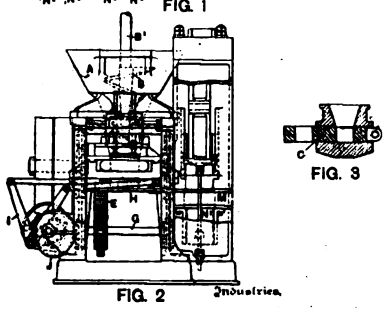


FIG. 2

FIG. 3

moved on to the surface of a plunger in one of two pressing moulds by one of the levers I, operated by means of a cam J on a horizontal shaft geared by bevel gearing with G. The rams K of these two pressing moulds slide in guides K^1, and are operated by means of two pairs of toggles connected together by a link (Fig. 1) and a rod L from the shaft of E. The moulds M have in them plungers M^1, which are connected to their respective rams by cross-bars N and rods N^1, furnished with elastic cushioned stops N^2. It will thus be seen that as the rams ascend the mould plungers will also ascend, so forcing the pressed brick out of the mould. Claims: (1) An improved duplex pressing machine for finish pressing bricks (in which the pressure is imparted by toggle movement) connecting two systems of toggles by a link, and actuating the same by one connecting rod from a rotating crank, the whole constructed, arranged, and operating as described; (2) the combination of a brick-making machine of the semi-plastic or other type, with the improved pressing machinery as described; (3) an improved pressing machine of the single type, having only one mould and plunger of the same kind as in the duplex machine referred to in Claim 1, in which one system of toggles is caused to pass beyond the dead point on both sides thereof, and pressing a brick at each passage of such dead point by the said toggles, thus pressing in and discharging from one mould two bricks at each rotation of the actuating crank.—No. 4368. March 20th, 1890. 8*d.*

ELECTRICITY.

ELECTRICAL DISTRIBUTION.—*H. E. Walter, London.*—The invention embraces safety apparatus for preventing danger from high-tension currents and for indicating faults in low-tension currents. An apparatus for this purpose is shown in side

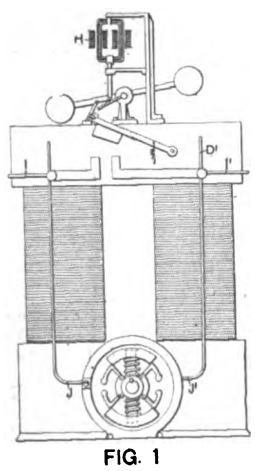


FIG. 1

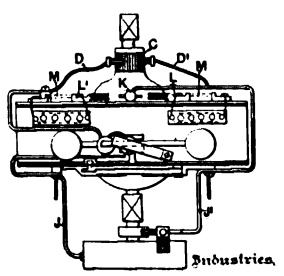


FIG. 2

elevation and plan respectively in Figs. 1 and 2, and a diagram of the connections thereof is shown in Fig. 3. Referring mainly to the diagram, A represents the generators supplying a three-wire system, of which B B^1 and B^2 are the main conductors. C is the armature of a switching electric motor placed at the central station, one pole of which is connected by a heavy conductor D with the neutral wire B^2 and the other pole by a heavy conductor D^1 with the earth. The coils of the field magnet E are connected by wires F F^1 from one terminal to the negative main conductor B^1, the other field terminal being joined to the wire D, so that the field is connected between the negative and neutral wires and is constantly charged. G represents an ampere meter in the ground connection, and H is a magnet controlling an alternating current switch adapted to close the circuit I I^1. A centrifugal switch of the motor armature is arranged to close the circuit J J^1 around such armature. K is a pivoted switch lever connected by wire with the grounded terminal of the motor armature and arranged to be placed in contact with one or the other of the plates L L^1 normally connected through incandescent electric lamps, the plate L^1 being connected with the wire extending to the negative main and the plate L to the wire extending to the positive main. These plates are also arranged to be connected by fusible safety catches M and wires M^1 M^2. N is the generator supplying a high-tension continuous current system, the main conductors of which are O O^1. The other connections are made substantially as shown in the diagram. The operation is as follows:—Suppose a ground connection to occur on the negative wire B^1 as indicated at P a ground circuit will be formed by means of wires D D^1 through the armature C, and the motor will be caused to run. If the ground connection was on the positive side the motor would run in the opposite direction. It will thus be seen that a ground exists, and on which side it exists, and such ground cannot result in injury to the system since the motor forms a translating device preventing an excessive flow of current through the earth. As a ground on the neutral wire does not affect the motor, the switch K may be used for testing for grounds thereon, the negative conductors being connected to ground through the resistance lamps, so that if there is no ground the motor will then run at its normal speed, but if a ground is made it will move very slowly. If the negative wire comes in contact with a wire of high-tension system as shown at P^1, and said high-tension system is grounded at P^2, by the above-described arrangements a low resistance path to ground for the high volt current is already provided, so that difference of potential does not occur. When a

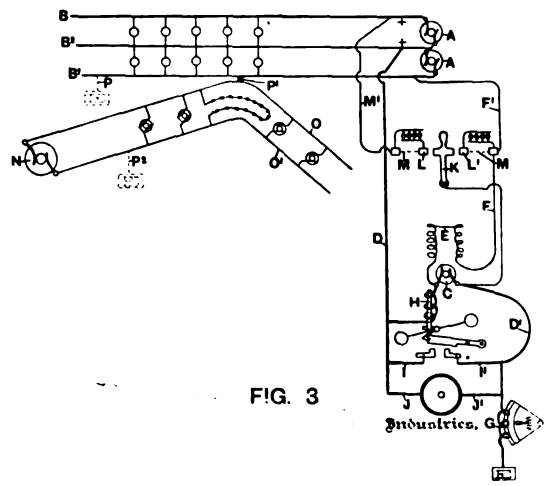


FIG. 3

high volt connection is made the motor C attains a high speed, so that the centrifugal governor is operated and closes the circuit J J^1, so stopping the motor. The inventor also describes an arrangement in connection with continuous current transformer systems. Five claims are made.—No. 2876. February 22nd, 1890. 8*d.*

FILAMENTS FOR INCANDESCENT LAMPS.—*H. H. Lake, London.* (*V. M. Hobby, New York, U.S.A.*)—The composition consists of the following ingredients, combined in the proportions stated:—Carbon, 1oz.; sugar, 1oz.; liquid mucilage, 1oz.; and liquid india ink, 1oz. The ingredients, after being thoroughly mixed to form a paste, are dried and cut with a knife to form a filament, then carbonised in the following manner:—The filament is placed together with a lump of the above paste in a graphite pot just large enough to contain them and a frame of wood, upon which the filament is wound. A graphite cover is then placed upon the pot and made air-tight by sealing with fireclay. Said pot is then put in a large graphite pot, having a space of about 2in. all round, which space is then filled with powdered graphite, lampblack, or powdered charcoal, and a cover put on and sealed. The whole is then raised to a white heat in an oven, and allowed to gradually cool. The filament is then cut to proper lengths, and is ready for use. Four claims are made.—No. 13791. September 2nd, 1890. 6*d.*

ARC LAMPS.—*R. Belfield, London.*—The lower carbon is stationary, but the upper carbon is attached to a rod having a rack gearing with a pinion on the axis of an escapement wheel which is engaged by an anchor on the axis of the brake wheel. When the brake wheel is free, the weight of the carbon and its holder causes it to slowly descend, turning the escapement wheel, and causing the anchor to vibrate the escapement anchor and brake wheel are mounted in bearings in a frame suspended from one arm of a nearly balanced lever near its fulcrum. The ends of this lever have suspended from them iron cores free to move inside two solenoids. The coil of one of these solenoids is of fine wire, and in a shunt to the lamp circuit; the coil of the second solenoid is of large wire, and in the lamp circuit. Thus movement of the gearing for releasing or holding the brake wheel is completely governed by the current passing through said solenoids. Claims: (1) In an arc lamp, in combination with a rack rod carrying the upper carbon, a pinion and escapement wheel, and an anchor and brake wheel or segment, all suspended from a lever carrying a core acted upon by a solenoid, so that when the resistance of the arc increases the brake wheel descends from a brake, thus liberating the escapement and allowing the upper carbon to descend slowly as described; (2) in combination with a lever above referred to, having two cores acted upon differentially by two solenoids, the one in the lamp and circuit, and the other in a shunt, a third solenoid, which, in case of excessive resistance in the lamp circuit, is brought into and closes the external circuit and maintains it closed.—No. 7599. May 15th, 1890. 8*d.*

CHEMISTRY.

COLOURING MATTERS.—*C. D. Abel, London.* (*The Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany.*)—By the action of one molecule of tetrazoditolyle upon one molecule of α-naphthylamine there results a product:—

$$C_7H_6 - N = N - C_{10}H_6NH_2HCl$$
$$\vert$$
$$C_7H_6 - N = NCl.$$

This diazo compound may, by treating with nitrous acid, be converted into a tetrazo compound which can be combined with phenols, amines, or their sulphur and carbo-acids, so forming colouring matter. Example: 10·9 kilos. of tolidine are converted in the well-known manner into the tetrazo compound; the solution of this is poured into a solution of a salt of 7·5 kilos. of α-naphthylamine. The mixture is allowed to stand for some time and afterwards acidulated with hydrochloric acid and again diazotised by treatment with nitrite of soda; the tetrazo compound formed in this way is combined with 40 kilos. of a soda salt of the α-naphtholdisulpho acid mentioned in the Specification No. 15775 of 1885. After standing for some hours the mixture is boiled, the colouring matter is precipitated by salt, filtered, and dried. This dyes unmordanted cotton a deep blue violet. Claims: (1) The production of colouring matters by combining one molecule of the tetrazo compounds of tolidine, dianisidine, or diphenetidine with one molecule of α-naphthylamine, diazotising the product thus obtained and reacting with this rediazotised compound upon either of the α-naphtholdisulpho acids, described in the Specification No. 15775 of 1885 or No. 4625 of 1888; (2) as new articles of manufacture the colouring matters herein described.—No. 6932. May 5th, 1890. 6*d.*

APPARATUS FOR THE PRODUCTION OF CARBONIC ACID GAS.—*H. H. Lake, London.* (*La Société J. Jay et Jallifier, Lyons, France.*)—A front and side sectional elevation is shown respectively at Figs. 1 and 2 in the annexed illustrations of an apparatus of the above description. The casing A, of enamelled metal, is closed hermetically by a lid B pressed downwards by a screw C as shown, and contains a glass vessel D, perforated at its lower extremity and containing bicarbonate of soda in the form of blocks. This vessel D is supported in the upper part of A by means of a flange as shown, and the lower part thereof projects into a second glass vessel E containing acidulated water. A hollow neck is cast on the lower part of A, through which the upper part of a rod F passes. The lower end of this rod is supported in an indiarubber tube G fixed by a flange to the neck on A, and around which is placed a helical wire and a protecting tube. The interior of this tube G is in connection with the interior of A, so that as the pressure rises in A the tube will be elongated, so allowing the rod F to fall. One end of a weighted lever H is connected to a metal cap on the lower end of

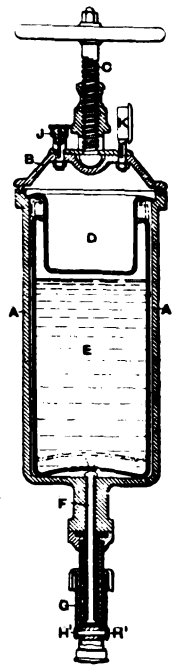


FIG. 1.

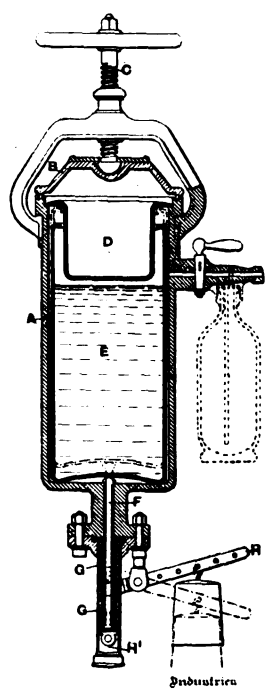


FIG. 2.

G by means of links H^1. It will thus be seen that, when there is no pressure in A, F, and consequently G E, will be forced upwards, so bringing the contents of D and E in contact, which gives rise to a regular disengagement of carbonic acid gas. As, however the pressure rises in A, E will be allowed to fall gradually, so diminishing the quantity of gas disengaged. The usual cock I, safety valve J, and pressure gauge K are connected with A.—Five claims are made.—No. 4473. March 21st, 1890. 8*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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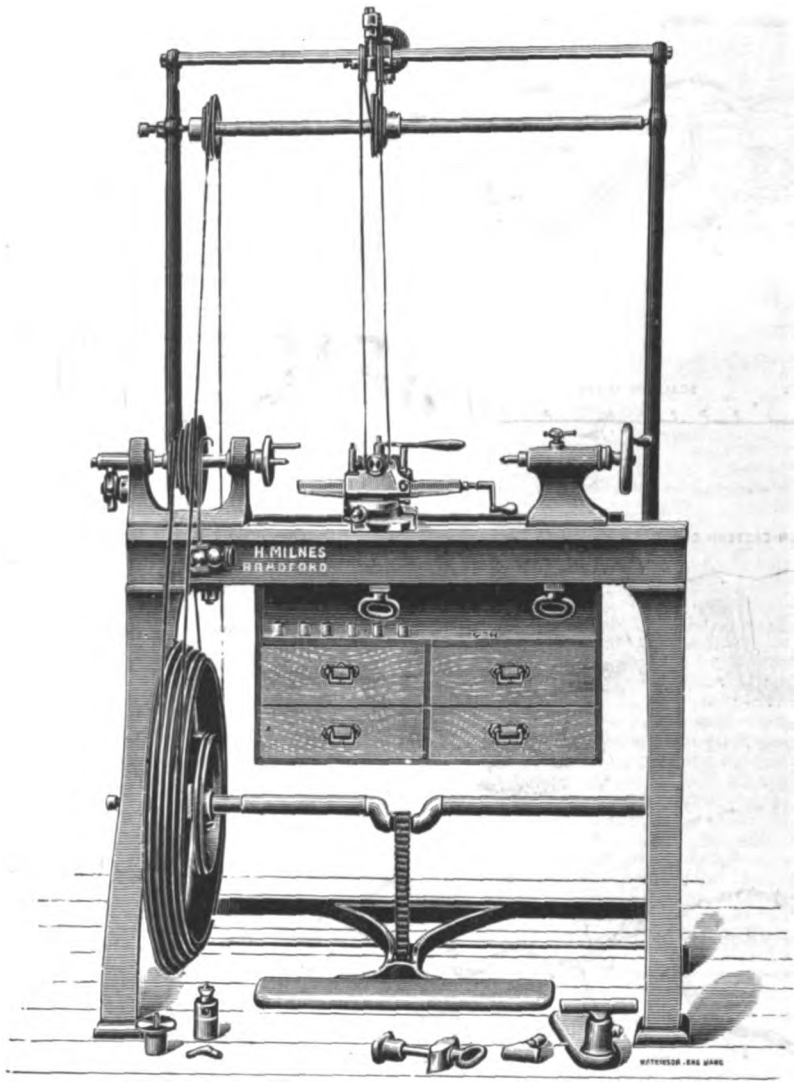
ORNAMENTAL TURNING LATHE.

THE illustration given herewith represents a 5in. ornamental turning lathe, made by Mr. Henry Milnes, Ingleby Works, Bradford. The bed is 3ft. 6in. long, and is scraped up accurately to a surface plate. The lathe headstocks are of recent design, and the front headstock has a hard steel traversing mandrel bored throughout, working in hard steel bushes. It has a gun-metal cone, with five circles of divisions, forming the following group, viz.:—192, 180, 160, 120, 100. The cone is so marked and figured that it can be read at sight, thus obviating the necessity of counting when used for the purpose of dividing. There is also provided an interpolating index pointer. In addition there are six screw guides and suitable apparatus for screw cutting. The back headstock mandrel is provided with a screw having ten threads to the inch, so that a complete turn of the hand-wheel advances the mandrel one-tenth of an inch. A disc fitted on the hand-wheel is divided into ten, so that in drilling the 100th of an inch may be measured. The lathe centres are of best cast steel, and made conical to fit into the spindles. The lathe comprises a driver chuck, drill chuck, prong chuck, tool board, and drawer of polished mahogany, hand rest fitted with two top rests, strong turned steel crank-shaft with ends hardened and working on hard steel long pointed centres, and easy going treadle motion, double bevel cast-iron fly-wheel, with six speeds, driving bands, and spanners.

The overhead apparatus is mounted on cast-iron bearers, which are bolted firmly to the lathe bed. There are also a long triangular bar, with gun-metal sliding carriage and guide pulleys, a lever and counterbalance weight, steel motion shaft, and speed pulleys. With this design of overhead arrangement it is possible to take in work 15in. long without moving the sliding carriage or the driving pulley. The slide rest for ornamental turning is 12in. long, and is fitted with a gun-metal cradle and stops for use in turning a surface or cylinder. There are also a graduated arc and elevating screw, tool receptacle with two steel screws for regulating the depth of cut, and a gun-metal ring for raising or depressing the height of tool point. The upper slide is fitted with a collar to ensure proper control without the use of a lever. The necks of the mandrel, after being hardened, are ground on the dead centres by a revolving lap. Great care has been taken to ensure easy running both for ordinary turning and for overhead work. There are a variety of fittings designed for this lathe, and altogether it is well designed and neatly finished. The workmanship and materials are, we understand, of the best throughout.

ORNAMENTAL TURNING LATHE.

CONSTRUCTED BY MR. HENRY MILNES, INGLEBY WORKS, BRADFORD.



GENERAL VIEW.

THE NICARAGUA CANAL.

II.

FINAL SURVEY AND PROPOSED ROUTE.

(*Continued from page* 290.)

IN our last article we gave a brief history of the various proposals, surveys, and negotiations relating to the construction of an inter-oceanic canal through the Central American isthmus, chiefly with reference to the Nicaraguan route, up to the date of the final concession to the company who now have the undertaking in hand. We have seen how, after a careful examination of the results of official surveys and estimates, a Commission, appointed by President Grant, unanimously reported in favour of the Nicaraguan scheme. The decision of this Commission was expressed in the following words:—"After a long, careful, and minute study of the several surveys of the various routes across the continent, we unanimously report, that the route known as the Nicaragua route possesses, both for the construction and maintenance of a canal, greater advantages, and offers fewer difficulties, from engineering, commercial, or economical points of view, than any of the other routes shown to be practicable by surveys sufficiently in detail to enable a judgment to be formed of their relative merits."

Of course, the chief *primâ facie* advantage of the Nicaraguan route, and that which caused attention to be directed to it early in the sixteenth century, is the existence of natural waterways over a large proportion of the proposed course, these waterways consisting in the River San Juan and Lake Nicaragua. In connection with this part of our subject, we may here remark—in anticipation of subsequent more detailed particulars—that although the total length of the route as finally decided on is about 169½ miles, of this 121 miles consist of natural waterways, leaving only about 48 miles to be artificially constructed, partly by means of dams and partly by excavation. The existence of Lake Nicaragua and the River San Juan also ensures an abundant supply of water, a very material advantage.

On the chart (Fig. 2) accompanying our first article, the present courses taken by vessels between various ports are compared with those which would be adopted after the construction of the canal, and in this connection the following particulars will be of interest:—

Route.	*Vid* Cape Horn.	*Vid* Cape of Good Hope.	*Vid* Canal.	Distance saved.
Liverpool to	Miles.	Miles.	Miles.	Miles.
San Francisco.....	14,690	—	7,508	7,182
Melbourne	13,352	13,140	12,748	392
Hong Kong.....	18,030	15,051	13,786	1,265
Yokohama	17,529	16,040	12,111	3,929
Valparaiso	9,600	—	7,448	2,152
Sandwich Islands	14,080	—	9,136	4,944
Guayaquil	11,321	—	5,890	5,431
New York to				
San Francisco.....	14,840	—	4,946	9,894
Hong Kong.....	18,180	15,201	11,038	4,163
Yokohama	17,679	16,190	9,363	6,827
Melbourne	13,502	13,290	10,000	3,290
Sandwich Islands	14,230	—	6,388	7,842
Guayaquil	11,471	—	3,053	8,418

The distances given refer to routes taken by slow trading steamers and sailing vessels, and not to those followed by mail and passenger steamers. As regards the advantages to be derived by this country from the use of the proposed canal, it must be remembered that not only the carrying trade between British and foreign ports is conducted in British vessels, but also a very large proportion of the trade of other countries, so that England has, for instance, almost as direct an interest in the reduction of the distances between New York and Hong Kong or San Francisco, as in shortening the routes from the latter places to Liverpool. It seems scarcely creditable to our enterprise, whatever from the prudential point of view may be said in our defence, that although Great Britain has such a preponderating interest in the commerce of the world, not one of the great inter-oceanic canal projects owes its inception to British energy or capital. This is perhaps the more surprising, since on two occasions, at least, to which we incidentally referred in our historical review, the British Government showed its appreciation of the advantages to be derived from a canal through the American isthmus by attempting to acquire territorial rights there.

Intimately associated with the shortening of routes is the question of the traffic to be expected through the canal, but it will be more convenient to consider this later on when dealing with the financial aspects of the undertaking.

During the official survey by the United States Government of the Nicaragua route, which was commenced in March, 1872, and continued until July, 1873, no less than eight different routes from the lake to the Pacific were explored, including that examined by Colonel O. W. Childs, in 1850, from the mouth of the River Lajas, which empties itself into Lake Nicaragua, to Brito, on the Pacific coast, the accuracy of which was confirmed. Childs found the lowest depression in the Cordilleras, between the oceans on either side of the isthmus, to be 152ft. only above sea level, and proposed to take the canal through this. The chief difficulty in the way of the execution of this scheme was the drainage of the valley of the Rio Grande, a problem at that time not satisfactorily solved. On this account certain modifications of the route in question were introduced by the Government surveyors, and a project was finally proposed embodying the following main features:—56·5 miles of lake navigation and 63·02 miles of navigation by the River San Juan, with 61·74 miles of excavated canal, twenty-one locks, and four dams across the San Juan. The total length would thus be 181·26 miles, and the estimated cost was $65,222,147.

Mr. A. G. Menocal, now chief engineer of the company constructing the canal, to whose admirable report we are indebted for much of our information, re-surveyed in 1880 the line adopted by Childs, with the results of re-

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THE NICARAGUA CANAL.

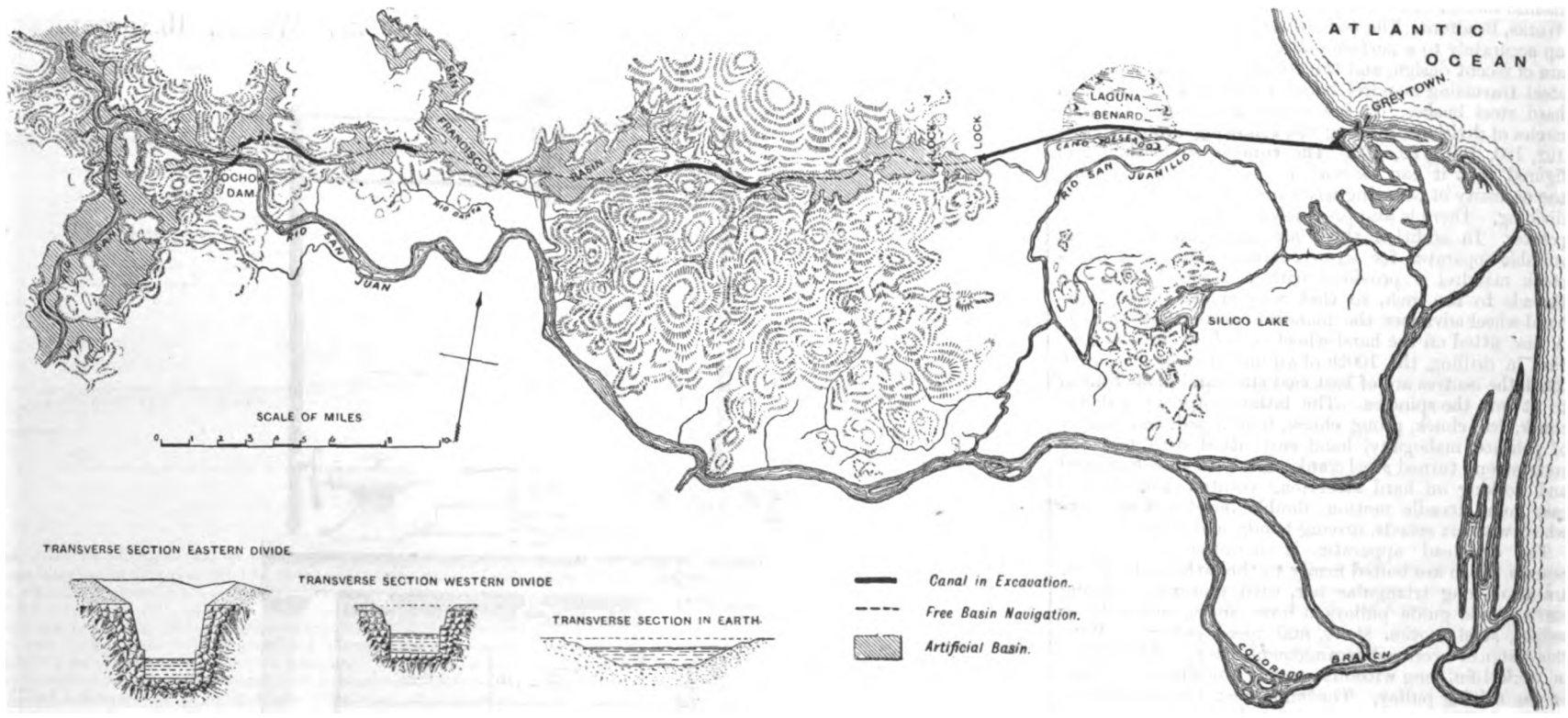


FIG. 3.—EASTERN DIVISION.

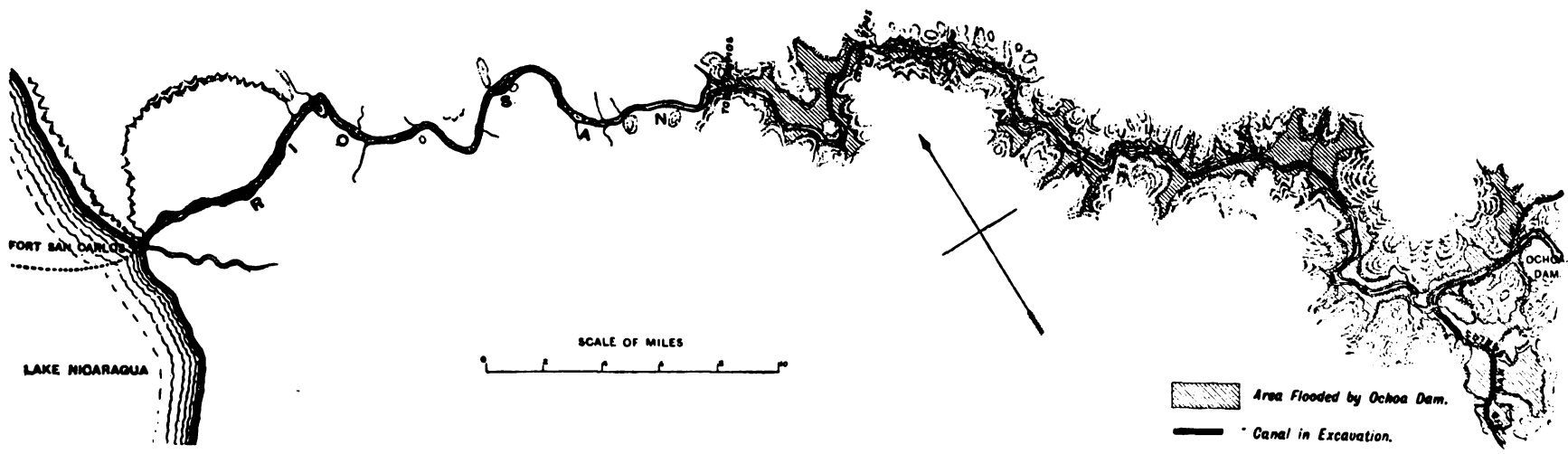


FIG. 4.—SAN JUAN RIVER OR CENTRAL SECTION.

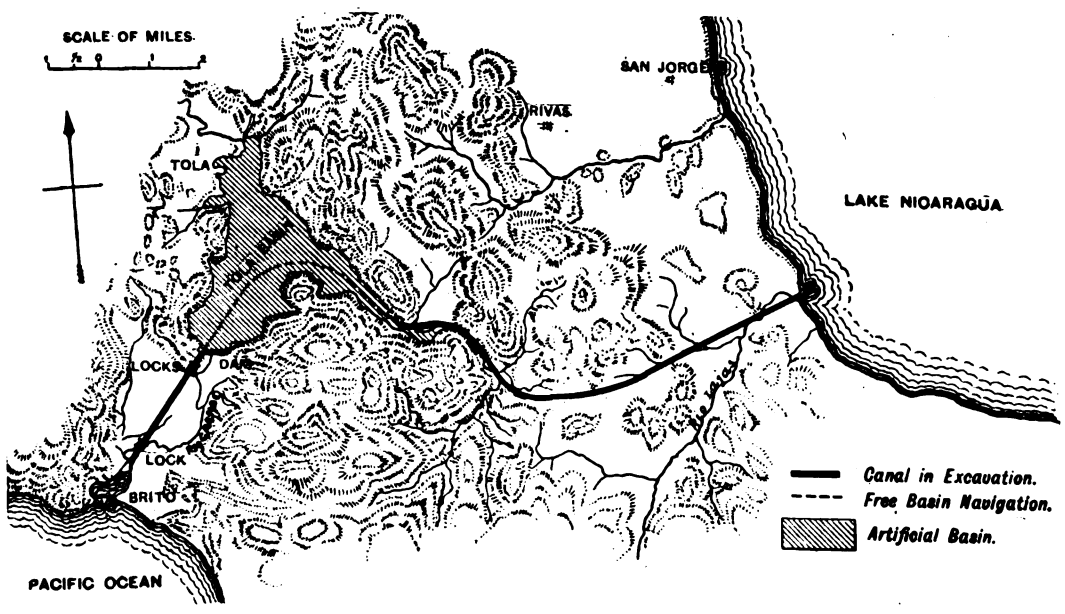


FIG. 5.—WESTERN DIVISION.

ducing the length by 1¼ mile, finding a satisfactory solution of the drainage problem by diverting the course of the Rio Grande, above its junction with the canal, through an artificial channel, and reducing the quantity of excavation required. In 1885 a rectification of the section of the proposed route to the east of Lake Nicaragua was also taken in hand by Mr. Menocal at the instance of the United States Government. This happened previously to the final incorporation of the present company, but subsequently another minutely detailed survey was undertaken, lasting two years and a half, the scope of which may be gathered from the fact that for every mile of final location forty miles of actual instrumental survey were required.

The route finally decided on, after the careful and laborious preliminary studies referred to, starts on the eastern coast at the town of San Juan del Norte, or Greytown, and terminates on the Pacific coast at Brito. All the proposed schemes for a Nicaraguan canal appear to have selected Greytown as the point of departure on the Atlantic, but various termini were suggested on the Pacific. The proposed course of the canal may for convenience be divided into three parts :—First, the eastern division ; secondly, the central or San Juan River section ; and thirdly, the western division.

The eastern division commences at the inner harbour of Greytown and extends to the River San Juan at Ochoa, the central section follows the San Juan River from Ochoa to its confluence with Lake Nicaragua, while the western division comprises that portion between the

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THE NICARAGUA CANAL.

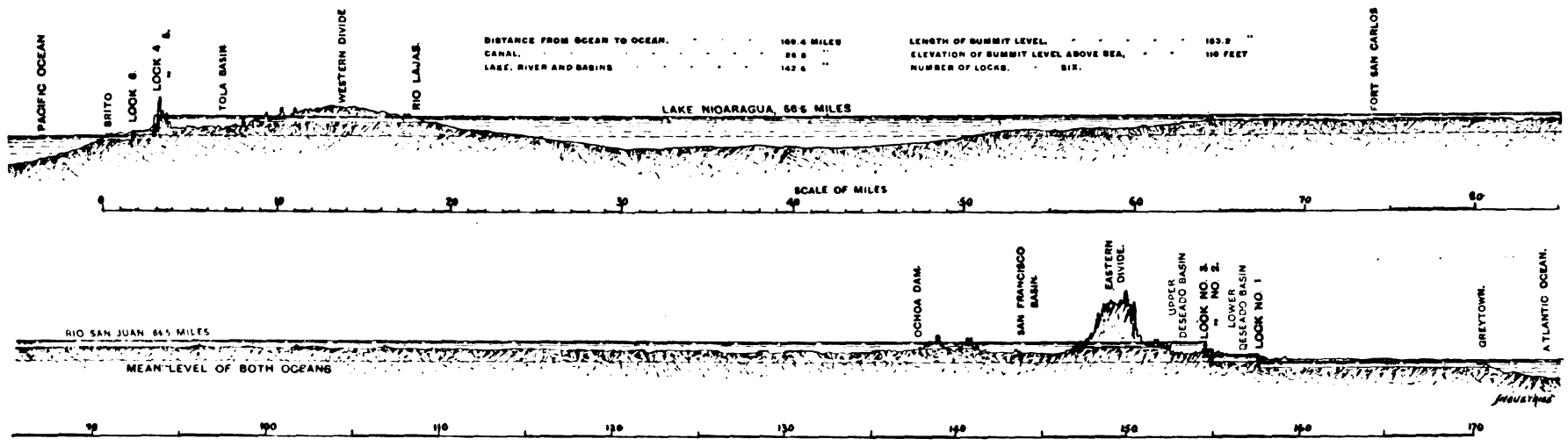


FIG. 6.—DIVIDED PROFILE SHOWING THE WESTERN, CENTRAL, AND EASTERN DIVISIONS OF THE CANAL.

lake and the Pacific. Plans of these divisions are shown in Figs. 3, 4, and 5 respectively. Before proceeding to describe in detail each section of the canal, it should be stated that there will only be six locks in all, three near the eastern and three near the western end. Commencing at the eastern terminus Lock No. 3 is to be only 12¾ miles from Greytown, and Lock No. 4, 2·15 miles from the Pacific port of Brito. Between these two points navigation will be unimpeded. The summit level of the canal will be that of Lake Nicaragua, taken at its mean value of 110ft. above mean sea level.

From the harbour of Greytown the projected canal runs in a westerly direction, with a slight southerly inclination, at sea level, for a distance of 9·297 miles, to Lock No. 1, following for a considerable portion of its length the valley of the Deseado stream, which at certain points will have to be diverted into artificial channels to avoid interference with the canal. Lock No. 1 will have a lift of 30ft., and its dimensions, like that of all the other locks, will be 650ft. by 70ft. From Lock No. 1 to Lock No. 2 the canal continues in the Deseado valley, which will here be partially flooded by the construction of four low embankments in conjunction with weirs for controlling the drainage. Between Lock No. 1 and Lock No. 2 there is an interval of 1·258 miles, and the latter has a lift of 31ft. 1·927 miles further west, and—as before stated—12¾ miles from Greytown, is Lock No. 3, with a lift of 45ft. Above Lock No. 3 the so-called Upper Deseado Basin is formed by an embankment 70ft. in height and 1,050ft. long, connecting the sides of the valley. This basin has a length of over three miles, with a depth of from 30ft. to 70ft., obtained for a distance of 2·590 miles without excavation. The dam is to be built of stone, with earth backing, and will have a weir 600ft. long on the crest. On the south side of the valley, in a gap between the hills, will be a second weir, 800ft. in length. At the western end of the Upper Deseado Basin is the "Eastern Divide," the cutting through which forms the heaviest piece of work on the whole canal, and contains 21 per cent. of the total estimated excavation. The length of the cutting is 2·917 miles, the maximum depth 298ft., and the average depth above the water level 111·2ft.

The material to be removed consists chiefly of solid rock, which will be utilised for building the dams and embankments required in the vicinity. On either side of the ridge an unlimited supply of water power is available for driving all the necessary machinery, while the climate is said to be one of the healthiest in Nicaragua. Fig. 6 represents a divided profile of the whole canal, which, together with the plans already referred to, will assist to make the preceding and subsequent descriptions more clear. On the western side of the ridge of the Eastern Divide another basin will be formed by constructing a series of embankments to close the gaps between the hills surrounding the valley of the San Francisco River and its tributaries. The total length of this, the "San Francisco Basin," will be 11·267 miles, including a length of 1·233 miles wholly, and another of 2·570 miles partly, in excavation. It is claimed that by the creation of basins instead of narrow excavated channels, considerable advantages are secured. In the first place, vessels can travel at full speed, lie at anchor, and pass each other at any point, while the basins immediately above the locks serve as "turn-outs" for ships waiting to enter. In the second place, with reference to the San Francisco Basin, Mr. Menocal says, in his report, "that without it the cut across the 'divide' would be of such proportions as to make the route commercially impracticable and the basin of the Deseado an impossibility." The embankments will be all so formed as to serve as waste weirs for the discharge of surplus water at various points of the basin, and in this manner it is calculated that very ample provision has been made against floods and freshets. The weirs in the basin alone, without taking into account the Deseado dam and weir and the culverts of Lock No. 3, are estimated as capable of discharging 90,200 cubic feet per second, before the water reaches the top of the higher embankments. The total length of what we have called the "Eastern Division" is 31·364 miles.

(To be continued.)

BOILER DEPOSITS.*

Two years ago I had the honour of reading a paper before this Institution on "Boiler Incrustations," in which I traced the formation of the scale, and the causes which led to the precipitation and hardening of the calcic sulphate, calcic carbonate, magnesic hydrate, and other compounds which are usually found to be present, and I pointed out that the scales formed by various kinds of water were so characteristic that one could speak with certainty as to the kind of water from which the incrustation had been formed by an analysis of the scale itself. The analyses given below may be looked upon as typical of the incrustations formed by fresh water, brackish water, and sea water respectively in marine boilers:—

Constituents.	River.	Brackish.	Sea.
Calcic carbonate	75·85	43·65	0·97
Calcic sulphate	3·68	34·78	85·53
Magnesic hydrate	2·56	4·34	3·39
Sodic chloride	0·45	0·56	2·79
Silica	7·66	7·52	1·10
Oxides of iron and alumina	2·96	3·44	0·32
Organic matter	3·64	1·55	trace
Moisture	3·20	4·16	5·90
	100·00	100·00	100·00

From this it is evident we may look upon the incrustation from fresh water as consisting of impure calcic carbonate, whilst that from sea water is impure calcic sulphate, the brackish water from the mouths of rivers yielding, as might be expected, an incrustation in which both these compounds are present in nearly equal quantities.

The importance of these differences in the deposit formed is very great, as it enables the shipowner to arrive at a conclusion as to the treatment that the boilers have received during the voyage, by examination and analysis of the scale which those boilers contained. Taking, for instance, the case of a ship which uses fresh water both for filling and make-up, it is manifest that on her return to port the scale should be very slight and should consist mainly of calcic carbonate; whilst, if the scale exceeds ⅛in. and shows a preponderance of calcic sulphate, it is manifest that such scale could only have been formed by sea water, either leaking in from faulty condensers or being deliberately fed into the boilers. The reception you were kind enough to give that paper, and the frequency with which it has been quoted since, lead me to hope that, in continuing and completing the subject, I shall be performing a not unwelcome task. So far the deposits taken into consideratton have been those formed from the impurities natural to the water itself; but with the introduction of high-pressure steam a new and highly dangerous form of deposit has added to the trouble of the marine engineer.

As early as 1878 the collapse of the furnaces of the boilers of the s.s. "Ban Righ" and a similar misadventure in the screw tug "Ich Dien," with no apparent cause to bring about the damage, caused some attention to be paid in marine circles to the action which had taken place, and the only clue to be found was that a certain amount of oily deposit had formed on the tops of the furnaces, and experiments made by Mr. Dunlop, of Port Glasgow, led to the conclusion that this oil, which had distilled into the boiler from the lubricants used in the cylinder, was so bad a conductor of heat that its formation on the plates allowed them to get superheated, with the result that they were unable to withstand the pressure of steam existing in the boiler, and in this way brought about the collapse. Similar cases of collapse became frequent after that date, no less than thirty vessels being disabled from this cause during the last few years.

The first case which came under my notice, in which damage to boilers had arisen from this cause, was the case of a large ocean steamer, and through the kindness of Mr. Milton, Chief Superintendent Engineer of Lloyd's, I was able to obtain samples of deposit from all parts of the boilers, and full particulars of the case. The steamer was a large one trading between Liverpool and Boston, averaged twelve days on the voyage, and was fitted with ordinary compound engines. She had three double-ended boilers, with three plain furnaces at each end, and three combustion chambers in each boiler. The furnaces were plain in one length and connected at the back end to the tube plates, being flanged up inside the chamber, whilst the front end plate is flanged inwards on to the furnace crowns. The furnace crown was ⅜in. plate, and the front bottom plate 11/16in., the working pressure being 80lb. The boilers are about five and a half years old, and have always been refilled with fresh water at the end of each run, both at Boston and Liverpool; whilst, as a rule, the waste on the voyage was made up by the use of about 70 tons of fresh water, but during the last voyage sea water was used for this purpose. Every four hours whilst under steam 4lb. of soda crystals were put in the hot well, making about 2 cwt. during the run, the total capacity of the boilers being about 81 tons. For lubricating purposes about seven pints per day of valvoline were used in the cylinders.

When in port the boilers were allowed to cool down, and the water was run off, and they were swept down with stiff brushes, and were afterwards sluiced out with a hose shortly before being refilled with fresh water. No trouble occurred with the boilers until five voyages before the final collapse, when some of the furnaces began to creep in; they were stiffened with rings and stays, and on the succeeding voyages the whole of the furnaces got out of shape, one after another. Examination of these boilers clearly showed that they had never been very heavily scaled, as in parts of the boiler where it would have been impossible to get at them to clear them out, no signs of heavy incrustation were to be found, and the absence of marks of scaling tools also showed that they had never been allowed to get very dirty. On the furnace crowns, where they had collapsed, there was only a slight white scale, not more than 1/32in. in thickness, whilst on the bottom of the furnaces there was a brown oily deposit 1/16in. in thickness, which in other parts of the boilers increased to between ⅛in. and 3/16in. I obtained from Mr. Milton samples of the thin scale from the top furnaces, and of the deposit from various parts of the boiler, and also specimens of cut-out portions of the boiler plates, Liverpool water, valvoline, and soda crystals put into feed water, and of all these analyses were made as given below.

I.—VALVOLINE.

The valvoline on analysis gave:—

Vegetable and animal oil	*nil*
Mineral oil	100 per cent.
Acids (free)	*nil*
Boiling point	371° C
Specific gravity	·889

II.—SCALE FROM FURNACE.

	From Top.	From Below.
Calcic sulphate	84·87	59·11
Calcic carbonate	5·90	6·07
Magnesic hydrate	2·83	11·29
Iron, alumina, and silica	2·37	2·85
Organic matter and oil	3·23	19·54
Moisture	0·80	1·14
Alkalies	*nil*	*nil*
	100·00	100·00

* Paper read by Professor Vivian B. Lewes before the Institution of Naval Architects on the 19th ult.

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III.—Deposit from Tubes.

	Scale on Tubes.	Deposit above the Scale.
Calcic sulphate	50·92	11·60
Calcic carbonate	4·18	0·82
Magnesic hydrate	14·12	22·21
Iron, alumina, silica, &c.	7·47	9·14
Organic matter and oil	21·06	50·20
Moisture	1·17	4·23
Alkalies	1·08	1·80
	100·00	100·00

IV.—Deposit from Bottom of Boiler.

Calcic sulphate	22·52
Calcic carbonate	*nil*
Magnesic hydrate	7·09
Silica, alumina, and iron	34·85
Organic matter and oil	27·95
Moisture	5·79
Alkalies	1·80
	100·00

The boiler plates were as good as the day they were put in, and showed no structural signs of having undergone any change, whilst the analyses of the Liverpool water and the soda crystals used showed that they could have taken no part in the action which had led to collapse.

On careful examination of the organic matter and oil present in these deposits, it was found that quite one-half of it was "valvoline," in an unchanged condition, which had collected round small particles of calcic sulphate. A consideration of these analyses, at first sight, yields no clue as to the cause of the collapse, the scale upon the furnace tops being not only free from oil, but perfectly harmless both in quantity and quality; but, on going more deeply into the question, it is evident that this scale cannot be in the condition in which it was originally formed, as the deposits from both top and bottom of tubes, from the bottom of the furnaces, and from the shell of the boiler, are all rich in oily matter; and it is impossible that, during this deposition, the furnace tops could have escaped whilst all other parts of the boiler became coated with it. Experiments, however, reveal the actions which had been at work and led to the formation of the deposit, and its absence upon the injured portions of the plates. The pressure at which the boilers were worked was 80lb., corresponding to a temperature of 155° C., or 311° F., which is so far below the boiling point of the valvoline that it was evident that it had not distilled over in the ordinary way, and experiments were made to see if it could be distilled in steam at a lower temperature. A retort containing valvoline was carefully heated over a sand bath, its temperature being ascertained by a thermometer, and steam was then blown through it, with the result that at 248° F. or 120° C. the steam became "greasy" and the oil commenced to pass over with it.

This experiment is, I think, important, as it shows that, in testing the capabilities of a lubricant, the fact that it has a boiling point well above the temperature of the steam is no guarantee that none of it will find its way into the boiler. Having thus entered the boiler, the minute globules of oil, if in great quantity, coalesce to form an oily scum on the surface of the water, or, if present in smaller quantities, remain as separate drops; but show no tendency to sink, as, their specific gravity being ·889, they are lighter than the water, and the difference in the gravity is probably even greater at the temperature existing in the boiler. Slowly, however, they come in contact with small particles of calcic sulphate and other solids separating from the water, and, sticking to them, they gradually coat the particles with a covering of oil, which in time enables the particles to cling together or to the surfaces which they come in contact with. These solid particles of calcic carbonate, calcic sulphate, &c., are heavier than the water, and, as the oil becomes more and more loaded with them, a point is reached at which they have the same specific gravity as the water, and then the particles rise and fall with the convection currents which are going on in the water, and stick to any surface with which they come in contact, in this way depositing themselves, not as in common boiler incrustations, where they are chiefly on the upper surfaces, but quite as much on the under sides of the tubes as on the top, their position being regulated by whether they come in contact with the surface whilst descending or ascending.

The deposit so formed is a wonderful non-conductor of heat, and also, from its oily surface, tends to prevent intimate contact between itself and the water. On the crown of the furnaces this soon leads to overheating of the plates, and the deposit begins to decompose by the heat, the lower layer in contact with the hot plates giving off various gases which blow the greasy layer, ordinarily only $\frac{1}{16}$in. in thickness, up to a spongy leathery mass often $\frac{1}{4}$in. thick, which, because of its porosity, is an even better non-conductor of heat than before, and the plate becomes heated to redness, and, being unable to withstand the pressure of steam, collapses. During the last stages of this overheating, however, the temperature has risen to such a point that the organic matter, oil, &c., present in the deposit burns away, or, more properly speaking, is distilled off, leaving behind, as an apparently harmless deposit, the solid particles round which it had originally formed. Such a deposit is much more likely to be produced with boilers containing fresh or distilled water, as the low density of the liquid enables the oily matter to settle more quickly, whilst with a strongly saline solution it is very doubtful if this sinking point would ever be reached; it is evident also that, when oil has found its way into the boiler, and is causing a greasy scum on the surface, the most fatal thing that can be done is to blow off the boilers without first using the scum cocks, because, as the water sinks, so the scum clings to the tops of the furnaces and other surfaces with which it comes in contact, and, on again filling up with fresh water, it still remains there, causing rapid collapse.

A very remarkable instance of this is to be found in the case of a large vessel in the Eastern trade, in the boilers of which an oil scum had formed. The ship having to stop some days at Gibraltar, the engineer took the opportunity of blowing out his boilers and refilling with fresh water, with the result that, before he had been ten hours under steam, the whole of the furnaces had come in. Under some conditions the oil-coated particles coalesce and form a sort of floating pancake, which, sinking, forms a patch on the crown of the furnaces at one particular spot, and under these conditions the general result is the formation of a "pocket."

A curious fact, which is worthy of attention, is that in most of these oily deposits copper is to be found in considerable quantity. In an analysis of deposit from the furnace of a vessel in which a "pocket" had formed from the above-mentioned cause, the scale showed, as in the case already cited, no reasonable cause for the injury at the damaged part of the boiler, whilst the deposit from the underside of the furnace tubes showed clearly the presence of large quantities of oil matters, which were partly combined with copper:—

Constituents.	Scale.	Deposit.
Calcic sulphate	90·354	1·02
Calcic carbonate	1·200	*nil*
Ferric oxide, Oxide of alumina	3·200	56·90, 2·30
Oxide of copper	*nil*	1·90
Magnesic hydrate	2·821	1·80
Organic matter, Oil	1·600	10·46, 17·84
Sand, &c.	0·825	7·78
	100·000	100·00

It is a fact that even mineral oils have a considerable solvent action upon copper and its alloys, and it is evident that the copper in the oily deposits has been obtained from the fittings of the cylinder and condenser. Fortunately, this copper is so well protected by oil that in most cases it is extremely unlikely to come in contact with, and deposit on, the metal of the boiler; but, if it did, very serious galvanic mischief would be the result.

(To be continued.)

THE MANCHESTER SHIP CANAL.

IV.

On pages 365 and 372 we give four further illustrations of this work. Figs. 7 and 8 show the Mode Wheel Locks. They are situated about three miles below the Manchester terminus of the canal, and about 33¾ miles from the Eastham entrance, and are the last of the series of locks. The first locks are at Latchford, 20½ miles from Eastham, and raise the level of the water in the canal 14ft. 6in.; the next locks are at Irlam, 27¾ miles from Eastham, and raise the level of the water 16ft.; the next are at Barton, 30½ miles from Eastham, and raise the level of the water 15ft.; and the last locks are the Mode Wheel Locks. With the exception of the Eastham Locks, all the locks are in pairs, the larger lock being 600ft. long by 65ft. wide, and the smaller one 450ft. long by 45ft. wide, all the upper locks being the same size of pairs, and of similar construction, the only difference being in the lifts and in the number of sluices. The 65ft. locks have intermediate gates to cut off 150ft., and the smaller ones cut off 120ft. The large locks have a sluice way in the wall 6ft. by 12ft., with four openings into the dock so as to distribute the discharge; the smaller locks having two sluice ways 4ft. 6in. by 8ft., with four openings in each wall. The sluice ways are lined with blue brick on a brick backing. The walls are built of concrete up to water level, above which they are faced with blue brick and have an 18in. granite fender course near the water line. The sills and roller paths are of granite, with sandstone backing, grooves being left in the end of the walls to receive a temporary dam or a caisson when any repairs are necessary. The wall between the locks is 29ft. 6in. thick, the concrete being in the proportion of 8 to 1 in the body and 4 to 1 in the face of 9in. The depth of water on the sills of the 65ft. locks will be 28ft., and on that of the smaller lock 25ft., the normal depth of the canal being 26ft.

The Mode Wheel Locks may be considered the entrance to the Manchester system of docks, for at this point the width of the canal at the bottom is increased from 120ft. to 171ft. At each of the locks is a series of sluices for passing away the flood waters; they are all 30ft. wide, and are made on Stoney's principle. At Mode Wheel there are four sluices, 30ft. by 13ft. lift; at Barton there are four, 30ft. by 15ft. lift; at Irlam there are five, 30ft. by 16ft. lift, the large area being necessary to take the waters of the various tributaries and streams; at Latchford there are two, 30ft. by 14ft. 6in. lift.

Fig. 9 illustrates the Little Bolton cutting, which is a few yards to the west of Mode Wheel Bridge, and is practically a diversion of the river. This portion is absolutely completed, and was the first to receive the water permanently, although it had previously been filled by the floods bursting in the banks in October, 1889, and in January, 1890, when 65 million gallons of water entered the canal in twenty minutes. When this length was afterwards filled permanently—the flooded water having been pumped out to enable the work to be completed—it took over six hours to raise the water 1ft. in height. It required over 2,000 waggon loads of sandstone and rubble to repair the damaged bank, and, now that the river is permanently diverted into the cutting, the contractor has a large bed into which he can tip his spoil excavated from other parts.

Fig. 10 illustrates the No. 1 Branch Dock at Manchester. At the Manchester terminus the canal branches out into a series of docks, three on the north side of the canal at Pomona, and five on the east and one on the west side at Manchester. The total area of the docks is 114½ acres, with quays 5½ miles long. The walls of the docks are composed of Portland cement concrete in the proportion of six parts broken stone or gravel, two parts of sand, and one part of cement. The face of the walls above the stony course is of blue brick, the fenders and coping are of granite, as are the hollow quoins, sills, culvert faces, &c., all the stones being made to templates at the quarries.

SOCIETY OF ENGINEERS.

At a meeting of this Society on the 6th inst, Mr. W. N. Colam, President, being in the chair, a paper was read by Mr. T. B. Lightfoot, on "A Trial of a Refrigerating Machine on the Linde System." The author described the construction and arrangements of a testing station for refrigerating machines that had recently been built at Munich, and gave the results of a test trial with a refrigerating machine on the Linde system. The station was erected by Linde's Ice Machine Company, Wiesbaden, and the Augsburg Engine Works Company, by agreement with a committee of the Munich Polytechnic Society. The selection of the site and the arrangement and fitting up of the buildings was under the entire control of the committee, and the trials of the machine were also undertaken by the committee, which appointed a special examining commission from its own members and from the staff of the mechanical division of German Polytechnic High Schools. Only those refrigerating machines were allowed to be exhibited and tested which were arranged for cooling brine, and which under normal working—*i.e.*, when reducing the temperature from 28·4 to 23° Fahr.—developed at least 200,000 thermal units per hour with a refrigerator surface of 670 square feet. The results ascertained by the commission comprised: (1) The determination of the efficiency of the refrigerating apparatus; (2) the quantity of steam and cooling water; (3) in addition, the special features of the machines are examined with the view of ascertaining to what extent, if any, they affect the continuous working of the apparatus. Experiments were made at the following brine temperatures:—

Inlet to Refrigerator.		Outlet from Refrigerator.
+ 42·8 Fahr.	.....	+ 37·4 Fahr.
+ 28·4 „	.....	+ 23·0 „
+ 14·0 „	.....	+ 8·6 „
− 0·4 „	.....	− 5·8 „

The arrangements for measuring the feed-water, the quantity of brine, and the quantity of the cooling water were described. In order to enable the feed water to be accurately measured during a trial of short duration, the steam for working the motor was obtained from a secondary generator in which evaporation was produced by steam drawn from an ordinary boiler. In this way fluctuations in the water level were almost entirely eliminated, and by means of a Vernier scale attached to the water gauge the actual water level could, in practice, be read off to within 1-32nd of an inch. The refrigerating effect was ascertained by taking the product of the weight of brine passing through the refrigerator per hour, with its specific heat, and the difference between the inlet and outlet temperatures. The brine was heated to the required extent and returned to the refrigerator.

A series of tests were made with a No. V. (12 ton) refrigerating machine on the Linde system. The plant consisted of a steam engine combined with a double-acting ammonia compressor, an ammonia condenser, and a refrigerator, together with the requisite connections. The dimensions of the principal parts were given in a table. A table was also given showing the results arrived at by the Commission. This table consisted of six parts; the first dealing with the steam engine, the second with the compressor, the third with the refrigerator, the fourth with the ammonia condenser, while the fifth gave the balance between the heat found in the condenser and that abstracted in the refrigerator, plus the thermal equivalent of the indicated horse-power in the compressor, and the sixth the actual refrigerator duty reduced to per pound of feed water, and per 1 h.p. in the steam engine.

PUBLIC WORKS IN ECUADOR.

The Guayaquil waterworks have been continued slowly throughout the year 1890, but they have not yet been completed, owing to the loss of two steamers that were conveying the tubes for the section from Aqua Clara to Duran. It is expected that these works will be terminated early this year, as only two more vessels with tubes are awaited in order to supply water to the city.

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THE MANCHESTER SHIP CANAL.

(*For description see page* 364.)

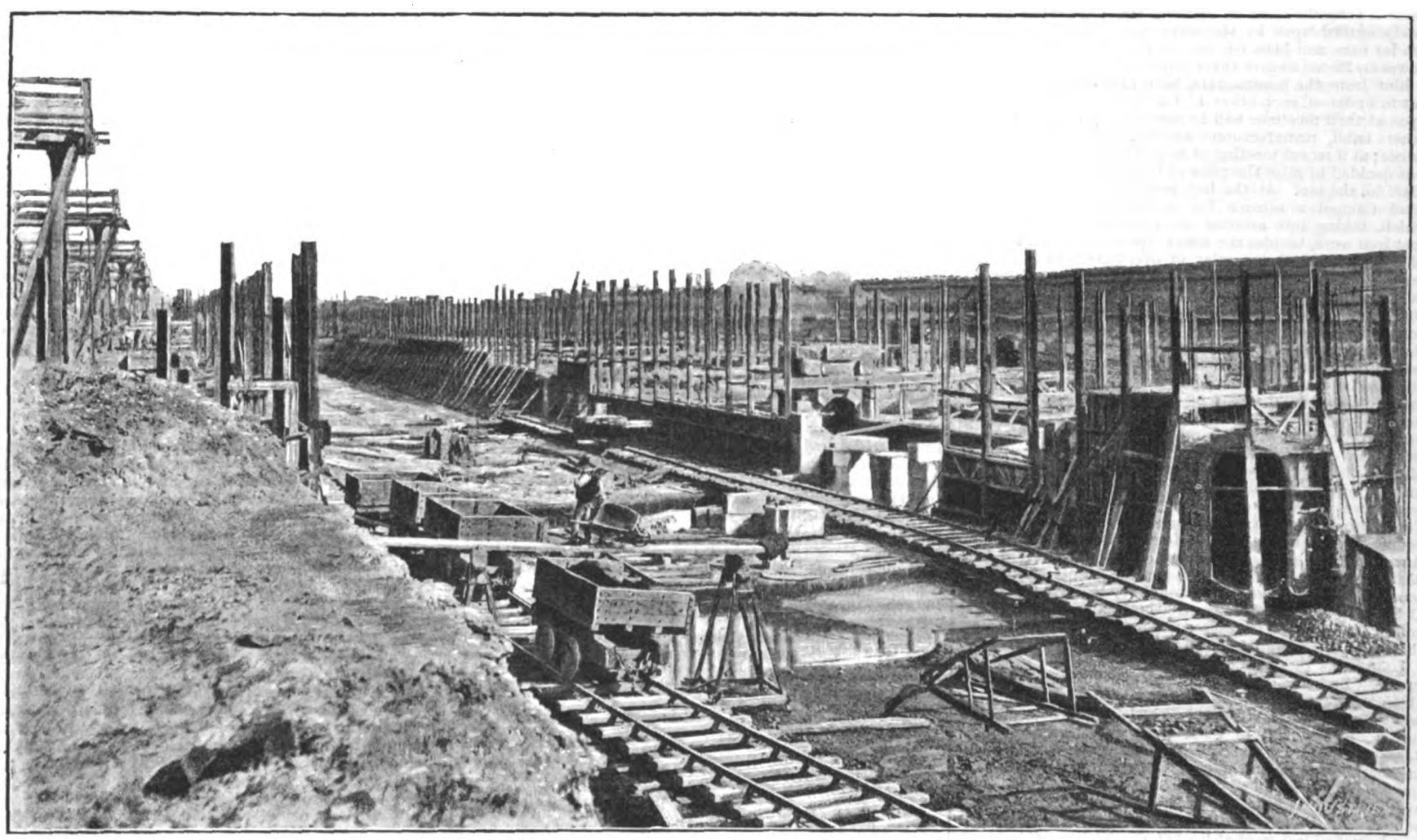


FIG. 7.—SMALL LOCK AT MODE WHEEL.

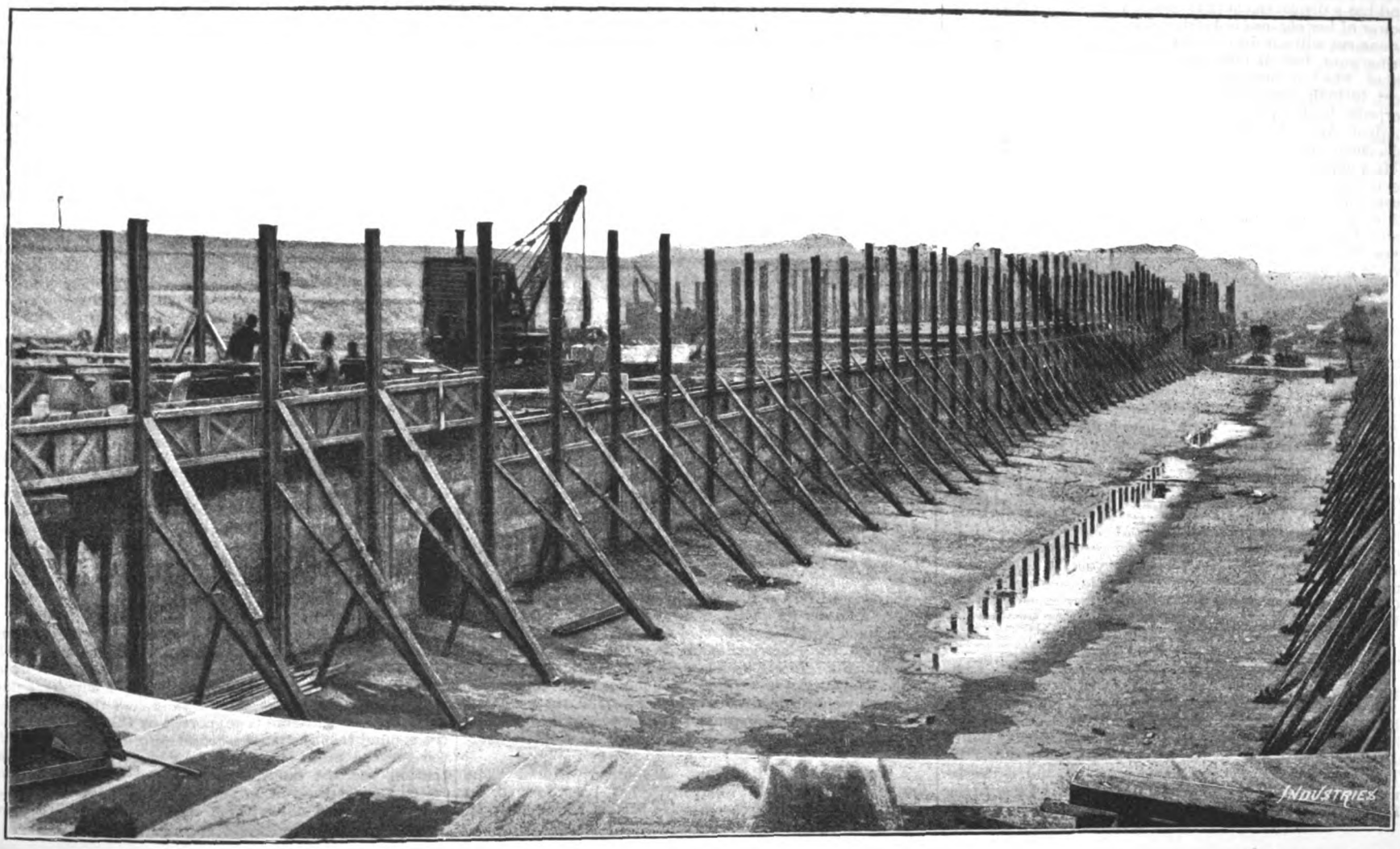


FIG. 8.—LARGE LOCK AT MODE WHEEL.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 14th April, 1891.

Iron.—The Paris market remains very firm, though there is some difficulty in securing the augmented prices lately agreed upon by the merchants—viz., 136s. 6d. per ton for bars, and 144s. 6d. per ton for joists. Buyers are, however, forced to give these prices, as the dealers, taking a hint from the ironmasters, have unanimously resolved not to undersell each other, and in future the prices fixed upon at their meetings will be strictly adhered to. On the other hand, manufacturers are inclined to raise their prices; at a recent meeting of forge owners in the North it was decided to raise the price of iron delivered at Paris to 124s. 6d. the ton. At the last meeting of the Paris Municipal Council a scheme for an aqueduct was adopted, which, taking into account the earthwork, masonry, and cast-iron work, besides the water pipe itself, which is to be of steel, will entail an outlay of over 5,000,000fr. At the same meeting it was decided to immediately commence building the Célestin barracks, which will cost about 500,000fr. As we have before stated, many of the railway companies have given large orders for rolling stock since the commencement of the year, the value of which is now estimated to amount to over one million sterling. This abnormal demand for carriages may be partly accounted for by a desire on the part of the companies to be ready for the reductions in passenger fares, which are to come into force in 1892, when a large increase in the number of third-class passengers is expected. In the Meurthe-et-Moselle district the resolution lately taken at a meeting of foundry owners, to reduce the output if necessary, in order to augment the value of the metal, is coming into effect. The following is a rough estimate of the orders now in course of execution in the North district:—Denain et Anzin, 50,000 tons; la Providence, 40,000 tons; Nord-Est, 35,000 tons; the Hauts Fourneaux de Maubeuge, 30,000 tons; Ferry-Curicque, 8,000 tons; J. Sirot, 6,500 tons; C. Sirot, 6,000 tons; Lesaffre, 6,000 tons; V. Dumont, 6,000 tons; Doremieux, 5,000 tons; G. Dumont, 4,000 tons; and the forges of La Sambre, 4,000 tons.

Launches of War Vessels.—On the 9th inst. the cruiser "Zaragota," built by the company of the Forges et Chantiers de la Méditerranée for the Mexican Government, was launched at Havre. This vessel is built of steel, and has a displacement of 1,200 tons; her engines are of 1,300 h.p., and she is expected to attain a speed of 13 knots an hour. The armament consists of two 12cm. guns, two quick-firing 57mm., and two 37mm. machine guns. This vessel is destined for the service of the Mexican naval school. Another torpedo despatch boat, the "Wattignies," was launched last week at Rochefort. This vessel has been built from the plans of M. Bussy, member of the Institute. The "Wattignies" is built of steel, and has two screw propellers; she is 232ft. 9in. long over all by 29ft. 1in. beam, and has a displacement of 1,310 tons. The indicated horse-power of her engines is 4,000, and her speed 18 knots. Her armament will consist of five 10c.m. and two 65mm. quick-firing guns, four 37 mm. revolver guns, and four torpedo tubes. She was commenced in October, 1889, and the total cost, including armament, will amount to 3,167,185fr. The torpedo boat "Le Levrier" was launched recently at Lorient Arsenal, Morbihan. Its dimensions are:—Displacement, 150 tons; length, over all, 196ft. 9in.; beam, 23ft.; depth, 10ft. 6in. The two screw propellers are driven by independent engines of 2,200 h.p., and the speed is estimated at 18·5 knots per hour. The vessel will carry one 65 mm. and three 47 mm. quick-firing guns, two machine guns, and four torpedo tubes. Another vessel of the same type, the "Leger," is on the stocks at Lorient, and nearly ready for launching.

BERLIN, 13th April, 1891.

International Exhibition in Berlin.—Preliminary arrangements for the holding of a large International Exhibition in Berlin were being discussed last month, and the proposal has now advanced a further stage. The industrial societies, which combined together to make the Berlin Trades Exhibition of 1879 a success, are considering the project of the holding of a large exhibition in Berlin in the year 1895. These united societies consider the chief scope of the proposed exhibition should be that of a large general German Exhibition. The important Union for the Promotion of Industrial Progress, which numbers among its members the principal State officials and representatives of the chief industries in the Empire, are, however, in favour of an International Exhibition. A committee has been formed to take the proposal into further consideration. The Government has expressed its willingness to support the Exhibition, in the event of its being taken up by the principal industries of the country, and the project is therefore likely to be brought to a successful issue.

The Baltic Ship Canal.—A canal of considerable importance to traders with the Baltic was opened recently. The canal, which runs from Kiel Bay to the mouth of the Elbe, crosses Schleswig-Holstein by way of Rendsburg, and has a total length of 61 miles. The surface width is 186ft., sloping down to 85ft. at the bottom, with a depth of 28ft. The canal was commenced four years ago, and, it is estimated, will reduce the time of transit from Kiel Bay to the Elbe to something like eight hours.

VIENNA, 13th April, 1891.

The Iron Market.—The state of the iron market shows a constant tendency to improve. The trade in material for building purposes is satisfactory, and the prospect for this year is very good. Agricultural machines and tools are in much request, and manufactories are briskly employed in trying to satisfy the demand. The manufacturers of all sorts of railway material are especially busy. At the end of February there were nearly 500 kilometres of railways in course of construction in Austria, chiefly for the Austro-Hungarian State Railway, the Carl-Ludwig Railway, and the larger local railway companies. Two thousand workmen were employed at that date.—The negotiations for a commercial treaty with Germany are still being prolonged, and trade will be carried on for some further time on the basis of existing agreements between the syndicates. The making of the treaty is likely to cause the syndicates to make new arrangements.

The Coal Market.—The coal market still continues extremely brisk, and the opening of traffic on the Elbe has given trade a considerable impulse. At a recent general meeting of the Brux Coal Mining Company the increase of the share capital by 3½ million florins was announced to have been successfully carried out, and regret was expressed at the loss of several lives in the Anna Mine disaster. The production, as shown by the sales at the company's mines in Tschausch, Dux, Teplitz, and Billin, amounted during the past year to 1·6 million tons, as compared with 1·15 million tons in the previous year. The net profits amount to 481,616fl., and a dividend of 8 per cent. will be paid. The Brux Coal Mining Company is negotiating with the Count of Westphalla for the purchase of his coal mines at Aussig. The price demanded is four million gulden. At a general meeting of the Industrial Coal Company the report showed that many accidents had taken place during the past year, and the production was therefore less than during the previous year. The sale of coal, however, amounted to 157,119 tons. In the year 1890, 681,638 tons of coal were forwarded along the Aussig-Teplitz Railway. The number of waggons despatched for the Elbe traffic was the largest recorded since the opening of the railway, and amounted to 163,765.

Statistics of Imports and Exports.—The Ministry of Commerce has collected some exact statistics with regard to the import and export trade, and the following results have been published for the month of January. The figures show the amount in 100 kilogrammes:—

	Imports.		Exports.
Sugar	129	..	150,658
Wood, charcoal	2,814,678	...	6,856,874
Minerals	154,168	...	426,030
Mineral oil and brown coal	82,390	...	2,214
Cottons, yarns, and webs	124,145	...	10,178
Flax, hemp, and jute	62,673	...	14,307
Glass	2,242	...	24,954
Iron	44,881	...	25,935

BRUSSELS, 14th April, 1891.

The Iron Market.—The market is almost inactive, and there few orders from abroad. The Government is criticised for not taking advantage of the sluggish state of the market to renew the rolling stock on the railways. Old orders are being worked off, and there are no signs of returning animation in the market.

The Coal Market.—In the important contract which the Belgian Government awarded on the 7th inst., the price of coal was higher by 1fr. than was expected, but it seems unlikely that the present firm tone will be maintained. The supply much exceeded the demand, and the abundance of offers showed the difficulty in finding a market for the present production. The prices of both coarse and close burning coal were not below those accepted in open market, and the importance of the contract is an additional ground of confidence. The maintenance of a firm tone is due to the coal owners' agreement not to yield to the demands of iron masters. In view of this agreement the Minister may possibly refuse to ratify the award of the 7th inst. The demand for universal suffrage might possibly lead to strikes among the workmen, which would be aggravated by questions of salary and length of hours of labour.

The Glass Trade.—The syndicate is receiving a steady supply of orders, but there is no change in prices. The demand is only moderate, and the situation is rather unsatisfactory for manufacturers. The export of glass to Columbia is likely to develop. Makers should take advantage of this outlet for trade, which is at present worked only by agents of the Hanse towns.

Electric Lighting at Antwerp.—Some years ago the General Electrical Company of Brussels made efforts to erect a central station at Antwerp, and considerable preparations were made by the erection of a workshop and by an order for cables, whilst connections had already been made with many houses. The gas company then restrained the electrical company from interfering with its monopoly. In consequence of protracted litigation the latter company was obliged to liquidate its affairs, and attempts were made without success to sell the property of the company. The project of electric lighting seems likely to be revived by an agreement between the two companies.

A New Electric Battery.—A company, named "The Economical Electrical Company," has been formed, in order to manufacture the primary battery invented by M. Buffet. The battery has an almost absolute constancy, a large capacity, and the value of the waste products is a large proportion of that of the original materials. These waste products consist of oxide of zinc, and of a liquid which can be easily transformed into an excellent chemical manure. Some extraordinary accounts of the performance of the battery have been published, but a more moderate estimate has been made by M. Lucien.

Gas Manufacture.—The managers of the principal gas works in Belgium and the North of France met on the 10th inst., at Brussels, to decide what course to adopt in view of the price of coal and coke and the sale of waste products.—On the 11th inst. a lecture was given at the Exhibition of the Belgian Gasfitters' trade by Mr. Aerts, manager of the Brussels Gasworks. The author commented on the various systems of lighting and heating recommended by the Association of Gasfitters, and referred to the Wenham and the gaso-multiplex lamps. The lecturer also spoke of the system of ventilation recently installed by Mr. Bandsept for the Association of Gasfitters.

Exhibition at Spa.—An International Exhibition of Hygiene and Sport is to be held at Spa during the present year. The Exhibition will be open for a period of two months—*i.e.*, from August 1st to September 30th—and will comprise the following sections:—Public and industrial hygiene, the hygiene of food and dwellings, sport, racing, hunting, fishing, shooting, cycling, and yachting. Intending exhibitors should apply to the Secretary of the Exhibition, M. C. Goffin, Avenue du Marteau 41, Spa.

DÜSSELDORF, 14th April, 1891.

The Iron and Steel Market.—The pig iron market continues dull; prices show a downward tendency in spite of the fact that the stocks of pig iron are not increasing. The production of the Rhenish-Westphalian blast furnaces has been reduced by about 20 per cent. as compared with the previous year. Best Westphalian forge pig iron is quoted at from 52 to 53½ marks, best foundry and hematite at 71 marks, foundry No. 3 at 60 marks, Thomas pig iron at 48 marks. Rolled merchant iron is selling at 125 marks on the average. The business in girders is suffering a heavy depression, and there has been a sudden reduction in price of about 15 marks, which is an immediate consequence of an arrangement made between the German and Austrian syndicates.

The Coal Market.—This market, in marked contrast to the iron and steel market, continues in a very brisk condition. The production of the Westphalian collieries was 7,527,390 metric tons in the first quarter of this year, against 7,344,770 tons in the same period of the previous year, an increase of about 2½ per cent. The contracts awarded at Magdeburg show that the price for 250,000 tons coal for locomotive engines was 10½ marks, lump coals 12 marks per ton, and briquettes 13½ marks per ton at the mine. The report that the United States are beginning to ship coals to Bremen and Hamburg has not had any important influence on the German coal market. One steamer, belonging to Hamburg, is now bringing over 3,500 tons of coal, and the steamers of the Lloyd line, trading with Bremen, are said to bring over 1,000 tons each. As, however, American coal costs at American ports about 12 marks per ton, and as the freight by sea is at least 5½ marks, the price of American coal c.i.f. Hamburg would be 17½ marks, whereas the Westphalian collieries are ready to sell at 14½ marks c.i.f. Hamburg.

The American Cutlery Trade and German Workmen.—A New York manufacturer has made arrangements with a large number of workmen skilled in the manufacture of cutlery to go across the Atlantic. They will obtain a free passage and high wages. This is a result of the McKinley Act.

The Atlantic Mails.—The steamers which carry the mails between Bremen, Southampton, and New York are to have an official of the post office on board for the purpose of sorting the letters and parcels, so that they may be forwarded to their destination immediately after the arrival of the mail. The "Havel," which sailed last week, was the first vessel to try the new arrangement.

Discovery of Potassium Salts at Duderstadt.—It is reported that a discovery of potassium salts has lately been made at Duderstadt. Borings are to be made at once by Messrs. Nitschke & Hübner, of Brunswick, on behalf of a syndicate of Westphalian firms. The first boring will be made on the south side of the Sulberg, at a distance of a quarter of a mile from the city. It is expected by geologists that sodium salts also will be found in the Trias at Duderstadt, and a workable quantity of "Abraumsalz." This would be at a depth of from 300 to 400 metres, and the boring will be done at the rate of about 100 metres per month.

AMSTERDAM, 13th April, 1891.

The Sugar Industry in Holland.—The First Chamber of the States-General has followed the example of the Second Chamber by adopting the Government Bill which compels beet sugar manufacturers to pay a supplementary tax if the sugar excise should yield less than 8½ million guilders. The measure is supported by the Government on the ground that the manufacturers are at present making too great a profit out of the raw material, but this contention has not done away with the serious objections raised against the Bill, principally by the growers of beet-root, who argue, not without reason, that it is they, and

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not the manufacturers of the beet sugar, who will have to pay the supplementary tax. This measure has already caused a rise in the price of the raw material and in rent, both of which must co-operate to restrict the growing of beetroot.

THE BLITONG TIN COMPANY.—The main provisions of the proposed agreement between the Government and the Blitong Tin Company are that the concession is to be extended to the year 1927, and that the State shall receive 5½ per cent. on the gross yield of the annual output. Should the net profit in any one year rise above 350,000 guilders, the Government will be entitled to one-half of such profit. In the case of an export duty on tin, the said 350,000 guilders will be increased by the yield of such duty.

NEW CHEMICAL COMPANY.—The prospectus has been issued of the Chemical Manufacturing Company at Roermond, in the province of Limburg, formed with a capital of 200,000 guilders, in shares and 5 per cent. bonds, in equal moieties, for the purpose of acquiring and working the chemical factories of Dr. A. Haagen. The chief manufacture is that of Prussian blue and cyanide of potassium. The prospectus states that it is intended to manufacture at least 250,000 kilogrammes of cyanide of potassium annually, 100,000 to serve in the manufacture of 80,000 kilogrammes of Prussian blue and 150,000 kilogrammes to be brought to market in Holland, Germany, and England. It is claimed that the Haagen process of manufacture is superior in many ways to other systems of production.

THE NETHERLAND AMERICAN STEAM NAVIGATION COMPANY.—In 1890 the company did badly, chiefly owing to the Argentine crisis, which has crippled that part of the company's business. No dividend will be paid, and there is a deficiency or loss of working of 3,000,000 guilders.

STOCKHOLM, 11TH APRIL, 1891.

SWEDISH COAL.—The anthracite coal industry of Sweden, which is in the hands of seven operating companies only, greatly improved in the year 1889. The production for the five years ending with 1889 was as follows:—In 1885, 239,356 tons; 1886, 234,203; 1887, 232,398; 1888, 232,383; and in 1889, 256,628 tons. In 1889 some 5,000 persons were employed in and about the mines, and only one life was lost through accident. At present but a small portion of the deposits are being worked, though a far more extensive development is expected to be made within a short time. The coal is found only in the extreme south of Sweden, in the province of Scania. The coals are of excellent quality for steam and similar uses, but being of the anthracite quality, and the mines being too distant from the iron districts, they cannot be expected to figure very largely in the iron industry.

THE HALDA WATCH MANUFACTORY.—An industry, which seems capable of extension and likely to prove remunerative, is the manufacture of watches at Halda. A few years ago only hand power was used, but the installation of steam power when completed will work about 150 different machine tools. In the main hall are sixty machine tools, many of these having been invented and constructed at the works.

NEW STEAMSHIP COMPANY.—A new steamship company has been formed at Oscarhamn, and a steamer has been ordered from the Motala Shipbuilding Company, which has taken shares in the new company. The steamer is to cost 75,000kr., and is to be ready by September 20th.

THE SVARTVIK SAW MILLS.—The Svartvik saw mills and forests have been sold by the Svartvik Aktiebolag to a syndicate of merchants in Sundsvall for 3,000,000kr. During 1889 the shipments amounted to 8,271 standards planks and battens, 4,550 standards boards, and 4,253 standards planed boards.

ELECTRIC LIGHT ON BOARD THE "GÖTA."—The new Swedish warship, the "Göta," has now been fitted with electric light, which has been installed by the firm of Messrs. Luth & Rosén, Stockholm. The installation consists of 150 incandescent lamps, each 16 c.p. Power is furnished by a vertical engine of 25 h.p., running at 400 revolutions per minute. Electricity is also used for projectors, of which there are four, each lamp requiring a current of about 60 amperes, and giving about 50,000 candle-power. These projectors are worked by two engines, each of 30 h.p.

COPENHAGEN, 11TH APRIL, 1891.

THE UNITED STEAMSHIP COMPANY.—The United Steamship Company, Copenhagen, has a fleet of 101 steamers. The profits during 1890 amounted to 1,889,635kr. against 2,952,044kr. during 1889, a result which can hardly be called satisfactory. The company is extending its business and increasing its fleet, and is altogether well managed. The gross profits for last year amounted to 13,767,453kr., the profits on commissions were 391,071kr., and 170,976kr. were carried forward from last year. The expenses were as follows:—Repairs, 873,212kr.; working expenses 10,521,348kr.; insurance, 250,291kr.; managing expenses, 307,707kr,; interest, 316,328kr. The surplus on the working has been appropriated in the following manner:—1,497,371kr., or 5 per cent. of the value of the ships, was added to the reserve fund, 267,758kr. were added to the insurance account, and various smaller sums were written off on other accounts, leaving an available balance of only 90,813kr., which, with the amount carried forward from previous year, amounted to 261,790kr. The shareholders received a dividend of 3 per cent., which represents 240,000kr.

THE GREAT NORTHERN TELEGRAPH COMPANY.—The net profits of the Great Northern Company amount to the sum of 4,303,891kr. for last year. Of this sum 675,000kr. are used for interest and sinking fund of debentures. It is proposed to give the shareholders a dividend of about 8·6 per cent., representing a sum of 2,325,000kr., 1,200,000kr. to be added to the reserve fund, 50,000kr. to the pension fund, 27,050kr. to the Board as tontine, and the balance to be carried forward to next year.

MADRID, 13TH APRIL, 1891.

SHALE IN ASTURIAS.—Some concessions for working bituminous shales in Asturias have been granted to a French mining engineer at Gijon, who acts as French commercial agent by appointment of the Government. Scotchmen, who are so well acquainted with this manufacture, might profitably turn their attention to shale, since oils produced in this country can be sold for three times as great a price as can be obtained in England

PHOSPHATES AT NAVALMORAL DE LA MATA.—This district, in the opinion of some competent engineers, is likely to give an important output of phosphates, though it has not yet been shown by actual working that the raising of the phosphates will pay. Spanish engineeers maintain that no regular formation will be found unless the workings are carried to a great depth, whilst English engineers say that the work will not be profitable unless good ore is found near the surface. Mr. Pickford, a well-known authority on phosphates, together with Mr. Turnbull, are now visiting the district, but their opinion has not yet been made known. They have already taken on trial some mines at Las Casistas de Belvis in the neighbourhood, and their property amounts to 320 hectares. The property at Navalmoral, which is in the hands of the original concessionaires, is about 550 hectares, and is more favourably situated for transport. M. L'Homme has stated that he can concentrate ores, of however poor quality, so that they will attain a richness of 70 per cent. If this be practicable, the upper deposits could certainly be worked at a profit.

SALE OF THE CACERES PHOSPHATE MINES.—The Caceres mines of the General Caceres Phosphate Company are to be sold by auction on the 11th of May with the land and buildings and the sulphuric acid and superphosphate works. The reserve price of this large property is only £20,000, which shows an evident wish to sell. The ores are said to yield 30 to 40 per cent., and it is estimated that there are still a million tons in the mines. The original shareholders are to lose all the capital. There is a very small market for these phosphates in Spain itself.

NEW RAILWAYS IN THE NORTH OF SPAIN.—Many new schemes are projected for narrow gauge railways in the North of Spain, whilst those in course of construction are being vigorously pushed forward. General confidence in the success of these lines is felt, in consequence of the success of the Durango Railway, the shares of which are quoted at 244. This company pays very high dividends, which will be further increased when the new line from Elgoibar to San Sebastian is finished in 1893. This line would, however, be adversely affected by the construction of the proposed broad gauge line from Bilbao to San Sebastian. Important lines are also being made in Asturias, Leon, Palencia, and Galicia, among which the line from La Robla to Valmaseda, 270 kilometres in length, is worthy of especial notice.

NEW YORK, 4TH APRIL, 1891.

SAW FOR BORING BARRELS.—The Mason Machine Works, Taunton, Mass., have just completed a core saw, for the purpose of boring out barrels from a solid log. The machine is entirely new, and can turn out a barrel complete in one minute. The saw was given a trial in the carpenters' department recently, and worked successfully, boring out a core 10½in. in diameter, and 21½in. long, in 30 seconds. This saw is made of wrought iron, in the shape of a barrel, with steel cutters distributed a certain distance apart about the cylinder, and will bore out all sizes of barrels.

NEW ELECTRIC LAMP.—Mr. J. W. Ellis, of Pittsburgh, has recently brought out a new electric lamp. It is said that the new lamp will burn continually for 500 hours without any attention or care, and without a change of carbons. This prolonged endurance is made possible through the peculiar construction of the carbons, which, instead of pencil-shape, are made in the forms of miniature emery wheels, 4in. and 8in. in diameter, one wheel of each size being used on every lamp. They are placed at right angles, the larger over the smaller one, and by an automatic electrical arrangement enclosed in the lamp they are kept in constant motion.

ELECTRIC WELDING.—The Thomson Electric Welding Company has made arrangements with the Pullman Palace Car Company for an electric welding plant to be located at Pullman, Ill. The plant will be used for miscellaneous car work, embracing the welding of truss rods and similar work on passenger, street, and freight cars.

FLOATING EXHIBITION.—It is reported that a society is in course of formation at Boston for the organisation of a floating Exhibition of North American products. The floating Exhibition will consist of four steamers, three of which will be used for exhibits, and the fourth for the accommodation of the exhibitors or their representatives. It is proposed to make a voyage of from three to six weeks' duration, visiting the West Indies, Central America, and South America.

ELECTRIC TRAMWAYS.—The Thomson-Houston Electric Company has entered into a contract for forty additional cars with the Cincinnati Street Railway Company of Cincinnati, O., and for six cars with the Pueblo City Railway Company, of Pueblo, Col. The company has also entered into contracts with the Creek Rock Railway, Washington, D.C., for twelve cars; Harrisburg City Passenger Railway, Harrisburg, Pa., fourteen cars; City Electric Railway, Little Rock, Ark., for twenty-eight cars; Jefferson Avenue Railway, St. Louis, Mo., twenty-five cars; Oxford Lake Line, Armiston, Ala., six cars; Allentown and Bethlehem Rapid Transit Company, Allentown, Pa., fifteen cars; Marquette City and Presque Isle Company, Marquette, Mich., three cars; Braddock and Turtle Creek Railway, Braddock, Pa., three cars; Salt Lake Rapid Transit Company, Salt Lake City, Utah, three cars; Buffalo Street Railway Company, Buffalo, N.Y., twelve cars; Pittsburgh and Birmingham, Pittsburgh, Pa., two cars; Troy and Alpia Street Railway Company, Troy, N.Y., twenty cars; St. Louis and Suburban Street Railway Company, St. Louis, Mo., forty-five cars; Chattanooga and North Side Railway, Chattanooga, Tenn., four cars.

A NEW LIQUID FUEL BURNER.—A new form of crude oil burner has recently been introduced by the Shipman Engine Manufacturing Company, of Rochester, for which some points of superiority are claimed. Among these may be mentioned simplicity of construction and manipulation, perfect safety, which is ensured by the placing of the oil trap a few inches below the level of the burner, and ease of regulation and cleaning. A specially designed oil cup for use with thick oil can be furnished, which makes it possible to use oil of a density heretofore impossible to use on account of the difficulty of atomising it, but which with this improvement may be thrown in as fine a spray as is desired.

PHILADELPHIA, 3RD APRIL, 1891.

THE COKE INDUSTRY.—The McClure and Frick Companies, who control the greater part of the furnaces in the Connelsville coke region, have issued notices that they desire their men to return to work at a reduction of 7 per cent. The men are assured that wages will not fall lower than $1 per 100 bushels, and are offered a sliding scale, with the understanding that if the price of coke increases to $2·15 they will be paid the old rates. Labour agitators are trying to persuade the men not to accept the offer. Some of the workmen have, however, already done so, in consequence of their distressed condition. There has been much excitement among the men, and some rioting has occurred.

TINPLATE WORKS IN ST. LOUIS.—The St. Louis Stamping Company is erecting tinplate works with a capacity of 500 boxes per day. At present the iron used by this company in the manufacture of tinplate is brought from Chattanooga, Penn., but it is proposed by the company to erect a large steel and iron mill near Madison, Ill. There will be 2,000 men employed.

NEW TRIAL OF THE "BENNINGTON."—The Secretary of the Navy has authorised a second trial of the gunboat "Bennington," which, in its recent trial, failed by 85 horse-power to develop the horse-power (3,400) required by the contract. The contractors, Messrs. N. F. Palmer & Co., having made some alterations, are hopeful of meeting the requirements.

PROGRESS OF THE NEW CRUISERS.—The new cruisers, "Nos. 5 and 6," now being built at Bath, Maine, are progressing rapidly, and it is probable that, if no unforeseen delay occurs, they will be launched in October. Orders have been received at the Portsmouth Navy Yard to commence work on outfits, consisting of spars, blocks, boats, furniture, and cooperage for those cruisers, as also for "Nos. 9 and 10," now being built at Baltimore, and "No. 11," being built at Boston.

RAILROAD SCHEMES.—The purchase of the Pittsburgh and Western Railroad and of the Union Bridge, which runs to Alleghanny and forms a connection with the lines of the former company and the lines from Pittsburgh by the Baltimore and Ohio Railroad Company, is probably the beginning of an enormous project on the part of the Baltimore and Ohio Company. It is stated that it is the intention of this company to construct a line parallel to the Pennsylvania Railroad from Baltimore to Chicago, a distance of over 1,000 miles. The acquisition of these properties will enable the Baltimore and Ohio to construct a direct line between those cities and reduce the distance materially. It is stated that Mr. Andrew Carnegie, of the firm of Messrs. Carnegie, Phipps, & Co., is the real author of this project, and that he intends to withdraw from the active management of his enormous iron interests in order to accept the presidency of the Baltimore Railroad. When the New York Central bought the Rome, Watertown, and Ogdinsburg Railroad, it was thought that the former would make some arrangement with the Canadian Pacific by which the latter company would obtain an entrance into New York. It is now announced that the Canadian Pacific will be permitted to run its trains over the Rome, Watertown, and Ogdinsburg and the West Shore Railroads.

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AN IMPROVED SKID FOR HEAVY VEHICLES.

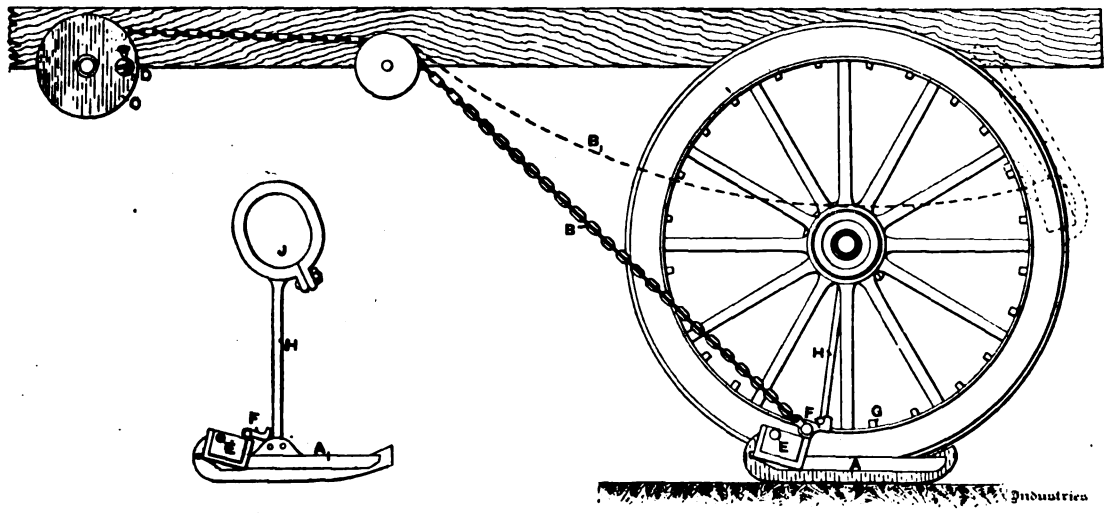


Fig. 1.

Fig. 2.

AN IMPROVED SKID FOR HEAVY VEHICLES.

The ordinary method employed for skidding the wheels of heavy road vehicles, such as lorries, vans, &c., has always been a source of danger to drivers, who frequently have to dismount from their vehicles to operate the skid. The apparatus we are about to describe, and which is shown in the accompanying illustrations (Figs. 1 and 2), is the invention of Mr. John Robertson, of 2, Victoria Street, Newton Stewart, Wigtownshire, N.B., and is intended to obviate the necessity of the driver stopping his vehicle and dismounting to apply the skid. It has, we are informed, been well tested in Scotland, and has given satisfactory results. The skid A, when not in use, is suspended by the chain B in front of the wheel, as shown by the dotted lines. When the wheel is to be skidded, the driver releases a chain wheel C by means of a split hand D, thereby paying out sufficient of the chain to allow the skid to reach the ground and the wheel to mount on the top of it. He then simply lets go the hand, and the chain wheel becomes again locked, and the skid is securely held by the chain. By means of a peculiarly constructed box E on the skid A, the driver is enabled to unskid the wheel without stopping the vehicle or dismounting. To do this he simply pays out a little more of the chain, and allows the wheel to ride off the skid, a claw F on which engages with a pin G on the wheel, thereby carrying the skid up to its normal position, shown in dotted lines. While the latter operation is taking place, the driver again winds up the chain, so that, when A has reached its extreme height, it falls, by its own weight, through a slight angle and tightens the chain, thus releasing the claw F from the pins G. The arm H, which connects the skid with the nave of the wheel, has upon its upper end a collar J (Fig. 1) of an elliptical form for embracing the nave, so that sufficient play is allowed between the skid and the tyre when the former is out of use, but which perfectly fits the wheel when upon the ground.

THE INSTITUTE OF MARINE ENGINEERS.

The annual meeting of this Institute was held on the 3rd inst. In the unavoidable absence of the President, Mr. Wymer, Vice-President, occupied the chair. The Chairman thought the Institute was to be congratulated on the satisfactory state of the finances.

On the subject of a building for the Institute, Captain G. E. Hodgkinson said there must be a special building, and he thought that when it was known that such important work was to be carried on, money would be forthcoming. A great deal might be done by the members, but all who were interested in shipping would see it was to their advantage to enable the marine engineer to attain to a fuller knowledge of his profession. The position of the new Institute must be central for the majority of the members; it must contain club accommodation, reading rooms, library, lecture rooms, and other rooms.

On the invitation of the Chairman, Mr. A. Thomson spoke on the subject of local centres, and said that it would be very important to have centres in large ports, as Liverpool and Glasgow, similar to that being established in Cardiff. A vote of thanks to the Chairman brought the meeting to a close. The ordinary meetings will be held on the second and fourth Tuesdays in April and May, when papers will be read or discussed.

CLYDE SHIPBUILDING FOR MARCH.

The condition of the Clyde shipbuilding industry is not very reassuring, as the demand for new vessels is not brisk enough to replace the removals from the stocks. The output during the month exceeded 41,000 tons, while the aggregate of the contracts booked barely reaches 20,000 tons, and, whereas the total amount of work in hand at this time last year was 230,000 tons, the estimated amount at present under construction is fully 20,000 tons less. Notwithstanding that the current prices of material are much lower than they were a few months ago, there appears to be considerable hesitation on the part of shipowners generally to come to terms with builders. Prices for all classes of vessels seem to have a downward tendency, and as an instance of the low figures at which contracts are at present being paid, it may be stated that a steel barque, to carry 2,100 tons deadweight, has been placed with a well-known firm of builders, the contract price for the same being only £12,500. Among the most important orders booked during the month are three screw steamers, each of 3,500 tons, to be built by Messrs. Caird & Co., Greenock, two being for the Nederland Steamship Company, and the other for the Gulf Line; a steel barque of 2,000 tons, to be built by Messrs. A. McMillan & Sons, Dumbarton, for a Greenock firm; a steamer of 1,850 tons, to be constructed by the Campbeltown Shipbuilding Company, for English owners; and two steamers, one of 1,000 tons and the other of 200 tons, to be built by Messrs. Scott & Co., Greenock, for Brazilian owners.

The majority of vessels launched were of the cargo type, and of small tonnage; two, however, call for special notice, the s.s. "Dunera" and the twin-screw, wood-sheathed, protected cruiser, "Indefatigable." The "Dunera" was launched from the Pointhouse shipbuilding yard of Messrs. A. & J. Inglis, and measures 440ft. in length over all, 48ft. in breadth, and 32ft. in depth. She will be fitted with triple-expansion engines by the builders to develop 5,000 i.h.p., and will have spacious accommodation in the bridge-house amidships for eighty first-class passengers, while second-class passengers to the number of forty will be berthed aft under the poop. Hydraulic gear of the most approved description will be fitted for manipulating the cargo, and she will also be supplied with refrigerating machinery and a complete electric light installation. The "Indefatigable" is the first of three second-class protected cruisers which are at present under construction by the London and Glasgow Engineering and Iron Shipbuilding Company for the British Admiralty. She is intended principally for service in foreign waters; her hull is therefore sheathed with teak and covered with copper to a height of 3ft. above the normal water line. The stem, stern post, and shaft brackets are of phosphor-bronze, and the propellers are of gun-metal. Her dimensions are as follow:—Length, 300ft.; extreme breath, 43 66ft.; depth, moulded, 22·75ft.; and displacement, 3,600 tons. She will be fitted with two sets of inverted triple-expansion engines capable of developing collectively 9,000 i.h.p., the diameters of the cylinders being 33·5in., 49in., and 74in. respectively, with a stroke of 39in., and with which it is expected that a speed of 20 knots will be realised. Steam will be supplied from five steel boilers, working at a pressure of 155lb. per square inch. The armament will consist of two 6in. breech-loading guns mounted on central-pivot carriages, one on the poop and the other on the forecastle, six 4·7in. quick-firing guns, eight 6-pounder Hotchkiss guns, four 5-barrelled Nordenfeldt guns, and four torpedo tubes.

The following are the particulars of vessels launched during the month:—

Screw Steamers.

"Acanthus," steel, 3,000 tons, built and fitted with triple-expansion engines by Messrs. Alexander Stephen & Sons, Linthouse, for Mr. John Bruce Murray, Glasgow.

"Ardgowan," steel, 230 tons, built and engined by James M'Arthur & Co., Paisley, for Messrs. Hendry & Steele, Glasgow.

"Bohemia," steel, 3,000 tons, 2,000 i.h.p., built and fitted with triple-expansion engines by Messrs. D. and W. Henderson & Co., Partick, for the Anchor Line fleet of Messrs. Henderson Bros., Glasgow.

"Cynthiana," steel, 3,000 tons, built by Messrs. Russell & Co., Greenock, and fitted with triple-expansion engines by Messrs. Blackwood & Gordon, Port Glasgow, for the general trade of Messrs. M'Lean & Sutherland, Glasgow.

"Dunera," steel, 5,600 tons, built and engined by Messrs. A. & J. Inglis, Pointhouse, for the Australian trade of the British India Association.

"Genkai Maru," steel, 1,380 tons, built by Messrs. Napier, Shanks, & Bell, Yoker, and fitted with triple-expansion engines by Messrs. J. & J. Thomson, Finneston, for the Japan Mail Steamship Company.

"Gulf of Genoa," steel, 3,300 tons, 2,000 i.h.p., built and fitted with triple-expansion engines by Messrs. Caird & Co., Greenock, for the Greenock Steamship Company.

"Hibernia," iron, 149 tons, 320 i.h.p., built and engined by Messrs. Mackie & Thomson, Govan, for Mr. Henry Bennett, Grimsby, for the North Sea fishing trade.

Hopper Barge, steel, 300 tons, 250 i.h.p., built and engined by Messrs. Wm. Simons & Co., Renfrew, for the Preston Corporation.

"Loo Sok," steel, 1,650 tons, built and fitted with triple-expansion engines by the Fairfield Shipbuilding Company, Govan, for the Scottish Oriental Steamship Company, for service on the China coast.

"Marie," iron, 191 tons, built by Messrs. Scott & Co., Bowling, and fitted with compound surface condensing engines by Messrs. Muir & Houston, Glasgow, for the fish trade of Messrs. M'Kinney & Rafferty, Glasgow.

"Red Rose," iron, 400 tons, built by Messrs. John Fullerton & Co., Paisley, and engined by Messrs. Hutson & Corbett, Glasgow, for the coasting trade of Messrs. R. Hughes & Co., Liverpool.

"Scotia," steam trawler, sister ship to the "Hibernia," by the same builders, for the same owners.

"Satung," steel, 2,500 tons, built and engined by Messrs. Scott & Co., Greenock, for the China Navigation Company.

Barges.

Messrs. Fleming & Ferguson, Paisley, shipped to China two barges, each of 400 tons and 500 i.h.p.

War Ships.

"Indefatigable," steel, wood-sheathed, 3,600 tons, 9,000 i.h.p., built and engined by the London and Glasgow Engineering and Iron Shipbuilding Company, Govan, for the British Government.

"Ab-bāss," 800 tons, despatch cruiser, built by the Ailsa Shipbuilding Company, Troon, to the order of the Egyptian Government, for service in the Red Sea.

Sailing Vessels.

"Ancoria," steel, 1,800 tons, built by Messrs. Russell & Co., Greenock.

"Bardowa," steel, 2,070 tons, built by Messrs. William Hamilton & Co., Port Glasgow, for Messrs. Harvie, Hamilton, & Co., Glasgow.

"John Carswell," steel, 1,400 tons, built by Messrs. Chas. Connell & Co., Whiteinch, for Mr. John Carswell, Greenock.

"Josephine Troop," steel, 1,580 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, for Messrs. Troop & Son, St. John, New Brunswick.

"King Edward," steel, 1,700 tons, built by Messrs. Russell & Co., Port Glasgow, for Messrs. J. A. Walker & Co., Glasgow.

"Tolus," steel, 2,000 tons, built by Messrs. Barclay, Curle, & Co., Whiteinch, to the order of Messrs. A. & F. H. Carmichael, Greenock.

In addition to the above the Abercorn Shipbuilding Company, Paisley, shipped abroad three barges, each of 95 tons, and two barges, each of 50 tons.

Yachts.

"May," steel," steam yacht, about 500 tons, 242ft. long, built by the Ailsa Shipbuilding Company, Troon, to the order of Mr. N. B. Stewart, Wemyss Bay.

Steam Launch, 10 tons, 42ft. long, built by Mr. R. Rodger, Greenock, for service in the West Indies.

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ANALYSIS OF LAUNCHES.

	Steamers. No.	Steamers. Tonnage.	Sailing Vessels. No.	Sailing Vessels. Tonnage.	Yachts. No.	Yachts. Tonnage.
Great Britain ...	14	27,069	4	7,170	1	500
Japan	1	1,380	—	—	—	—
China	2	800	—	—	—	—
Egypt	1	800	—	—	—	—
New Brunswick	—	—	1	1,580	—	—
West Indies ...	—	—	—	—	1	10
Destination withheld	—	—	6	2,185	—	—
Total.....	18	30,049	11	10,935	2	510

SHIPBUILDING NOTES.

ON the 3rd inst. the "Oscar," a steel screw steamer, which has been built by Sir Raylton Dixon & Company, to the order of Messrs. Potter Bros., of London, for Messrs. Giovanni G. Gargurerich & Co., of Trieste, proceeded from the Tees to the Tyne on her trial trip. This vessel is built on the web-frame principle, with raised quarter-deck, bridge, and forecastle, and is of the following dimensions:—Length, over all, 243ft. 9in.; breadth, 34ft. 6in.; depth, moulded, 17ft. 1in. The engines have been supplied by the North-Eastern Marine Engineering Company, Limited, Sunderland, and have cylinders 19in., 30in., and 49in., by 33in. stroke.

ON the 7th inst. the "Mira," a screw steamer of 1,000 tons, was launched by Messrs. A. & J. Inglis, Pointhouse. The vessel has been built to the order of "Det Bergenske Dampskibsselskab," Bergen. The dimensions are:—Length, 204ft.; breadth, 30ft.; depth, 23ft. 9in. Her engines are triple-expansion, with cylinders 20in., 32in., and 52in. in diameter respectively.

ON the 9th inst. Messrs. Sir Raylton Dixon & Co. launched from their No. 2 Dockyard, Middlesbrough, the steel screw steamer "Endsleigh," which has been built to the order of Messrs. Bellamy & Co., of Plymouth. Her leading dimensions are:—Length, over all, 290ft. 3in.; breadth, 39ft.; depth, moulded, 21ft. 11in., with a deadweight capacity of about 3,500 tons. Her engines will be fitted by Messrs. Blair & Co., Limited, of Stockton, having cylinders 21in., 35in., and 57in., by 39in. stroke.

ON the 9th inst. a large screw steamer, the "Croft," was launched from the building yard of the Blyth Shipbuilding Company, Limited, at Blyth. This vessel has been built to the order of Messrs. Dent & Co., of Newcastle and Blyth, and will be a valuable addition to their well-known Arrow Line of steamers. The dimensions of the vessel are as follow:—Length, 312ft.; breadth, 40ft.; and she is built of steel, with web frames and cellular double bottom for water ballast throughout. The engines for this vessel are triple expansion, and are being made by Mr. J. Dickinson, of Sunderland.

ON the 9th inst. Messrs. Craig, Taylor, & Co. launched from their Thornaby shipbuilding yard, Stockton-on-Tees, the steel screw steamer "Highland Mary," of the following dimensions:—323ft. by 41ft. by 28ft. 7in. The vessel is built for the dead meat trade, and it is intended to carry 100,000 carcases. The holds are insulated, and the vessel will be fitted with refrigerating apparatus by Messrs. J. & E. Hall, Limited, of Dartford, Kent. The engines, on the triple-expansion three-crank principle, are by Messrs. Westgarth, English, & Co., Middlesbrough, and the diameters of the cylinders are 23½in., 37½in., and 60in., by 42in. stroke. The vessel has been built to the order of Messrs. Hugh Nelson & Co., of Liverpool.

ON the 10th inst. Messrs. Wm. Simons & Co. launched complete from their yard at Renfrew the second of three steam hopper barges for the Corporation of Preston. The dimensions of the vessel are as follow:—Length, 130ft.; breadth, 24ft.; depth, 9½ft.; and it has a hopper capacity to contain 300 tons of dredgings. The engines will indicate 250 h.p. The first of these vessels, which was launched last month, is now at work at Preston.

ON the 10th inst. Messrs. Edward Withy & Co. launched from their yard at Hartlepool a large steel screw steamer, "Castle Ventry," built to the order of Messrs. Sivewright, Bacon, & Co., West Hartlepool. The vessel measures over 320ft. in length, and is built throughout of Siemens-Martin steel, with a large deadweight capacity, and is built to the highest class at Lloyd's. The vessel has a long raised quarter-deck, long bridge-house, and a top-gallant forecastle. The holds are fitted with iron grain divisions, and all decks, deck erections, skylights, bulwarks, bulkheads, &c., are constructed of steel and iron. A cellular bottom is fitted fore and aft for water ballast. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. She will be fitted with triple-expansion engines by Messrs. T. Richardson & Sons, Hartlepool.

ON the 11th inst. Messrs. Schlesinger, Davis, & Co. launched from their shipyard at Wallsend a new vessel which they have built for the Tyne Steam Shipping Company, Newcastle. The vessel is intended for the trade between Newcastle and London. The following are the dimensions of the vessel:—Length, over all, 280ft.; length between perpendiculars, 270ft.; breadth, moulded, 35ft.; depth, moulded, 18ft.; depth of hold, 17ft. The vessel has been constructed to class 100 A1 at Lloyd's. The vessel will be lighted throughout by the electic light, to be supplied and fitted by Messrs. J. H. Holmes & Co., of Newcastle. The engines, which are placed in the after part of the vessel, have been constructed by the North-Eastern Marine Engineering Company, Limited, at their Wallsend works, and are designed to indicate 2,700 horse-power. They are on the triple-expansion three-crank type, having cylinders 30½in., 48½in., and 77½in diameter, and a stroke of 48in. Steam is supplied from four large boilers arranged so that the firing can be done in one stokehold.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, April 17th, at 9 p.m. Lecture on "Magnetic Rocks," by Professor A. W. Rücker, F.R.S. Saturday, April 18th, at 3 p.m. Lecture II., on "The Dynamo," by Professor S. P. Thompson.

PHYSICAL SOCIETY.—Friday, April 17th. Papers to be read: "On a Property of Magnetic Shunts," by Professor S. P. Thompson; "An Alternating Current Influence Machine," by Mr. J. Wimshurst.

JUNIOR ENGINEERING SOCIETY.—Friday, April 17th, at 8 p.m. Papers to be read: "On a Pitchometer," by Mr. W. H. De Ritter; "Concrete and its Uses," by Mr. F. R. Taylor.

NEXT WEEK.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, April 20th, at 8 p.m. Papers to be read: "Stoneware and its Application to Chemical Apparatus," by Mr. W. P. Rix; "Tanning by Electricity," by Dr. S. Rideal and Mr. A. P. Trotter.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, April 20th, at 8 p.m. Sessional meeting.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 21st, at 8 p.m. Paper to be further discussed: "The Cost of the Generation and Distribution of Electrical Energy," by Mr. R. E. B. Crompton, M.Inst.C.E.

ROYAL INSTITUTION.—Tuesday, April 21st, at 3 p.m. Lecture on "The Geography of Africa," by Mr. J. Scott Keltie. Thursday, April 23rd, at 3 p.m. Lecture on "Recent Spectroscopic Investigations," by Professor Dewar, F.R.S.

SOCIETY OF ARTS.—Tuesday, April 21st, at 4.30 p.m. Lecture on "China," by Sir Thomas Wade, G.C.M.G., K.C.B. Wednesday, April 22nd, at 8 p.m. Lecture on "Bimetallism," by Sir Guilford Molesworth, K.C.I.E.

PRICES CURRENT, 15TH APRIL, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £	s.	d.	Best. £	s.	d.	
Middlesbro' Bars.....	5	15	0	6	5	0	f.o.t. wks.
,, Angles	5	10	0	6	0	0	,,
,, Plates.....	5	12	6	6	2	6	,,
Staffordshire Bars	6	10	0	7	0	0	London.
,, Angles	6	12	6	7	2	6	,,
Crown Sheets	7	0	0	7	10	0	,,
,, Hoops	7	0	0	7	10	0	,,
"Siemens-Martin" Steel Boiler Plates.....				7	5	0	,,
,, Ship and Girder.....				6	10	0	,,

PIG IRON.

Middlesbro' Warrants, No. 3.		38/-	Cash.
Scotch Warrants, m/n		42/10½	,,
Hematite Warrants, m/n		47/1½	,,
Stocks in Stores. Scotch	519,989—Dec. for week	4,070	Tons.
Middlesbro'	119,303—Dec. ,,	2,226	,,
Hematite.....	173,691—Dec. ,,	4,252	,,

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	64/6	58/-	f.o.b.	Glasgow.
Gartsherrie	60/-	56/-	,,	,,
Summerlee	60/9	55/6	,,	,,
Clyde	58/3	54/3	,,	,,
Eglinton ex store	49/-	47/6	,,	,,
G.M.B. ,, ...	43/6	43/3	,,	,,

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	63/6	56/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton.....	1/9
Do. at Broomielaw, Glasgow.....	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)...	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay).....	5/-

METALS.

		£	s.	d.		£	s.	d.
Spelter:	Ordinary	£24	7	6	to	24	12	6
Copper:	British Cakes and Ingots	56	10	0	,,	57	0	0
,,	Chili Bars, G.O.B.'s	51	17	6	,,	52	5	0
,,	Other sorts, G.M.B.'s (equal to Chili Bars)...	51	17	6	,,	52	5	0
,,	Manufactured (strong)...	65	0	0		.....		
Lead:	Common Pig	13	10	0	,,	13	15	0
,,	English Sheet.....	14	5	0	,,	14	10	0
Tin:	Straits.....	90	7	6	,,	90	15	0
,,	Australian	90	5	0	,,	90	15	0
,,	English Ingots	94	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: There is no change of importance to report in the position of the copper market. The amount of business taking place is unimportant, and values are a shade weaker. Chili bars have receded about 10s. during the past week, to-day's quotations being £51 17s. 6d. to £52 5s. cash, with quiet market. Manufactured steady at £65, "strong," with a possible concession for good orders.

TIN: Quiet, with a tendency to lower values. Prices of foreign are down 10s. during the week.

LEAD: Steady; prices unchanged.

SPELTER: A little lower, owing to extreme depression in the galvanising trade.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals .....lb.	0	0	5½	to	0	0	6¼
,,	,, Liquid .....gal.	0	1	0	—	.....		
,,	Citric .....lb.	0	1	8½	—	.....		
,,	Oxalic ..... ,,	0	0	3½	—	.....		
,,	Sulphuric .....ton	1	15	0	—	.....		
,,	Tartaric .....lb.	0	1	3½	—	.....		
Alum:	Lump (powder 10/- ex.) ...ton	5	12	6	—	.....		
Ammonia:	Carbonate .....lb.	0	0	3½	—	.....		
,,	Muriate (Grey).....ton	23	10	0	—	.....		
,,	,, (White) ..... ,,	26	10	0	—	.....		
,,	Sulphate..... ,,	11	2	6	—	11	5	0
,,	Liquor.....lb.	0	0	3	—	.....		
Antimony	.....ton	75	0	0	—	.....		
Bleaching Powder	..... ,,	6	12	6	—	.....		
Bisulphide of Carbon	..... ,,	13	0	0	—	.....		
Borax	..... ,,	29	0	0	—	.....		
Benzole (90 %)	.....gal.	0	4	5	—	.....		
,, (50/90 %)	..... ,,	0	3	3	—	.....		
Copper Sulphate	.....ton	16	10	0	—	.....		
Copperas	..... ,,	2	0	0	—	.....		
Kieserit	.. .. ,,	.....			—	.....		
Lead: Nitrate	..... ,,	21	10	0	—	.....		
,, White Sugar	..... ,,	26	0	0	—	.....		
,, Brown	,, ... ,,	19	10	0	—	.....		
Potash: Bichromate	.....lb.	0	0	3¾	—	.....		
,, Caustic	.....ton	22	0	0	—	.....		
,, Carbonate	..... ,,	20	10	0	—	.....		
,, Chlorate	.....lb.	0	0	5½	—	.....		
,, Prussiate (Yellow)	..... ,,	0	0	10½	—	.....		
,, Sulphate (Basis 90 %)	.....ton	4	0	0	—	.....		
Precipitate: Red	.....lb.	0	3	6	—	.....		
,, White	..... ,,	0	3	6	—	.....		
Salts: Epsom	{Bags .....ton	3	0	0	—	.....		
	{Casks ..... ,,	3	15	0	—	.....		
,, Glauber	..... ,,	1	10	0	—	.....		
Sulphur: Sublimed Flowers	..... ,,	10	10	0	—	.....		
,, Recovered	..... ,,	7	0	0	—	.....		
Soda: Ash	.....deg.	0	0	1¾	—	.....		
,, Caustic	(White 70%).....ton	10	17	6	—	.....		
,, ,,	{,, 60%)..... ,,	9	12	6	—	.....		
,, ,,	{Cream 60%)..... ,,	9	5	0	—	.....		
,, Crystals	..... ,,	3	7	6	—	.....		
,, Bicarbonate	..... ,,	7	0	0	—	.....		
,, Hyposulphite	..... ,,	6	10	0	—	.....		
Solvent Naphtha	.....gal.	0	1	7	—	.....		
Tartar, Cream of	.....cwt.	5	7	6	—	.....		
Zinc Sulphate	.....ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Sulphate of ammonia is very dull, and prices again lower. Benzoles are unaltered. Carbolic acids are still quiet, but crude is more firmly held. Sulphate of copper continues in plentiful supply, but prices are steady. Yellow prussiate of potash has advanced, and is in demand.

OILS.

		£	s.	d.
Cocoanut:	Cochin.....per ton	36	0	0
,,	Ceylon..... ,,	30	0	0
Cottonseed	..... ,,	21	5	0
Cod	..... ,,	23	0	0
Lard	..... ,,	35	10	0
Linseed	..... ,,	21	17	6
Olive, Spanish	..... ,,	44	0	0
Palm, Lagos	..... ,,	26	10	0
Rapeseed: English	..... ,,	30	10	0
Seal: Pale	..... ,,	.....		
,, Brown	..... ,,	.....		
Sperm	..... ,,	49	0	0
Whale	..... ,,	22	0	0
Turpentine	.....per cwt.	1	9	0
Coal	.....per gal.	.....		
Petroleum (Refined)	..... ,,	0	0	5¾
Spirit	.....	0	0	7

MESSRS. LAING, WHARTON, & DOWN have sent us an illustrated catalogue of their electric light machinery. It includes almost everything needed for electric light installations, and contains a number of line illustrations of designs of a very large assortment of artistic fittings.

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HOME INDUSTRIES.

LONDON, 16th April, 1891.

The Money Market.—The withdrawal of substantial sums in gold from the Bank of England for Russia has upset the money market, and the shadow of an advanced Bank rate hung over Lombard Street since the end of last week. Discount business has been restricted by the hardening of rates, but loan money has remained plentiful and fairly cheap. In the stock market the week began promisingly, and prices advanced in nearly every department. The improvement did not last long, and a reaction quite as marked as the upward movement occurred. American railroad securities had led the market up, and a set-back in them, induced by the failure of a conference of railroad officials at Chicago, on which great hopes had been based, depressed other securities. Grand Trunk stocks, which, in sympathy with Americans and Canadian Pacifics, had been strong for several days, gave way in consequence of the cold reception of Sir Henry Tyler at the half-yearly meeting and the shareholders' refusal to re-elect the retiring directors. In home railways no feature has developed, and, but for a little activity in the stocks of the lines most affected by Sir Edward Watkin's new London project, and for an advance in the Scottish stocks, due to the closing of "bear" accounts, there has been little to record. Foreign securities have been very quiet, South Americans showing fresh disposition towards weakness. Shares in industrial companies have been inactive, and mining shares have been rather neglected.

Institution of Mechanical Engineers.—The ensuing ordinary general meeting of this Institution will be held on the 30th inst. and the 1st of May, at 7.30 p.m., under the presidency of Mr. Joseph Tomlinson. The following papers will be read and discussed:—"Research Committee on Marine Engine Trials: Report upon Trial of the Steamer 'Iona,'" by Professor A. B. W. Kennedy, F.R.S.; "On Some Details in the Construction of Modern Lancashire Boilers," by Mr. Samuel Boswell. The anniversary dinner is announced to take place on the evening of the 29th inst.

The Junior Engineering Society.—On the 6th inst. a large party of members of this Society visited the electrical engineering works of Messrs. Siemens Brothers & Co., at Charlton. The visitors were shown round in small parties, an arrangement which greatly enhanced the success of the visit. The instrument section proved very interesting, as did also the contents of the show room, which included keys, relays, switches, Morse instruments arranged for simplex, duplex, and translation work, Wheatstone automatic instruments capable of sending 400 words per minute, galvanometers, resistance coils, block signalling apparatus, and special automatic block systems for electrical railways. The process of manufacture of indiarubber core was seen, and also the wire-testing shop, cable machine shop, cable tanks, and cable-testing room. Here a special bridge for very low resistances was shown; its range was from 1 ohm to 1 millionth of an ohm. The manufacture of lead-sheathed core by means of powerful hydraulic machinery was in progress, and in the large machine shop the heavy parts of dynamos were being prepared. The mode of erection of an iron telegraph pole and the general arrangements of telegraph work were explained.

Electric Traction at Greenwich.—Some successful experiments have recently been carried out at Messrs. Merryweather & Sons' Tramway Works, Greenwich, on behalf of the Gordon Electric Car Syndicate, and have given excellent preliminary results. The track has closed conduits, and the general idea of the system is a series of contacts changed by means of automatic magnets in a box placed in the ground every hundred yards or so, about sixteen to a mile. The working pressure is 250 volts and the current 30 amperes. The current taken in energising the magnets is ¼ ampere, and the greatest loss in running across the sections is about 1 ampere—that is, in all, including resistance, say, 4 per cent. of that used. Any gearing or motor can be used—at present an Immisch motor is employed, with ordinary spur gearing. It is expected that the system will shortly be applied to a complete tramway line, in order to verify under ordinary conditions of street traction the satisfactory results shown by the experiments. Messrs. Merryweather & Sons have sent us a copy of their new circular referring to the patent Sphincter grip armoured hoses, and the non-kinkable red grey hoses, &c., of which the firm make a specialty.

Exhibition of Artistic Silken Fabrics.—The second Exhibition of artistic silken and other fabrics of British manufacture will be held at the Æsthetic Gallery, 155, New Bond Street, early in May. The object of these Exhibitions is to further the efforts of the Ladies' Committee of the National Silk Association on behalf of home manufactures by establishing a central depôt in the West End of London for the distribution of artistic British textile fabrics. Further particulars will be shortly announced.

Business Announcement.—Messrs. Woodhouse & Rawson United, Limited, have opened new show rooms at 34, Cannon Street, at the corner of Queen Victoria Street. In view of the large number of orders for steam and electric launches and tugs the company have resolved to extend their riverside premises, and have, therefore, just purchased a piece of ground, situated close to Kew Railway Bridge on the Surrey side, with a frontage to the river of between 600ft. and 700ft., the total area being about 2½ acres. Good dock accommodation will be provided in connection with these works.

MANCHESTER, 16th April, 1891.

Manchester Association of Engineers.—On the 11th inst. Mr. C. F. Budenberg, B.Sc., read a very interesting paper before the Association on "Steam Engine Governors." After dealing exhaustively with the well-known Watt, Buss, Porter, and Proell types, the author described the "four-pendulum" governor, the Lüde and Soho governors, and a simple expansion gear made by Messrs. Cochrane, Grove, & Co., Middlesbrough. We hope, in a later issue, to reproduce this paper in full.—On the 13th inst. about 130 members of the Association paid a visit of inspection to the recently erected locomotive works of the Lancashire and Yorkshire Railway Company at Horwich. They were conducted through the extensive works, and were enabled to see most of the shops. Among the special objects of interest an ingenious application to a drilling machine may be mentioned, by which a single-spindled radial drilling machine is enabled to drill three holes simultaneously. The centre drill is fitted in the chuck of the drill spindle, on which is fixed a spur wheel, which engages with two similar wheels fastened on two chucks which are borne in a square frame carried on the drill spindle. In this way three drills are easily employed, and the drilling of fire-box plates and similar work is thus more easily accomplished. In the signal department a special combined milling and drilling machine, made by Messrs. Wm. Muir & Co., is noticeable. The machine is employed to mill the faces of quadrant brackets on which there are six faces, all of which are milled at one operation, the two wings being hinged and brought up to their work when required. The drilling head is at the back of the machine, and has three spindles, which are easily brought into operation when necessary. The steel foundry is now in full operation, and some creditable specimens of wheel centres and motion work are being turned out. The shops are a fine range, and their orderly arrangement were much remarked upon. A vote of thanks to Mr. J. A. F. Aspinall was cordially passed at the conclusion of the visit.

Technical Education in Cheshire.—The Technical Instruction Committee of the Cheshire County Council have decided to recommend to the Council the granting of several sums to various institutions in the county for increasing the provision for instruction in agriculture and dairy practice. In addition to this a certain proportion of the sum at the disposal of the Council is to be granted to such urban authorities as decide to place themselves under the recent Act. The Cheshire Chamber of Agriculture proposes that the County Council should rent and equip a farm on which instruction in practical and theoretical agriculture can be given. The cost for rent and salaries is estimated at about £1,000, and that of fixed stock and implements at from £1,000 to £2,000. It is suggested that three-fourths of the cost should be subscribed by the Council and the remainder by private subscriptions.

Cotton Machinery.—Messrs. John Hetherington & Sons, Limited, have received the order for the whole of the machinery required for the Milton Spinning Company, Limited, Mossley, consisting of 80,000 spindles and the usual preparation machinery. This is the sixth mill during the past half year for which the order for the machinery has been secured by this firm.

Business Announcement.—Mr. David Fulton, F.I.P.A., Assoc.Mem.Inst.C.E., of 1, St. James Square, and of the Middle Temple, was successful at the Easter Final Examination for call to the Bar. Mr. Fulton has during the last six years practised as a consulting engineer and patent agent at Manchester, in partnership with Mr. E. K. Dutton.

The Fifty-three Hours Question.—Although a specially convened meeting of the Iron Trade Employers' Association has decided that its members should not accede to the demand for the shortening of the weekly hours to 53, the question is not likely to give rise to any prolonged dispute. The state of trade is such that many firms are quite prepared to yield, and are, it is stated, preparing for the change. Careful inquiry shows that there is a widespread conviction that the demand will be granted, and that even a partial strike is unlikely.

The Arts and Crafts Exhibition.—The attendance at this Exhibition since it opened has exceeded expectation In three weeks 74,926 visitors have passed the turnstiles, and 6,259 catalogues have been sold. Although the collection might be amended, it is in many respects one of the most notable ever got together in this city, and a large number of artisans have visited the Exhibition. There are many specimens of iron work of considerable merit, and a case of silk embroidery from the Macclesfield School is also worth special attention.

The Linen and Jute Trades.—There has been a steady business this week, and a striking development in the fancy linen branches. Firms engaged in this department state that the industry is growing every year, Bavarian houses benefiting chiefly from the circumstance. Fancy linen damasks are now largely bought, and the designs shown are remarkable for their originality and style. There is little change in the general linen trade. Distributors are steadily employed, and manufacturers are receiving a few occasional orders. The demand, however, is not equal to expectations, and merchants are anxiously looking towards the future. For shipment there is not much doing. South American trade still continues dull, and shippers do not anticipate a change for the better just yet. Linen threads, for which there is always a good demand, are being freely taken off the market. The wholesale clothiers of this district are extensive buyers. Jute goods, especially in fancies, are in good request.

GLASGOW, 16th April, 1891.

The Iron and Coal Markets.—On the reopening of the market on the 14th inst., after the spring holiday, there was an increase in the demand. Prices advanced rapidly, and, "bears" beginning to cover their transactions, the advance was maintained for a time. There has been a better feeling in mineral circles during the past few days. Several large mineral contracts are on the point of being made, including one of 40,000 tons of coal for the Danish State Railways, and generally the foreign demand is rather brisker. The uncertain issue of the present labour agitations on the Continent is helping to stimulate forward contracts for Scotch coal, especially for German consumption. Pig iron shipments, however, for last week showed a large decrease. The foreign shipments were only 2,886, against 5,565 tons for the corresponding week last year; coastwise shipments were 2,980 tons, against 4,221 tons last year. The decrease of pig iron shipments up to date this year is 55,571 tons. Coal shipments last week increased 17,574 tons, the decrease for the year being now reduced to 53,108 tons.

The Railway Schemes.—The Committee of the Edinburgh Town Council, which is carrying on negotiations with the North British Railway Company with respect to their proposal to acquire a portion of Princes Street Gardens for the purpose of enlarging the Waverley Station at Edinburgh, held a conference with the directors, manager, and secretary of the company in Edinburgh on the 14th inst. The conference was held in private, but it is understood that some terms of agreement were arrived at.—The Brechin and Forfar Railway, which, though not promoted by the Caledonian Railway, is ostensibly projected for the purpose of reducing the distance between Perth and Aberdeen by about six miles, is opposed on the ground that the interests of Forfar would suffer through the town being left off the main line.

Threatened Wages Dispute.—The Steel Company of Scotland some time ago gave notice of a reduction of 5 per cent. in the wages of their men. This reduction was generally accepted, but the men in charge of the gas producers have announced their desire to resist the reduction. The company has stated that unless the men submit there will be a general lock-out at the works at Newton and Blochairn. It is to be hoped that an amicable arrangement may be arrived at.

Launch of an Orient Liner.—The "Ophir," a steel twin-screw steamer of 6,700 tons, built for the Orient Steam Navigation Company by Messrs. Robert Napier & Sons, Govan, was launched on the 11th inst. The dimensions of the new vessel are:—Length, 482ft.; breadth, 53ft.; depth, 37ft. The "Ophir" will be employed in the Royal Mail service between London and Australia. The vessel has been built to class 100 A1 at Lloyd's, and is one of the handsomest vessels of the fleet, to which it forms an important addition. There are two sets of triple-expansion engines. The steam is supplied by seven steel boilers with a working pressure of 160lb. to the square inch. The speed is expected to be fully 18 knots. The hull is subdivided by water-tight bulkheads and there is a cellular double bottom. The dining saloon is placed on the upper deck between the funnels, where vibration is at a minimum. There is a promenade deck, unusually ample owing to the great breadth of the vessel. Among the accessories are mechanical ventilation, hydraulic cargo and steering gears, refrigerating apparatus both for stores and for dead meat traffic. The vessel will be fitted throughout with electric light.

The Raising of the s.s. "Utopia."—The Anchor Line steamer "Utopia," which was sunk in Gibraltar Bay, is to be raised. The work has been entrusted to the British Marine Salvage Company, Limited, Glasgow, in conjunction with the East Coast Salvage Company, Limited, Leith. The operations will be superintended by Captain Meikleroid, the marine superintendent of the Anchor Line.

(From our own Correspondents.)

LIVERPOOL, 15th April, 1891.

The Furniture Wood Trade.—There is a good demand for all classes of mahogany, and the market continues firm. There is a good opening for Honduras, the market being poorly supplied. Sound straight logs of Tabasco are in good request, and, as the stock consists of only 125 logs, the prospects for future imports are good. Cargoes from Minatitlan and Cuba will meet with a ready sale at good prices, the inquiries having been large. Logs of St. Domingo of large and medium dimensions are in good request, but small curls under 3ft. long are not required; curls up to 5ft., of good growth, are in demand. There has been a large arrival of African mahogany, which has met with a ready sale at satisfactory prices. There is no stock of pencil cedar, but there is little or no demand. The stock of American walnut is light, although it has arrived very freely; the market has a downward tendency. There are no inquiries for Italian and Circassian, and prices are low. There is a fair demand for logs and planks of whitewood of good quality, and the prices do not fluctuate. There is no stock of Rio and Bahia rosewood, and a small parcel of Honduras has arrived. There has been no business in satinwood, and prices are falling.

The Vyrnwy Pipe Line.—Very little progress has been made with the tunnel under the Mersey at Fidler's Ferry, the contractors having met with serious difficulties in driving the heading. Much difficulty has also arisen in

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connection with the temporary pipe line which it is proposed to lay across the bed of the river to serve as an auxiliary supply during the construction of the tunnel. It was necessary to obtain the consent of several authorities interested in the navigation of the Mersey before the pipe could be laid. The Corporation of Warrington have raised strong objections to the proposed plan, and have appealed to the Board of Trade to prevent the pipe being laid as proposed. They contend that, as the bed of the river changes its depth so often and so suddenly, if the pipes are not laid well below low-water line they may be washed clear of the bed of the river, and, if not broken by their own weight, they will, at any rate, seriously interfere with the navigation of the river. They wish to have the pipe laid from bank to bank, 7ft. below low-water level.

Liverpool Engineering Society.—At the last meeting of this Society, held at the Royal Institution on the 8th inst., Mr. Alexander Ross, M.Inst.C.E., chief engineer of the Manchester, Sheffield, and Lincolnshire Railway Company, read a paper on "Railway Signalling and Interlocking." The subject was exhaustively treated, the principal systems adopted from the earliest railway times to the present day being fully described and illustrated by wall diagrams.

NORTH STAFFORDSHIRE, 15th April, 1891.

The Iron Trade.—There are no signs of any change for the better in this industry. The quarterly meeting at Birmingham, on the 11th inst., was poorly attended, and there was little buying. Steps are being taken to obtain a reduction in the wages of blast furnacemen. The price of forge pig iron is now from 42s. 6d. to 45s. at works, according to quality, which leaves no margin of profit for manufacturers; on the other hand, blast furnacemen's wages are from 40 to 50 per cent. above the minimum, the last advance having been granted when pig iron was selling at 60s. per ton.

The Coal Trade.—The demand for coal for household purposes continues good. The consumption of fuel for manufacturing purposes is, however, limited, and prices begin to show a weaker tendency.

The Electric Lighting of Trains.—Messrs. Bumsted & Chandler, of Hednesford, have recently supplied a Chandler compound engine and dynamo to the Cape Railways for the electric lighting of the trains on those lines. This is the third set of engine and dynamos supplied to the Cape Railways, two sets having been at work for more than a year. The entire weight of engine, dynamo, and fittings, lamps, &c., for a train of fourteen coaches, having one hundred lights, does not exceed 14 cwt., and the steam consumption is not more than that required for a 6 horse-power engine.

DERBY, 15th April, 1891.

Railway Schemes.—It was stated, at a meeting held at Newark in support of the proposed Lancashire, Derbyshire, and East Coast Railway, that only about 1 per cent. of Derbyshire coal found its way for shipment, whereas 30 per cent. of the Yorkshire coal did so. The new line would stimulate the industry of coal getting, and develop many large manufactures. The proposed line could be constructed at an estimated cost of only £26,000 per mile. The Corporation of Lincoln are opposing the Bill. The inhabitants of Chapeltown have presented a memorial requesting the directors of the Midland Railway to reconsider their intention of constructing heavy stone bridges and an unsightly embankment on the new line from Wincobank. Instead of these structures, they urge that bridges of a light and graceful character should be adopted, whilst for the embankment they would substitute girder bridges, presumably something like those of the New York elevated railroads. Mr. G. H. Turner, the goods manager of the Midland Railway, has been appointed assistant general manager to help Mr. Noble in the increasing duties caused by recent railway legislation.

Electric Lighting.—Mr. Alderman Hobson has announced at a public meeting that the scheme for lighting the town by electricity, which Sir Frederick Bramwell has prepared after his recent visit to Derby, will shortly be laid before the Council, and Mr. Hobson has no doubt it will be adopted at least for the central part of the town.

CARDIFF, 15th April, 1891.

Coal and Coke.—The steam coal trade shows no further signs of weakness, and prices are well maintained. It is, however, necessary that the demand should continue large, as the output from new collieries is steadily increasing, and with the sinking operations now being carried on is likely to expand further. Steam coal is quoted as follows:—First quality, 14s. 3d. to 14s. 9d. f.o.b.; second quality, 13s. 3d. to 14s. f.o.b.; third quality, 12s. 9d. to 13s. f.o.b.; fourth quality, 12s. 3d. to 12s. 6d. f.o.b.; small steam, 5s. 3d. to 5s. 9d. In the house coal market there is little activity compared with the recent demand: best house coal realises 14s. 6d. to 15s.; No. 2 qualities, 12s. 6d. to 13s. 6d. There is only a quiet tone noticeable in the coke trade: furnace qualities are quoted at 17s. 6d. to 19s.; foundry, 20s. 6d. to 21s. 6d.; best foundry, 23s. to 25s.

Iron and Steel.—The result of the quarterly meetings has not been favourable to the manufactured iron and steel trades. The gloomy outlook in the tinplate trade affects the steel trade. Steel tinplate bars have been quoted by makers at £5 2s. 6d. For steel rails one or two contracts have been given out at £4 12s. 6d. to £4 15s. per ton for heavy sections, which is a drop of £3 in little more than twelve months. Tinplates realise 17s. to 17s. 6d. for Bessemer steel cokes. In the iron ore trade good Rubio realises 13s. 6d. to 14s. c.i.f. Cardiff and Newport, with 50 per cent. iron. The freight from Bilbao is 4s. 9d. as against 4s. 3d. a week ago.

Severn Navigation Scheme.—A deputation, comprising members of the Severn Commission, the Worcester Town Council, and Cardiff merchants, waited upon the Corporation on the 13th inst. with the view of inducing the Corporation to confirm the advance of £5,000 to the Severn Navigation Scheme. The Corporation agreed to confirm the advance of the money. The improvements will be at once commenced, and vessels of 400 tons burthen will thus be enabled to trade up the Severn with timber, iron ore, grain, and other imported produce, and to bring back manufactured iron and hardware goods.

BARROW-IN-FURNESS, 15th April, 1891.

Hematite.—Further depression is shown in the hematite pig iron trade this week by the marked absence of new business. There is no change to note in values, which are quoted at 47s. 6d. for warrant iron net cash, while makers are asking 49s. to 50s. for mixed Bessemer numbers f.o.b. Makers are proposing to blow out additional furnaces with the view of diminishing stocks, so as to be able to take advantage of improved trade when it arises. Stocks this week have been reduced 3,823 tons, leaving the aggregate of stocks 175,066 tons. Forty furnaces are in blast and thirty-six are standing idle.

Steel.—The steel trade is quiet, and there are few orders either for Bessemer or Siemens-Martin qualities. Rails are in fair request for heavy sections, but lighter rails are quiet. Heavy sections are still quoted at £4 12s. 6d. per ton net. Steel shipbuilding material is quiet, but good orders are expected from home as well as from general sources. Ship plates are quoted at £6 5s., angles at £6, and steel boiler plates at £6 15s. Orders are scarce for blooms, billets, slabs, and tinplate wire. Extensions are contemplated in the Siemens-Martin department of local steel works, and in the manufacture of steel wire, for which purpose it is intended to acquire large works which have been standing idle in the vicinity of the Barrow Steel Works.

Iron Ore.—Business in the iron ore trade is quiet, and metal is being stored at many mines, with little prospect of a speedy clearance. Prices are steady at 10s. to 10s. 6d. per ton. Some pits are closed temporarily.

A New Industry.—A new feature in the development of the bulk import petroleum trade of Barrow is the commencement of new oil and grease works at Barrow, under the auspices of Messrs. Goodall & Co. Already a large cargo of natural crude mineral oil has been imported, and new developments of this industry are expected.

Shipping.—There is a slight improvement in shipping this week, but the aggregate of metal shipments this year is 32,000 tons less than last year.

MIDDLESBROUGH, 15th April, 1891.

Pig Iron.—The iron market is somewhat more favourable in tone, and prices of pig iron have risen. More business was done on 'Change yesterday than has been done for some time past, though it was small at the best. The advance in Scotch warrants of 1s. 3d. per ton since the 9th inst. has had a good influence on buyers, though it has not much affected the price of Middlesbrough warrants. On 'Change yesterday makers and merchants were willing to take 38s. 3d. per ton for prompt f.o.b. deliveries of No. 3 G.M.B., and were able to get it, though as a rule buyers only offered 38s. Afterwards 38s. 6d. per ton was generally quoted, and buyers raised their offers to 38s. 3d. Some business was reported as having been done at 38s. 6d. by makers. Middlesbrough warrants are 38s. 3d. cash buyers and 38s. 6d. cash sellers. The stock in Connall's store was 119,954 tons on the 13th inst., a decrease of 2,740 tons this month up to date. Grey forge is now quoted at 37s. 3d., and some firms will not sell under 37s. 6d. East Coast hematite is 51s. per ton for mixed numbers.

Manufactured Iron and Steel.—The finished iron and steel industries are very quiet. Nevertheless quotations are fairly well maintained, because it is recognised that a reduction of prices would not lead to an increase of business at present. Common bars are quoted at £5 12s. 6d.; best bars, £6 2s. 6d.; best best bars, £7 2s. 6d.; iron ship plates, £5 12s. 6d.; iron boiler plates, £6 12s. 6d.; steel ship plates, £6 2s. 6d.; iron angles, £5 10s.; steel angles, £5 17s. 6d., all less 2½ per cent. f.o.b. Heavy steel rails are £4 12s. 6d. net.

Coke.—The price of blast furnace coke is the same as last week, 13s. 6d. per ton.

Shipments.—Shipments are improving, and were 28,602 tons up to the 13th inst., as against 30,005 tons to the 13th of last month. They promise to be large for the rest of the month. Of the 28,602 tons, 16,755 tons went to Scotland, 2,280 tons to England and Wales, and 9,567 tons to foreign parts.

Work and Wages.—The South Stockton Iron Works have recommenced operations this week, the directors having secured some specifications at remunerative prices. The representatives of the Cleveland ironstone miners met the members of the Cleveland Mineowners' Association on the 11th inst., in reference to a claim made by the latter for a reduction of 12½ per cent. on the men's wages. The men's representatives asked for an adjournment to enable them to put the matter before the men in the district, and the next interview was fixed for the 21st inst. The masters stated that they were not prepared to make a less reduction than 10 per cent., to date from the beginning of the ensuing week. However, if the men wished it, the masters would agree to submit the matter to arbitration, the question to be determined being whether the reduction should be more or less than 10 per cent. At meetings of the men held this week the opinion was expressed that, following so close on the recent reduction of 5 per cent., the demand of the masters is unreasonable, and should be strenuously opposed.

SUNDERLAND, 15th April, 1891.

The Shipping and Coal Trade.—During last week 72,972 tons of coal were shipped, an increase of 29,992 tons over the previous week. 46,596 tons went coastwise, and 26,376 tons to foreign ports, as well as 1,104 tons of coke. Other coastwise shipments were 680 tons of patent fuel, 240 tons of steel plates, 100 tons of pig iron, 20 tons of cement, 76 tons of lime, and 13,000 dozen glass bottles. The imports for the same period included ten cargoes of timber, besides iron ore, silver sand, and moss litter.

Shipbuilding.—There is a revival in the building of sailing vessels, both of medium and great burthen. Recently Messrs. John Blumer & Co., North Docks, entered into four contracts for sailing vessels, and Messrs. Robert Thompson & Sons, Southwick, are building four of the same class of vessels. Messrs. Wm. Pickersgill & Son, Southwick, are also engaged in this class of work, and Messrs. William Doxford & Sons, Pallion, are at present fitting out a large four-masted full-rigged ship. The new National Line steamer "Europe" has been dry docked at this port, as none of the graving docks on the Tyne were capable of accommodating such a large vessel. This vessel has been built by Messrs. Palmer's Shipbuilding and Iron Company, Limited.

NEWCASTLE, 15th April, 1891.

The Coal Trade.—The demand for manufacturing and gas coals continues satisfactory, and prices are well maintained. Milder weather has, however, lessened the demand for household coals. There is only a small demand for "bunker" coal, but the early resumption of trade with the Baltic ports will cause an increased demand. A Shipowners' Committee has been appointed for the purpose of preparing a scheme of "minimum freights" for the coal trade, and a report on the subject will shortly be submitted to a general meeting of North-East Coast shipowners. The shipments of coal and coke at Tyne Dock during last week amounted to 94,491 tons, being an increase of 13,865 tons as compared with the shipments for the corresponding week last year.

The "Fielding" Gas Engine.—A depôt for the sale of the "Fielding" gas engine, which is manufactured by Messrs. Fielding & Platt, hydraulic and general engineers, Gloucester, has been established at 32, Collingwood Street, under the management of Mr. Gilham, who was formerly the agent in Newcastle of Messrs. Crossley Brothers, Manchester. Though the "Fielding" gas engine has only lately been introduced, the demand is already far in excess of the capabilities of production. The patentees, however, are now erecting extensive premises for the manufacture of these engines. Several engines of this type have already been sold, including a 16 h.p. engine, purchased by Messrs. Clarke, Chapman, & Co., Gateshead.

Government Contract.—Messrs. George Angus & Co. have for the fourth time obtained the contract to supply the whole of the leather hose required by the Admiralty departments for the next twelve months.

North-East Coast Institution of Engineers and Shipbuilders.—At a meeting of this Institution on the 10th inst., under the presidency of Mr. W. Richardson, the discussion on Mr. W. C. Mountain's paper on "Electrical Engineering" was continued, and turned principally on the comparative advantages of the systems of double and single wiring for electric lighting of vessels. Mr. Newitt gave the result of experiments with the single wire on board one of the Elswick cruisers, and said that with a wire 3ft. in a horizontal direction from the compass there was a deflection of 58 deg. The double wire system was preferable for three reasons—(1) In the single wire system there is double the chance of a break-down; (2) more danger of fire through bad contact with the ship and exposed wire eaten away by the salt water; (3) the serious effect upon the compass. The extra cost of the alternating current to avoid all this would in an ordinary ship not exceed £60. Mr. W. Hök then read his second paper on "The Unsinkability of Cargo-carrying Vessels."

Electric Lighting.—Messrs. J. H. Holmes & Co.'s works, Portland Road, are very busy, and new orders continue to be received. The firm have completed a very large number of steamship installations this year, and have carred out some important work in connection with the electrical equipment of two Atlantic liners.

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THE MANCHESTER SHIP CANAL.

(*For description see page* 364.)

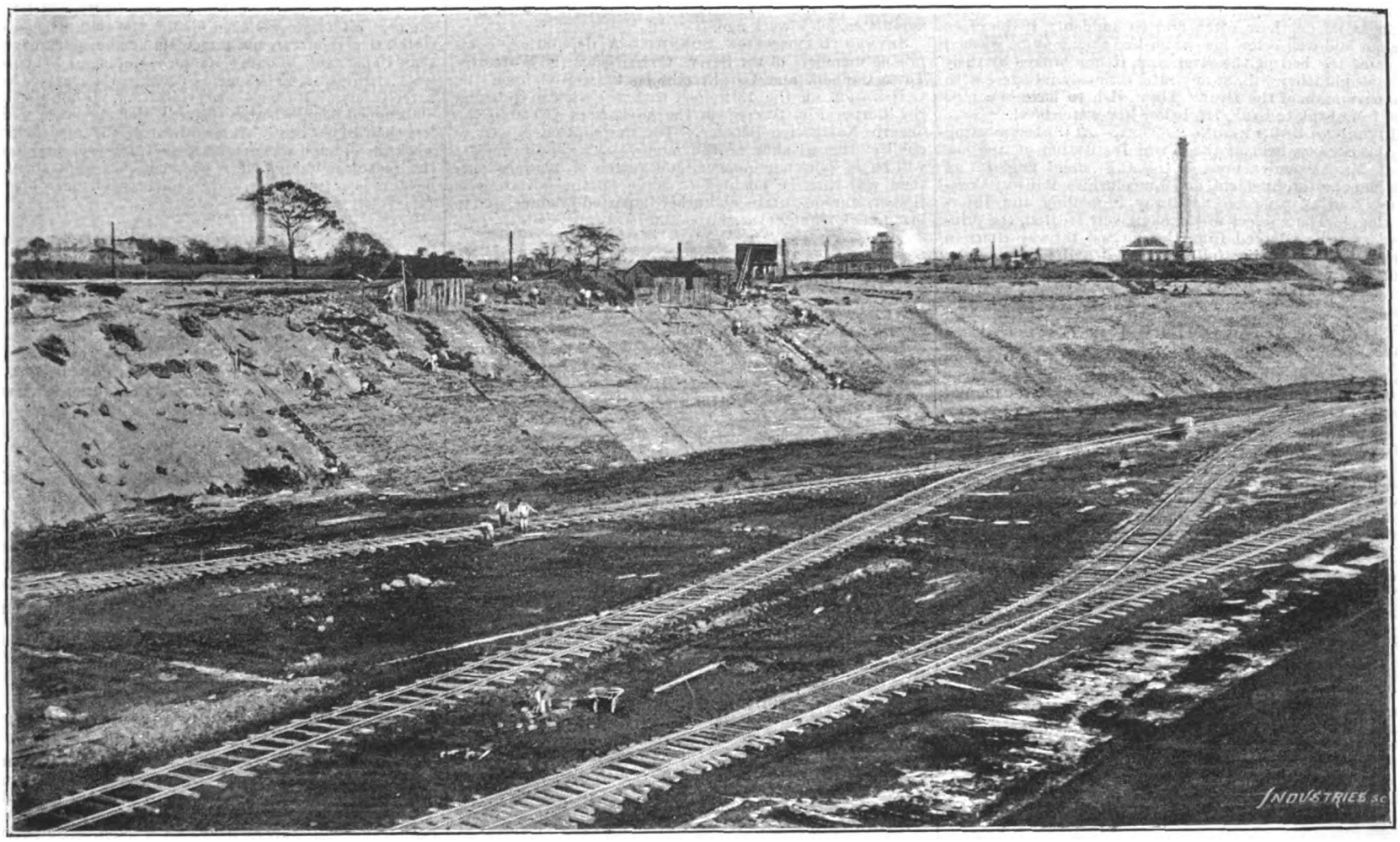


FIG. 9.—LITTLE BOLTON CUTTING.

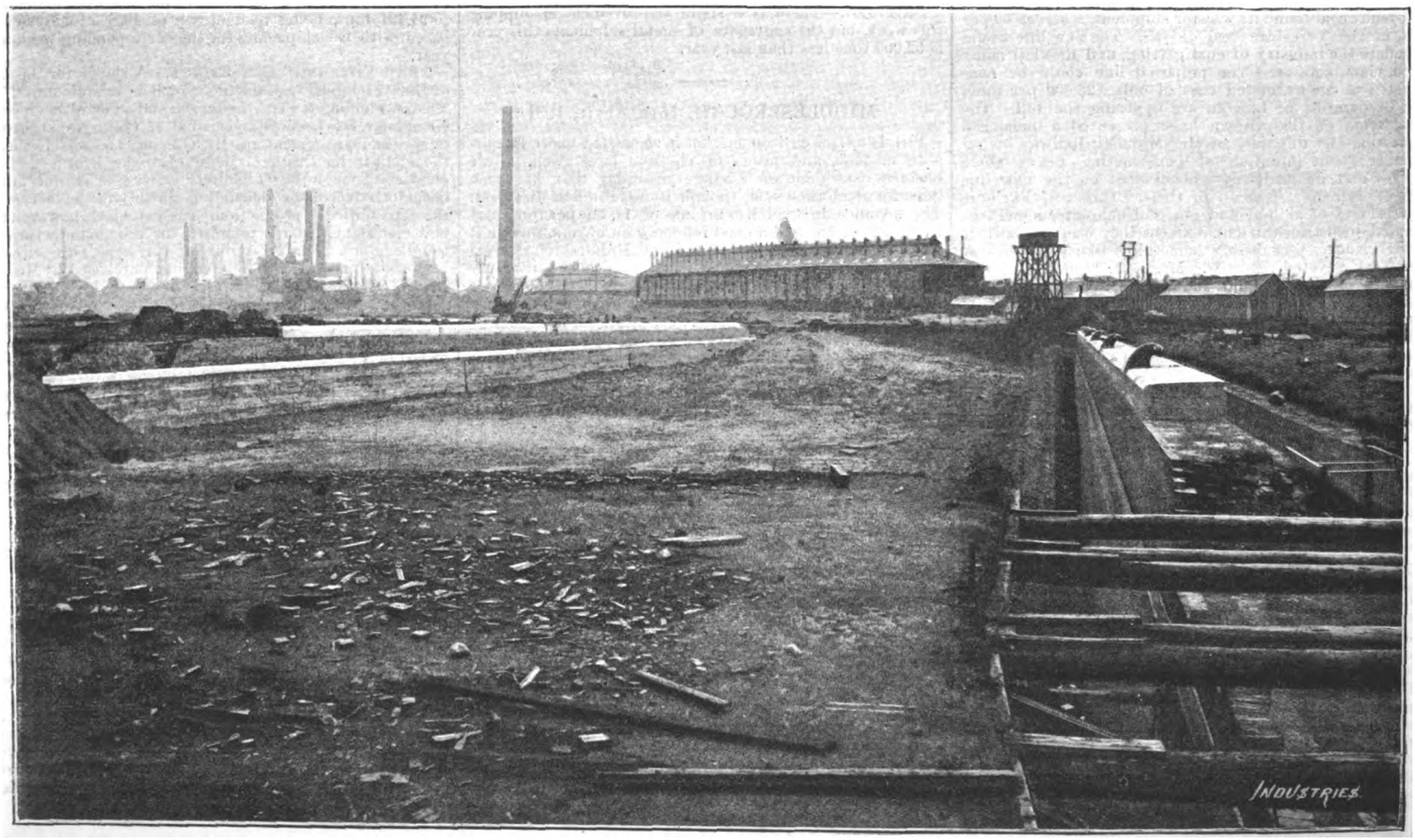


FIG. 10.—NO. 1. BRANCH DOCK, MANCHESTER.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 17TH APRIL, 1891.

THE RECENTLY APPOINTED LABOUR COMMISSION.

WHEN a Government desires to shelve an inconvenient question, the appointment of a Royal Commission is a favourite expedient. Such a plan provides a safety valve, by means of which those who are over-zealous in a particular direction may blow off surplus steam; to those who clamour for the Government to do something by way of remedy for real or supposed evils it offers the appearance of action, while to those who disapprove of Government interference it offers the too obvious reality of doing nothing. It is a little absurd to regard the appointment of a Labour Commission as a new departure. During the past three-quarters of a century we have hardly been free from labour commissions, not, perhaps, explicitly so-called; but still labour commissions to all intents and purposes. The Factory Commissions, the Commission on the Employment of Children and Women in Agriculture, the Trades Union Commission, even the Commission on Depression of Trade and Industry, were all in fact, if not in name, labour commissions. It must be admitted that, save the last named, these commissions produced some good results beyond the publication of ponderous Blue Books. The contents of these mainly exist now for the bewilderment of German economists, who search their pages for evidence in support of some economic theory, or with the less worthy object of making a pedantic array of foot-notes. The terms of reference of the Commission on Trade and Industry of 1885 were so vague, and the general character of the quest so hopeless, that there was no practical outcome of its labours. The same may be said, as yet at all events, of the Commission on the Precious Metals of 1887, and the same may also be said of the terms of reference and the quest of the Labour Commission of 1891. These terms are similar to those of the Trades Union Commission, except that the commissioners in that case were instructed to inquire into the relations between employers and employed as regards the specific matter of combinations. While it is open to question whether or not a new commission on this subject is needed, one might have been more hopeful of the result of such a commission than of one which is instructed to inquire into any and every subject connected with industry. An open charter might, under some circumstances, have been an advantage, but the composition of the Commission is at once too heterogeneous and not representative enough to encourage much hope in this connection. We do not make serious objection to any of the names on the Commission, though a considerable number of the members might more fittingly have given evidence as witnesses. With the exception of two or three names, there are none of first-rate eminence, and the Commission as a whole, therefore, lacks weight. The parade, too, which has been made of its representative character is hardly justified. The mechanical trades are inadequately represented, Sir Edward Harland being representative at once of the industries of Ireland and of shipbuilding and engineering generally. There are five representatives of the coal and iron trades, two of the cotton trade, two of shipping, two of dock labour, one of gas, one of political economy, and one of jurisprudence, while shipbuilding and mechanical engineering of all branches in England and Scotland are absolutely unrepresented. Only one representative has been chosen to act for this group of industries, and, though a man of distinction, his interests are more specially connected with Ireland. A few of the nine politicians might, perhaps, have been spared to make room for one or more engineers having special acquaintance with the conditions of the engineering industries in England and Scotland. Mr. William Mather, M.P., or some other prominent engineer who takes an interest in the labour question might even yet find a place upon the Commission with universal acceptance. We are not so much concerned about the precise character of the possible good to be done by the Commission as of the possible evil it may do. It may raise false hopes, and point the way to a delusive short cut to class well-being. Its strongly marked antagonisms, however—eight representatives of capital against eight of labour, with two professors and nine politicians to arbitrate in the fray—give small promise of any result being attained. Is it possible that the Government has so concocted the mixture that the elements will mutually neutralise and sterilise each other? If this be the case, it is possible that this amiable intention may be frustrated, and that many of the politicians may side with the labour section and clamour for legislation of such a character as would sweep away the remaining vestiges of individual liberty. Even if the Commission is to do nothing more than elicit information upon the various industries of the country, this can only be done efficiently by the inclusion of representatives of all the leading industries, and not merely of a few of them. The engineering artisans, who make no clamour, who seldom strike, and who quietly and successfully attend to their own affairs, have been left unrepresented, while the railway men, dock labourers, and miners, who never cease to trouble with a grievance of some kind, are fully represented. And in the same way English and Scottish engineering capital is left out in the cold, as if it did not sustain one of the most important industries in the country. There is, for obvious reasons, no special hardship in this neglect; but there is a certain disadvantage in the omission. Nothing characterises the great engineering establishments of the country so much as their excellent organisation, and the demonstration of this fact before the Commission would perhaps go far to explain why it is that there are so few strikes and so little discontent in the mechanical engineering trades. High technical skill is essential in the leader of an engineering establishment, and generally inspires respect and loyalty on the part of the workmen. Highly skilled workmen, whose ordinary work involves the surmounting of continual difficulties, are usually easily managed. Their knowledge and experience cause them to be fairly reasonable in their demands. Revolts arising from defects in organisation are very few, and thus a large class in the whole category of strikes is almost obliterated. General panaceas by sanction of Royal Commissions or otherwise are ineffectual; but it seems worth while to point out that the high development of technical skill brings out qualities both in masters and in men that go far to solve by their merely spontaneous action the difficulties of the labour question.

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THE BRAKE QUESTION ON SOUTH AUSTRALIAN RAILWAYS.

In the early part of last year the Government of South Australia appointed a Railway Brakes Board, consisting of the following gentlemen—viz., Mr. L. Grayson, M.P. (chairman), Mr. Thomas Roberts, locomotive engineer South Australian Railways, Mr. J. Quan, manager Glenelg Railways, Mr. Allison D. Smith, acting locomotive engineer Victorian Railways, and Mr. D. H. Neale, New South Wales Railways. The Board was appointed to inquire into the respective merits of the Westinghouse, vacuum, and other brakes. The report of the Board has now been published, and will form an interesting document to engineers and railway officials.

The Board conclude their report by recommending the adoption of the Westinghouse quick-acting automatic brake as the standard brake for the colony, or any other that may afterwards be proved to be superior that will couple with it. The result of the invitation made by the Board was that four brake companies declared their intention to compete. Three of them, however, withdrew, leaving only the Westinghouse Brake Company in the field. The Board decided notwithstanding to go through with their programme, and put this company's brake to practical tests. These tests took place on the 9th, 10th, and 11th October, 1890, between Petersburg and Jamestown. In framing the trial tests the Board kept in view the necessity of making experiments under the severest conditions that a rapidly growing traffic would be likely to bring into operation, and endeavoured to conduct the trials so that they should fulfil the following essential conditions:—(1) The behaviour of the brake should, as far as possible, be tested under all the various conditions likely to arise in ordinary practice; (2) the brake should be tested so as to show its merits and defects under both ordinary and unfavourable circumstances; (3) the results obtained at the trials should be accurate, and checked by an electrical automatic indicator and by independent observations. The Board also specially directed its attention to the following points in regard to the Westinghouse brake:—(*a*) Complexity, especially of the triple valve, and consequent liability to become injured by dust and grit; (*b*) graduating power; (*c*) liability to become exhausted by repeated application; (*d*) time taken to release; (*e*) frequency of burst hose pipe; (*f*) liability of pump to fail. On the points (*b*), (*c*), and (*d*) the brake was subjected to the most severe tests.

Repeated trials proved that a train heavy enough to require three engines on an ascending gradient could be safely taken down the steepest gradient (1 in 61) by one engine, the brake-power being entirely under the control of the driver, who could regulate the speed and stop when required. The liability to become exhausted by repeated application was tried both by running down inclines and repeatedly applying the brake, and also by applying the brake at intervals of thirty seconds when the train was standing in a siding. In the former tests the pressure at the foot of the incline was invariably higher than at the summit, showing that the brake gained rather than lost in potential power. In the latter test the pressure in the train-pipe fell 5lb. in six minutes, and, on making a stop with the diminished pressure, the train was stopped in 570ft. when running down an incline of 1 in 80 at 34½ miles per hour, showing an ample reserve of power. The release was quickly effected, the brake-blocks coming off all the wheels and the train starting from a state of rest in three seconds after the driver moved his handle to the release position. The stopping power in an emergency on the longest trains at maximum speed, as shown by several tests, proved that the train could be stopped in less than one-fourth the distance on the level with continuous as against hand brakes. The figures being for Trials 20 and 21 on the level, the continuous brake stopped the train in 377ft. from 34·5 miles per hour, whilst the hand brakes required 1,683ft. to bring it to rest from 32 miles per hour. The equivalent distance in which a similar train could be stopped when travelling at 40 miles per hour down a gradient of 1 in 60 would be 634ft. for the continuous brake and 11,592ft. for the hand brakes. The times, distances, pressures, and speeds were taken by an automatic recording apparatus, which, by means of several Richards indicators, drew diagrams of the pressures and speeds on an endless paper band driven from an unbraked axle of the rear van.

The Board regrets that the quick-acting automatic vacuum brake was not brought forward for trial, and that therefore its performance could not be judged from actual observation. The agent for the Vacuum Brake Company appeared before the Board after the brake trials at Petersburg, and handed in a report of a trial of their quick-acting brake which took place on the Manchester, Sheffield, and Lincolnshire Railway on July 21st, 1889. The trials, the Board states, appear to have been of a somewhat informal character, and the results given are too meagre to enable the Board to form any definite opinion as to the suitability of this brake for use on the South Australian railways. Two members of the Board, whilst signing the report, dissent to certain portions of it. Mr. Roberts, whilst favouring, for the 5ft. 3in. gauge, the adoption of the Westinghouse automatic quick-acting brake, which is almost exclusively used in the United States, recommends that communication be opened with the railway authorities of Queensland, and, if considered desirable, with Western Australia, with a view to adopting a uniform brake for the 3ft. 6in. gauge lines. These colonies have adopted the automatic vacuum brake, so far as they have fitted continuous brakes, which is not to a great extent. To this inquiry the Premier of Queensland telegraphed the reply that "some engines and carriages are fitted with automatic vacuum brake, but are not thought suitable for working long mixed trains, Westinghouse being considered better adapted. A few vehicles are about to be fitted therewith for sake of comparison, but no competitive trials are proposed between the rival companies."

THE INFLAMMABLE LIQUIDS BILL.

The announcement made by the Home Secretary in Parliament on Monday, that "The Inflammable Liquids Bill," to which we alluded in our issue of the 20th ult., would be withdrawn, is only what was to be expected when we take into account the opposition which the measure has aroused in Parliament and throughout the country. More than fifty members of the House of Commons, representing all political parties, were pledged to move its rejection, and if they failed in that, and the Bill reached its Committee stage, there seemed to be a prospect of amendments being proposed for every clause. We observed in our previous notice of the Bill that many of its provisions were very drastic, and that the country shopkeepers and the mineral oil manufacturers were up in arms against it. It may be the case that our present regulations are defective in some points of importance, and fall short of those of other countries, but at the same time it is possible, by a sudden change, to cause great hardships and inconvenience. The opponents of the Bill admit that some further legislation is necessary, but they contend that the provisions of the Bill are needlessly stringent and complicated, and, if passed into law, would cause great damage to an important and increasing industry, without ensuring any corresponding advantage to the public. The chief points insisted upon by the Home Secretary and his advisers are the absence of regulations at present for controlling the storage or conveyance of mineral oil, and of powers of universal application for securing the safe keeping of inflammable liquids, the defective character of the regulations for the conveyance of these liquids, and, lastly, of defective provision as to control by the local authority. In defence of the proposals contained in the Bill the Home Secretary has issued a Parliamentary paper of about 120 pages, in which he reviews the past history of legislation on the subject, and explains the grounds on which he has brought forward the Bill. This paper will be of great value in educating public opinion on the subject, and we trust that it will form a basis of agreement among those interested in the matter, and that another Bill will soon be introduced, which will sufficiently protect the interests of the public without hampering trade and industry.

THE SHIPPING FEDERATION AND INSURANCE FOR SEAMEN.

A scheme for the insurance of seamen has lately been organised by the Shipping Federation in order to bring about more satisfactory relations between employers and employed. It was felt that the Employers' Liability Act could be applied with difficulty to the shipping trade, and a definite scheme has now been formulated as the result of a discussion by the more important branches of the Federation. Every seaman or fireman who takes out a Federation ticket—for which a shilling is charged by way of registration fee—will, by reason of his possession of that ticket, and without any further payment, effect thereby an insurance of £25 in case he should be killed or lost at sea while serving on a Federation ship. In the case of captains the insurance—on the same conditions—will be £100, first engineers £100, other engineers £50, and mates £50. In the event of a Federation ship being lost at sea with all hands, insurance money to the amount stated would be paid to the legal representative of every man on board. The ticket itself, duly stamped, will be the insurance policy, and on it, probably, the holder will write to whom this money shall be paid, a duplicate ticket being kept at the shipping office in case of need. If any seaman or officer should wish to be insured for a larger sum this can be arranged by the Federation; but he would be required to pay for any insurance over the £25, which—but for the ordinary registration fee of a shilling—will be given gratuitously. The funds of the Federation are to be held responsible for the payment of the insurance money, and the Federation hopes to secure the services of a better class of men, and to obtain other advantages, from the fact that on taking out a "Federation ticket" the holders would be pledged to work both with union and with non-union men. The Federation would, moreover, obtain some security for the efficient discharge of duty on the part of the seamen, by the fact that they would lose all benefit from the scheme if they should be dismissed for any good reason. The exact details of the scheme are now being fully worked out by a committee of representatives of important shipping associations. In a correspondence published in the *Times*, between Mr. Chamberlain and Mr. Martin, one of the members representing the Clyde district of the North of England Association, the former suggested that the proposed provision is not sufficient, but should include a superannuation or annuity after a certain age. Mr. Chamberlain pointed out that a plan of this sort has already been tried by the Great Eastern and other railway companies. Mr. Martin, in reply, points out that the nature of the service differs from that on railways. "A man may enter the employment of a railway company and work in its service for a lifetime, having his share of the annuity fund regularly deducted from his wages, whereas sailors are a floating population, seldom serving twice on board the same vessel, or for any length of time in the employment of the same shipowner." A suggestion has been made that the insurance of £25 should be so arranged as to include sick pay in case of disablement, but no definite decision on this point has been arrived at. Mr. Martin states that the Shipping Federation has an anxious desire to establish good relationships with its men, and no effort will be spared to establish a broad and liberal assurance scheme for the benefit of its employés.

COAL, IRON AND COGNATE INDUSTRIES.

Since our last review of these industries their general position has undergone a material change for the worse. Values in every branch have fallen, and it is generally recognised that iron manufacturers are now working at an absolute loss. In order to fully gauge the situation a brief retrospect is desirable. From December, 1888, to January, 1890, prices rose rapidly, wages being proportionately advanced. A reaction in values, however, occurred, to which no check has at present been experienced. Curiously enough, where no sliding scale was in operation, the organised forces of labour even during the reaction succeeded in obtaining higher rates of wages—two advances of 5 per cent. each being conceded to colliers and ironstone miners in March and August of last year. At the highest point pig iron was sold at 65s. to 72s. 6d. per ton; bar iron was worth £9 per ton, the value of these commodities affording a fair index to the general trade. In comparison, their present prices stand at 40s. to 45s. and £6 per ton respectively. The published balances of public companies connected with these industries showed that 1890 proved a fairly prosperous time for proprietors, the first half of that year reaping the full benefit of contracts entered at the highest rates. The present position is that, while prices all round have fallen to the extent already indicated, the cost of labour remains practically at the highest point. There appears little, if any, immediate prospect of a higher level of prices, and several works have been brought to a standstill through the anomalous relation of costs and selling values. The eventual outcome is inevitable; the cost of the raw materal must be reduced, and this can only be effected by a reduction in wages. The Board of Trade returns for March and the first quarter of the year clearly indicate the serious state of our export trade, and the quarterly meetings recently held are equally conclusive of the falling off in the home demand in connection with the industries under review. The question as to why this anomalous position is allowed to exist presents a curious social phenomenon. On the one hand, labour organisation has attained a high state of perfection, and Parliamentary sympathy with the working classes is very strong, while on the other hand combinations of capitalists and manufacturers are comparatively weak, and competition so keen, that in any struggle between the two forces the chance of victory is in favour of the former. The result is that with the exception of a few recent strikes, which have been fought at enormous cost, matters are being permitted to take their own course, the weakest firms are going to the wall, at nearly all works short time is adopted, and the trade of the coun-

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try is becoming paralysed. At the present time the relative position of value and cost is worse than at the lowest state of the previous trade depression, and therefore we may regard the position as somewhat alarming.

The maintenance of high prices for coal for shipment has exercised a large influence in keeping wages up, but bearing in mind the enormous quantity of fuel raised in inland centres and utilised in the production of iron and steel, we feel convinced that a proportionate adjustment of the cost of labour to selling values of the finished product will shortly become a necessity.

THE BOILER INSPECTION AND REGISTRATION BILL.

On the 21st inst. an endeavour will be made to pass the second reading of a Bill for the Registration and Inspection of Boilers. This Bill has been introduced to the House by Sir William Houldsworth, Mr. Maclean, Mr. William Mather, and Mr. Burt. It is understood to have been prepared by the Steam Users' Association of Manchester, but from its character we should not assume that it has the approval of the members of that body, but merely that of its officials and committee. In fact, there is little doubt that if the majority of the members of that Association were fully alive to what is being done under their name they would object to the present Bill as a whole. Last year a Bill having the same support was introduced by Sir William Houldsworth, but, as it was pretty clear that its main object was simply an attack upon existing boiler insurance companies, it has been allowed to drop to make room for the present Bill.

Before any legislation is effected, it would be well to carefully inquire what is the necessity for a Bill of this kind, and what is the extent and importance of the support given to the suggested legislation. It appears from the returns of the Board of Trade that accidents to persons from explosions occurring to boilers, kiers, steam pipes, &c., have for the last few years been reduced to an annual average of about thirty-two killed and fifty-seven injured. Of these it appears, from an examination of the Board of Trade reports upon the causes of boiler explosions, that about one-third are due to what may be called non-preventable explosions, which no system of inspection could have averted. When the enormous extent of steam generating operations in this kingdom are considered, this death-rate is not alarming when compared with the number of accidents which occur in many branches of industry not nearly so extensive in their character. For instance, it would appear from the return of railway accidents that, for the year ending 31st December, 1889, there were (after deducting eighty-four suicides) no less than 992 persons killed and 4,386 injured. There were also, during the twelve months ending October 31st, 1889, no less than 443 persons killed and 7,524 injured in the various factories and workshops in the Kingdom. In various collieries and mines during 1890 there were 1,206 killed, exclusive of a large number injured. From private but reliable statistics, to which we are able to refer, it appears that among an average of 266,302 persons employed during each of the past ten years in workshops of various kinds, a total of 302 have been killed and 11,913 have been injured. Of these only three were killed and six injured from any accident arising from steam generators during the whole ten years, or one person killed per annum in every 887,000 persons employed. It would appear, therefore, from these figures that, with a view to reducing loss of life and injury to workpeople and other persons, further legislation is more urgently required in regard to the working of railways, collieries, mines, workshops, factories, &c., than with regard to the use of steam.

With regard to the extent and nature of the support given to the proposed boiler legislation, it would be found that it is of a comparatively unimportant character, and centralised in the officials and committee of the Steam Users' Association. There has been no decided public call for action in this direction. With trifling exceptions, no notice has been taken of the matter by the press of the country. The majority of the Chambers of Commerce which have considered the matter have pronounced against any further Government interference at present with the steam using public, notably the Oldham Chamber of Commerce, which has expressed its opinion, not only on the present Bill, but on former Bills, in unmistakable terms. In short, the Bill is suggestive of an attempt to extend the business of the boiler inspecting associations at the expense of the public by means of Parliamentary interference. If such a Bill were passed there would naturally be a very large number of boilers to be inspected, and as the matter would require immediate attention existing associations would be likely to obtain the business.

The Boiler Explosions Act of 1882 has only been completely put in force since August, 1889, and already the number of explosions has fallen to a large extent. A few years' further trial of the present Boiler Explosions Act, properly enforced, will probably effect all the improvement that is conveniently possible in this direction, and it is therefore undesirable that further legislation should impose unnecessary restriction upon the boiler owner or steam user either in regard to the design or working of steam boilers.

We are behind no one in demanding that public safety should receive all the aid that legislation can give, but we object altogether to vexatious and unnecessary measures which tend to harass industry. In short, the position we take up on this question is that expressed a short time ago by Sir Michael Hicks-Beach—namely, "that a continuance of the policy of Formal Investigations may render further legislation practically unnecessary. . . . At any rate, it was a policy which should be persevered in, and its results ascertained, before any further legislation was attempted. . . . Publicity and penalties would do more good than anything Parliament could do."

We have nothing to say against the registration part of the Bill, as it is possible that the returns obtained would be useful for statistical purposes.

Letters to the Editor.

THE USE AND ABUSE OF MATHEMATICS.

To the Editor of "Industries."

Sir,—When first I read "Electrician's" letter on this subject it seemed to me to have been written in a fit of splenetic humour, and to contain nothing more than a cynical depreciation of man in general, and the "college man" in particular. As, however, universal disparagement is a sure sign of mediocrity in its author, and as "Electrician" is evidently a man who combines in himself the qualities of the true theorist and practical man, it might be worth consideration whether there is not some foundation for the writer's criticism on mathematics and mathematicians. It might further be advisable to consider what practical steps can be taken to ensure that mathematicians shall be more in touch with the actual work and needs of engineers, and not merely concerned with investigations on such problems as deal with "an elephant without weight spinning on the point of a needle," &c.

In the first place, mathematics in its most developed branches is largely an inductive science, and its extension depends on habits of accurate observation and comparison; in short, the study of mathematics may be said to exercise all the faculties of the scientific mind. That such views as these of the nature of mathematical study are held by Sylvester and Cayley, and Henrici, and other eminent mathematicians, and may be found in their presidential addresses to Section A of the British Association, is a proof that the study is something more than "concentrated deductive reasoning about quantity," and is in reality "a very high intellectual exercise."

After some questioning of the superiority of Cambridge mathematicians, the writer hopes that "some one may write a book on practical mathematics which contains just those subjects which are necessary for engineers." Now, apart from the fact that "the useful is only a small part of the important," as Goethe somewhere remarks, I venture to think that the attempt to write such a book would only end in failure. Nature, as shown, for instance, in the working of a dynamo, is not simple, but highly complex, and as mathematics should be the symbolical representation of laws of nature, it follows that the practical mathematics recommended by "Electrician" would also be highly complex, and could not be entirely apprehended without a study of much that seems unpractical. In short, Euclid's remark that "there is no royal road to learning" remains as true now as it was two thousand years ago. As to the importance of graphical solutions of problems, the Cambridge man would probably agree with "Electrician."

It is, however, to the intended establishment of an engineering school at Cambridge, as advocated by Professor Stuart and by Professor Ewing, that we must look for help towards making mathematics more practical. This measure will have an important effect in various and, perhaps, unexpected directions. Intellectual activity is not incompatible with mechanical expertness—nay, it may possibly be assisted by it. The study of nature in her actual working is essential to the advancement of applied science, and will, perhaps, teach the "college man" that modesty, of which "Electrician" is so anxious to see him possessed, by showing him how difficult it is to find complete mathematical explanation of all the facts observed. The mathematician must become an engineer, and the engineer must become a mathematician.

Yours, &c.,
Ne Sutor Supra Crepidam.

London, 9th April, 1891.

To the Editor of "Industries."

Sir,—The letter from "Electrician," which appears in your issue of the 3rd inst., on the subject of "The Use and Abuse of Mathematics," sets forth a very sensible view of a subject which is of great importance to engineers, but if he had been, as I have been, a constant reader of your journal, he would have seen that the opinions he expresses agree with those which have appeared in the leading and educational articles which have appeared in *Industries* from the very first. You have always insisted on a combination of theoretical and practical knowledge, not only for the engineer, but also for the physicist and mathematician.

I believe that at the social meetings of a certain society in London the toast "Success to pure mathematics, and may it never have any application," is very often proposed amidst great enthusiasm, and I must say that to a certain extent I sympathise with the sentiment, which in this case may be carried to an extreme, but which generally means that knowledge should be sought for its own sake, and not for the pecuniary gains or practical applications which are likely to result. Some of the most valuable discoveries in the leading departments of industry have flowed either directly or indirectly from the researches of men who never allowed pecuniary or practical considerations to influence them in the smallest degree. The name of Faraday, for instance, only requires to be mentioned as an example of a man who had no time to make money, and who had no desire to be rich, and yet he laid the foundations of the modern science of electricity with its ever-increasing applications. He was almost entirely ignorant of mathematics, but he wrote and spoke in mathematical language, and, in fact, taught the mathematicians how to interpret their own expressions, and to clothe with living meaning the abstract formulæ which they had ground out of their mills by a mere mechanical process. But it cannot be doubted that even Faraday would have been a great deal the better for at least a certain amount of practical as well as mathematical training. It is well known that the most important developments in the theory of electricity have been the direct results of investigations made in connection with practical applications.

We cannot expect a scientific man, who devotes the greater part of his time to theoretical investigations, to keep himself acquainted with all the developments of practice, nor can we expect a practical man largely absorbed in business to know all about the latest theoretical investigations relating to his department, but each should try to keep up in the main lines of development. For the practical engineer there can be no doubt that Professor Kennedy was right when he said some years ago that he had "no hesitation in saying that a man's knowledge of mathematics ends exactly where his ability to work problems ends; anything beyond that is useless, so far as his profession goes, and is even liable to have, in certain cases, disastrous consequences."

Professor Osborne Reynolds, at a somewhat later date, put the matter very clearly when he said, "All the more useful branches of science are now within the reach of the student of engineering, and in the forms most suitable for him. So that as a step towards understanding the theory of machines, it is not now necessary for him to begin with the theory of astronomy or the doctrine of chances. The miserable form in which the only mathematics to be obtained was wrapped has compelled engineers to work out methods for themselves, and now that the demand for such knowledge has increased, we find that the first mathematicians in the land have, so to speak, patronised our system. And as is natural, the extension of the practical use of mathematics has infused new life into their study. Learnt as it now may be, with a special view to the application of practical mechanics, a knowledge of mathematics and science is much more useful than it was. But this is by no means all. This would not be much were it not that the accumulated experience of engineering work has to a great extent been systematised and reduced to a form capable of mathematical treatment."

These opinions express the proper use to be made of mathematics, and also indicate how the study of the subject has been abused by those who were engaged in it, and who underrated the importance of all others.

Yours, &c.,
Teacher.

Glasgow, 8th April, 1891.

THE ENGLISH ULTRAMARINE INDUSTRY.

To the Editor of "Industries."

Sir,—In your annual review of the Chemical Industry for 1890, in your issue of January 9th last, you recommended that attention should be given to the manufacture of ultramarine in this country. There is no doubt that this view of the English industry—at a time when all the German ultramarine manufacturers have formed a "ring," and are endeavouring to cultivate trade in all parts of the world—is a correct one, and in accordance with the spirit of the times. Why should England, who, as I show below, imports and consumes nearly half of the whole of the German production of ultramarine, not endeavour to supply its own wants and thus become independent of Germany? The necessary raw materials, such as china clay, sulphur, soda ash, and rosin, may all be obtained in England cheaper than in Germany, and the difference in wages paid in the two countries is not of importance. The belief that the English climate is not suitable for the manufacture of ultramarine is altogether a wrong one.

The following table gives the total exports of ultramarine from Germany in the years 1889 and 1890, and also shows the quantity imported into England from Germany:—

	1889.		1890.
German exports of ultramarine	5,283 tons.	...	5,258 tons.
Quantity exported from Germany to England.....	2,005 ,,	...	2,076 ,,

To this amount is to be added the imports from Austria, France, and Belgium, which are not altogether insignificant. Taking the price of ultramarine at £25 per ton, England pays annually to Germany about £51,900

I conclude this short letter with the hope that English chemical manufacturers will consider it to their advantage to give greater attention to the manufacture of ultramarine in this country.

Yours, &c.,
Ultramarine.

Hull, 9th April, 1891.

THE SHIPS AND ENGINES OF THE NAVY.

To the Editor of "Industries."

Sir,—I hope the suggestion made by a correspondent in your issue of the 3rd inst., regarding the information which might be supplied by the Admiralty about the ships and engines of the navy, will be taken up by some energetic M.P. who is able to take an intelligent interest in the matter, as I have long felt that engineers and shipbuilders might thus receive a great deal of information which would be most valuable to them. Lord Randolph Churchill has evidently been primed by someone regarding the necessity for the report mentioned by you a short time since, but your

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"GUTTMANN'S" NITRIC ACID PLANT.

CONDENSATION RESULTS.

Each charge consists of 12 cwt. undried nitrate and 13 cwt. of sulphuric acid. The tower acid is not taken into consideration. All other acid runs into a general collecting vessel.	Analysis of					Used.				Result.								
	Nitrate of Soda.				H_2SO_4.	Nitrate of Soda.		Sulphuric Acid.		Cwt. Strong Acid.	Analysis.				Net Result.		Theoretical Yield, HNO_3. Cwt.	Loss of HNO_3.	
													N_2O_4.		HNO_3.				
	H_2O. %	NaCl. %	$NaNO_3$. %	$NaNO_3$ available. %	%	Cwt. Gross.	Cwt. $NaNO_3$ available.	Cwt. Gross.	Cwt. H_2SO_4.		Sp. Gr.	Total Acidity as HNO_3. %	%	Equivalent to HNO_3. %	%	Cwt.		Cwt.	%
Best charge made hitherto	2·480	0·590	95·670	94·814	94·98	12·00	11·350	13·00	12·377	8·563	1·517	96·52	1·88	1·27	95·25	8·156	8·412	0·256	3·04
Good average charge	3·080	0·515	94·838	94·091	96·38	12·00	11·291	13·00	12·530	8·206	1·515	95·87	2·11	1·45	94·42	7·748	8·368	0·620	7·40
Charge made without using Lunge's plate tower	2·912	0·538	95·938	95·158	95·70	12·00	11·419	13·00	12·441	8·054	1·525	95·11	3·77	2·57	92·54	7·453	8·464	1·011	11·95

correspondent in his letter indicates many other points which might be attended to with great advantage. For some years past I have been particularly interested in one department on which I find it impossible to obtain any definite information—I mean, the friction of the mechanism of marine engines. We have gone on improving the methods of using the steam in the cylinders and measuring the indicated horse-power, but we know little or nothing about the relation of that to the brake horse-power, or to what is generally called the effective horse-power in the case of a marine engine. Froude's figures, which he gave a good many years ago, were largely hypothetical, and, moreover, the types of engines and ships have been entirely changed. The only systematic experiments the results of which have been published are those by Taurines. These were made nearly thirty years ago, but it is only seven years since they were awarded a prize by the Academy of Sciences, which looked very much like an afterthought, possibly owing to the growing interest in the subject. They were thereafter printed and published by Gauthier-Villars, of Paris, and are very interesting in their way, but they are altogether out of date, both ships and engines having been revolutionised in the interval. The experiments were carried out at the expense of the French Government, and I am afraid, unless the British Government takes up the matter, it is too much to expect any private persons, or even any engineering association, to do so. What your correspondent says about life on board a man-of-war is quite true—there is not very much of an intellectual nature about it, and work of the kind suggested might be the means of attracting to the service and keeping them in it men who were not only good practical engineers, but who were also imbued with the true scientific spirit.

Yours, &c.,
London, 9th April, 1891. ANOTHER M.I.N.A.

"GUTTMANN'S" NITRIC ACID PLANT.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Since the publication of your description of this plant in *Industries* of the 5th September, 1890, a twin battery of nitric acid condensers has been erected, and been in nearly constant work for more than two months. The working of these batteries has been purposely left entirely in the hands of the foreman and his workmen, in order to see how soon they would become accustomed to the altered method of working. It was found that on the second day the work went on without a hitch.

The above table summarises the results obtained.

At the dynamite factory where these results were obtained it is most important that the acid should have a maximum of monohydrate, whilst 1 to 2 per cent., more or less, of hyponitric acid is of no importance, so that no precautions have been taken to keep the percentage of this down to a minimum. At the same time it is essential that the battery should exclusively condense acid of the highest concentration, and weak acid should only be produced in the tower.

The average loss of 7 per cent. is composed of—(*a*) the acid remaining in the nitre cake; (*b*) the hyponitric acid formed; (*c*) the acid from the tower; (*d*) the small remainder which escapes into the chimney.

The tower acid has no value at the factory above mentioned, and it is therefore not collected, but in factories where weak acid (of between 1·300 to 1·400 sp. gr.) can be sold, nearly the whole of the quantity shown under "loss" can be recovered, since the Lunge tower only allows traces of gases to escape uncondensed. It depends, of course, upon the attention of the workmen how large the loss is, and, with greater care in working, the average mentioned here will be found to be much too high.

The influence of the Lunge tower upon the yield was forcibly shown, when, in consequence of an exceptional frost, the water pipe leading to the tower burst, and could not be repaired for some time. Of course, the draught on the battery became, in consequence, much larger, and it was, in spite of every precaution, impossible to heat so slowly as to prevent part of the gases from escaping uncondensed into the chimney. Under these adverse conditions, only 4½ per cent. more than usual was lost, and the amount of hyponitric acid present rose but slightly.

The time for the distillation has now been reduced to ten to eleven hours for a charge of 12 cwt. The pottery material used by the manufacturer of this plant (Mr. Ludwig Rohrmann, of Krauschwitz, near Muskau) permits the tubes to be made with a thickness of $\frac{3}{8}$in. (9mm.) only, in spite of their great length of 8ft. 4in. (2·50m.). The battery has, in consequence of these very thin tubes, a largely increased condensing power. It is also evident from the experience gained that these tubes withstand high temperatures much better than those of the ordinary thickness; on some occasions the fire was by accident continued so long that only sulphuric acid condensed in the batteries, and the charge was finished in nine hours or less. Such a short duration is not desirable, on account of the large wear it entails upon the retorts, and the distillation is now simply regulated by leaving the last tube cold and the last but one warm. In this case a minimum of gases escape into the tower, and the time of distillation is, as before mentioned, ten to eleven hours.

The joints behave in a very satisfactory manner, and, as they are all either vertical or at an inclination of 45 degrees, there is no dripping. The battery is so mounted that the long tubes can expand quite freely.

The acid obtained on different days has been repeatedly analysed by Messrs. Bate and Sandford, and has always proved to be free from chlorine, iodine, sulphates, &c. The residue calcined after careful evaporation was always $\frac{30}{100000}$ per cent., consisting of $\frac{2}{100000}$ per cent. PbO and $\frac{28}{100000}$ per cent. Fe_2O_3. The excellent quality of the acid may be seen from the fact that, after having removed the hyponitric acid, this acid is used with very good results as chemically pure nitric acid in the laboratory.

Yours, &c.,
OSCAR GUTTMANN.

Dunster House, Mark Lane, London, E.C.,
9th April, 1891.

THE LATE MR. BENJAMIN WALKER.

WE regret to record the death of Mr. Benjamin Walker. Mr. Walker died on Tuesday, the 14th inst., in his 71st year. He was a member of the Institution of Civil Engineers, a member of the Council of the Institution of Mechanical Engineers, and of the Iron and Steel Institute. In 1862 he started an engineering works in Leeds, which has since become one of the largest establishments of the kind in the world, and became the head of the firm well known as Messrs. Tannett, Walker, & Co. His earliest training as an engineer was undergone in Leeds, and at the age of twenty he was foreman to Messrs. Kitson, Hewitson, & Thompson, of Leeds, who were among the very earliest builders of locomotives. Subsequently he was engaged to start the works at Belfast now known as Messrs. Combe, Barbour, & Combe's. His career as an inventor began by his bringing out a self-acting motion for steam hammers and the wrought-iron wheel now universally used for traction engines, instead of the old-fashioned wooden wheel with a metal tyre. The slotting machine was also patented by him. Mr. Walker, at a very early period, became associated with the Bessemer process. In 1863 he proposed to a Sheffield firm of steel producers the use of a forging press instead of the steam hammer, but nothing came of the suggestion until a few years ago, when some more potent means of dealing with great masses of steel were necessary than those which had heretofore been used. The use of such forging presses has made the work of manipulation now comparatively easy. These presses have been made by the late Mr. Walker's firm for all the European Governments, and are employed in forging guns and doing other heavy work in several arsenals.

Legal Proceedings.

TUCKER *v.* KAYE.

IN our issue of the 27th ult. we reported this case, and in doing so remarked that the learned Judge—Mr. Justice Romer—who tried it had apparently taken a severe view of the patent, inasmuch as he decided against the plaintiff upon the double ground that the patent was invalid and the alleged infringement unproved, although the latter ground alone would have been sufficient to support the decision, and appeared to be, as we then observed, unassailably strong. The case has now been considered by the Court of Appeal, the plaintiff having decided to carry his complaint before that tribunal. He was represented, as in the Court below, by Mr. Bousfield, Q.C., and Mr. Reid; Mr. Aston, Q.C., Mr. H. Greenwood, and Mr. Waugh appearing for the respondent.

The decision at which the Court of Appeal has arrived confirms quite curiously in detail the view which we at the time expressed. We then remarked that the strong view taken by the Judge, which led him to pronounce, without any pressing need to do so upon the validity of the patent, was, in comparison with the practice of his judicial brethren, somewhat unusual. The Court of Appeal appear to have taken the same view, for, although the respondents were not called upon to answer the arguments of the appellant's counsel. Lord Justice Lindley, in giving judgment in their favour, expressed a guarded opinion upon the question of the validity of the patent, and said that he preferred to base his judgment upon the ground of non-infringement. Lord Justice Bowen concurred in this judgment, so that, although Lord Justice Kay expressed an opinion that the other grounds on which the action had been resisted were equally well founded—that is to say, that the patent sued upon was invalid for want of novelty, and particularly by reason of Wilson's anticipation of its principle—it is nevertheless clear that the weight of judicial authority is in favour of that tender treatment of patent rights of which we spoke as characteristic of our present jurisprudence. This favourable inclination towards an inventor is, we think, the right attitude of mind for the judicature to assume in such matters. The risks of patenting are serious enough as matters stand. The patent law would ill serve the public interest if it were administered in a hostile temper towards the rights which it creates, and, although it is of prime importance that patentees should not be put in a position to harass their neighbours with groundless or vexatious charges of infringement, it is a matter of importance only second, if second, to this that the patentee's rights, when acquired, should be both substantial and secure.

THE SKILLED LABOUR MARKET.

ACCORDING to the returns sent in to the Board of Trade by twenty-two unions of skilled workmen, with an aggregate membership of 245,772, 7,000 men, or 2·8 per cent., were out of work in the month of March, as compared with 6,149, or 2·6 per cent., in the preceding month. In March of last year the percentage of unemployed was 1·7. The number of strikes in February was 116, whilst in March there were only 53, of which 17 occurred in the cotton trade and 8 in the coal trade. The demand for skilled labour is generally less strong, but the building trade shows an improvement as compared with a year ago. The shipbuilding trade also continues firm, which must be accounted for by the large amount of repairing and converting work now being carried out. The reduced amount of new shipping would otherwise have caused a falling off. The engineering trades remain fairly steady, and the proportion of men out of work has only slightly increased. In the general iron trade more men are out of work than there were a few months ago.

Books Received.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Parts III., IV., and V. Vol. VII.

Hilfsbuch für die Elektrotechnik bearbeitet und herausgegeben. Von C. GRAWINKEL und DR. K. STRECKER. Berlin: Julius Springer.

The Reports of the Visit of the Tenant-Farmer Delegates to Canada in 1890. Part IV.

The Forth Bridge and other New Works, as they Affect Employment, Wages, and Trade. Reprint of a Paper read before the Newry Church of Ireland Young Men's Society by HENRY BARCROFT.

Jahresbericht der Technischen Staatslehranstalten zir Chemnitz, Ostern, 1891.

Proceedings of the Society of Architects. Vol. III. No. 9.

Le Chemin de Fer de Fiège à Zermatt. Par M. J. MEYER. Paris: Vve. Ch. Dunod.

Traité Elémentaire d'Electricité. Par J. JOUBERT. Deuxième Edition. Paris: G. Masson.

American Journal of Mathematics. Vol. XIII. No. 3.

Proceedings of the Société des Ingénieurs Civils. Feb., 1891.

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An Introduction to Dynamics, including Kinematics, Kinetics, and Statics. By CHAS. V. BURTON, D.Sc. London: Longmans, Green, & Co.

Modern Changes in the Mobility of Labour. A Report to the Toynbee Trustees. By H. LLEWELLYN SMITH. London: Henry Frowde.

The Metal Worker's Handy-Book of Receipts and Processes. Edited from various sources by WM. T. BRAUNT. London: Sampson Low, Marston, Searle, & Rivington, Limited.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Proceedings, February 24th, 1891.

The Journal of the Franklin Institute. March and April, 1891.

American Chemical Journal. Vol. XIII. No. 13.

Leçons sur L'Electricité. Par ERIC GERARD. Tome I. et II. Paris: Gauthier-Villars et Fils.

Les Chemins de Fer de Grande Altitude des Andes sur la Côte du Pacifique. Paper read by M. CHARLES LEGRAND before the Belgian Society of Engineers.

Reviews.

ELECTRIC LIGHT INSTALLATIONS. By Sir David Salomons. London: WHITTAKER & Co. 1891.

This is the sixth edition, and is very much the same as the fifth. There is an additional chapter, and an introduction, which is a reprint of a magazine article. There are still many slips, and it would be wise for the author to have his proofs read before publishing, on the principle that two heads are better than one. The slips are not, however, generally important, and the book is full of practical points.

THE ELECTRICAL TRANSMISSION OF ENERGY. By Gisbert Kapp. London: WHITTAKER & Co. 1890.

This is the third edition of Mr. Kapp's well-known work. It would be difficult for anyone to guess the contents of a book with the present title; but most of the work is outside the limits of the subject proper. This is, however, no fault, and the book contains a great deal of valuable information about dynamo design and kindred matters. If such a thing could be done, we would suggest that when the next edition is called for, as we think it soon will be, Mr. Kapp should alter the title, and make it a book on dynamos and motors.

MAY'S POPULAR INSTRUCTOR FOR THE MANAGEMENT OF ELECTRIC LIGHTING PLANT. By Dr. Oscar May. Frankfort. 1891.

This is a little book containing succinct and clear instructions to the practical man who has to look after dynamos, secondary batteries, and private installations generally, and, if he absorbs all the information in this small work, and follows all the recommendations given in it, he will do very well. The translation from the German has been placed in the able hands of Mr. O. Berend, and the printing has been done in Germany. The "Electrician" Publishing Company are agents for England.

TREATISE ON CHEMISTRY. Vol. III. ORGANIC CHEMISTRY. Part III. By Roscoe and Schorlemmer. London: MACMILLAN & Co. 1891.

The authors of this well-known treatise are determined to keep their book well up to date. The present volume has been prepared by Dr. H. G. Colman, and consists of a revised edition of the old volume on "Aromatic Chemistry." It includes an admirable introduction to aromatic compounds, discussing the modern views of isomerism and the simple derivatives of benzene, including the recent researches of Nietzki and his assistants on the higher substitution products of this hydrocarbon.

VENTILATION, AIR TESTING, &c. By W. P. Buchan. London: CROSBY LOCKWOOD & SONS. 1891.

This little volume is one of considerable value and interest, and places before its readers, first, the various means by which the atmosphere may become contaminated in our dwellings. It then describes the older and more faulty systems of ventilation, and, finally, those now adopted in schools, workhouses, dwellings, and hospitals. Upon the whole, the author advocates natural in preference to mechanical systems of ventilation, but he is by no means biassed, and he places the good and bad points of each system fairly before his readers. It may be thought unfortunate that he has in several instances, perhaps unduly, praised apparatus of his own invention. In the section upon the ventilation of drains the system shown is of a much more elaborate character than is necessary, rendering it most complicated and expensive, although nothing can well be said against its efficiency. A chapter upon railway carriage ventilation, and another upon the methods of examining the air of buildings for impurities, will be read with considerable interest.

AIDS TO PRACTICAL GEOLOGY. By Grenville A. J. Cole, F.G.S. London: C. GRIFFIN & Co.

This book is intended by Professor Cole as a companion to the ordinary text-books of geology, and he hopes that it may be of special service to the student for determining the results of his excursions into the field. In our opinion, it will not only do this, but it will also be of the greatest possible use to travellers, to explorers, and to miners and prospectors in their search after ores and minerals. All theoretical matters are excluded, and the work is solely confined to the practical side of geology. The book is divided into four sections:—(1) The sampling of the earth's crust; (2) the examination of minerals; (3) the examination of rocks; and (4) the examination of fossils. The first part deals with field operations generally and the treatment of specimens; this section may fairly be said to bristle with useful "wrinkles." The examination of minerals with wet reagents, with the blowpipe, and by the other usual means is dealt with sufficiently fully to enable all the ordinarily occurring minerals to be identified. Micro-chemical reactions also take a prominent position. The examination of rocks is similarly dealt with. Directions are given for determining their physical properties and for isolating their constituents. A condensed list of minerals and of the several varieties of rocks are given in such a form that, for the purpose of the prospector, all other books might easily be dispensed with. The last section in the book is devoted to fossils, and here the author gives such a description of the hard parts of fossil invertebrates that the determination of most fossils is rendered practical as far as necessary for approximating to the age of the strata. The book is replete with practical hints, and contains an enormous amount of useful matter condensed within its pages, the whole being written in a thoroughly clear and scholarly manner, and elucidated by the aid of numerous well-drawn diagrams. A valuable feature is the addition of a short bibliography to each section.

PROPOSED NEW WATER SUPPLY FOR BIRMINGHAM.

IT has been determined by the Water Department Committee of the Birmingham City Council to apply for powers to carry out a very extensive new scheme of pure water supply from the Welsh mountains surrounding the upper basin of the Wye. The population of Birmingham has grown so fast, and its consumption of water is increasing so rapidly, that the Engineer of the Water Department, Mr. J. W. Gray, reports that the present sources will become inadequate to meet the demand in three or four years, even if they be developed to the fullest extent they are capable of. In 1876 the average consumption throughout the year was 8·30 millions of gallons per day; in 1881 it was 11·42; in 1886 it became 12·95, and went up to 14·28 in 1889. At present the maximum daily consumption goes up to very nearly 20 million gallons.

The present supply is from five watersheds, all situate in the comparatively flat and low-lying country to the east and north-east of the city. The total area of these is 111 square miles, and in this are built no less than thirteen reservoirs, with a total storage capacity of 618 million gallons. It is pumped up to a certain level, from which it flows by gravitation to the lower part of the city, and is thence pumped in two stages to the higher levels. An additional supply is obtained by pumping from seven deep wells in the New Red Sandstone. The minimum yield of these sources is 17½ million gallons per day, and as years go by the quality is sure to deteriorate, partly from being overworked and partly from the steady increase of population and farming industry spread over this district. So long ago as 1871 Sir Robert Rawlinson, who was consulted at that time by the Corporation, pointed out that these works could not be given a character such as to permanently supply the needs of Birmingham, and suggested the desirability of going west of the Severn Valley for a supply, the purity of which could be depended on as permanent, and the quantity of which might meet the demands for the next fifty years and more. The Corporation has now come to the conclusion that it would be wasteful expenditure to further bolster up the existing works, seeing that in all probability they will at no very distant future date have to be abandoned, either partially or wholly, at least so far as the supply to Birmingham itself is concerned.

The new gathering ground now selected has to its nearest point a distance of rather over eighty miles from Birmingham. It is the same as was recommended by Sir Robert Rawlinson in 1871. At that time Mr. J. Mansergh was Sir Robert's assistant in this investigation, and it is Mr. Mansergh who has now been consulted by the Corporation, and has recommended the present scheme. Bewdley lies about twenty miles west of Birmingham on the Severn. Almost exactly due west of Bewdley at fifty miles distance the river Elan joins the Wye in Radnorshire. At the junction the Elan flows nearly due east, and three miles above this junction with the Wye it is joined by the River Claerwen. These two drain an area available for Birmingham supply of 39,700 acres of almost uninhabited mountain-land (at present there are 180 persons living on it), the elevation of which varies from 800ft. to 2,100ft. above mean sea level. This height is sufficient to run the water by gravitation for eighty miles to the Monument Road Reservoir in Birmingham, the height of which is 532ft. above sea level, and from this service reservoir the water flows easily to nearly the whole of the city, the Aston reservoir, which is in the lowest part, being 235ft. lower. For the higher district of Edgbaston, the water is pumped from Monument Lane to a small covered service reservoir 70ft. higher. The quality of the water from the new district is the finest possible, containing less than 8 parts in 100,000 of total solids, only ·017 in 100,000 of organic nitrogen, the ammonia and sewage contamination being nil, and the hardness only 2·3 grains of bicarbonate of lime per gallon. Samples of the water have been tested by various experts, and it is found not to be injuriously affected by lead, so that no difficulty with the ordinary kind of service pipes will arise.

According to Rawlinson's plan, the highest reservoir to be constructed on this district would be 960ft. above O.D., and would store 540 million gallons; two others, at slightly lower levels, would store 1,160 millions; and yet two more would store 840 millions. These together give 2,540 million gallons. According to a rough estimate made by Mr. Mansergh, who is now asked to prepare a scheme for a larger supply than that contemplated in 1871, a site for a single large reservoir storing something like 4,000 million gallons exists in the valley of the Elan the dam being placed at a point 700ft. above O.D. This would be a compensation reservoir, and supply reservoirs would be constructed at various higher levels as the increasing demands of the city necessitated. The mean annual rainfall from a gauge near the lowest levels is 64in., this being taken from twenty years' observations. Mr. Mansergh puts the average at 66in. over the whole area, and calculates that at least 40in. could be collected. The 40in. over 39,700 acres gives an annual supply of 36,000 million gallons, or an average daily supply of 98·6 million gallons, from which has to be deducted a percentage for compensation, and a further percentage for evaporation and other waste. In 1890 the supply was 5,740 million gallons, and the rental about £133,000.

The present scheme is being laid out on the supposition that fifty years hence the needs of the city will have increased to 60 million gallons per day, the present rate of growth of the consumption being about 3 per cent. per annum. To finance the scheme it is calculated that the water rental, which is now £133,000, would by its natural growth be double this amount in the year 1913. An addition to the water rates is proposed which would make the water rental amount to £164,000 in 1892, and increase to just over £300,000 in 1913. A first rough estimate of the cost of carrying out the new scheme is given by Mr. Mansergh—viz., £4,000,000—and this expenditure would be spread over not less than ten years from 1892 to 1902. The proposed income would exceed the expenditure up to about 1898; from that time until about 1908 there would be a deficiency of income; and after that date there would be a rapidly increasing surplus of income. This calculation includes payment of interest on the expended capital and provision for the paying off of each portion of the debt thus created within sixty years of its being contracted.

The conduit is not yet designed in any detail, but throughout the higher parts of the line the water will flow in a masonry culvert of section sufficient for 60 million gallons per day. The length of this is estimated at about 44½ miles, of which 8¾ miles will be tunnel. Where the line descends into valleys and crosses rivers the water will be conveyed by steel pipes, and about 34½ miles of these will be necessary. There will be five such pipes, each 45in. in diameter, only two of which will be laid on the first construction of the works, the others being added as they become needed. At some point about half-way between the Elan and Birmingham, a reservoir of 100 million gallons capacity will be constructed. The chief rivers to be crossed on the route are the Wye, the Ithon, the Teme, the Severn, and the Stour. No opposition to the scheme has manifested itself, and the vote of the City Council to be taken on the 21st inst. is expected to be unanimous in its favour.

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NOTES ON THE DESIGN OF MULTI-POLAR DYNAMOS.

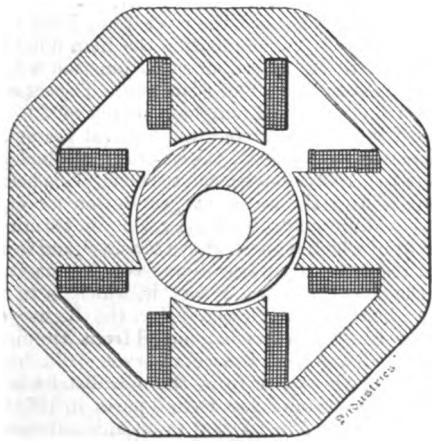


FIG. 1.

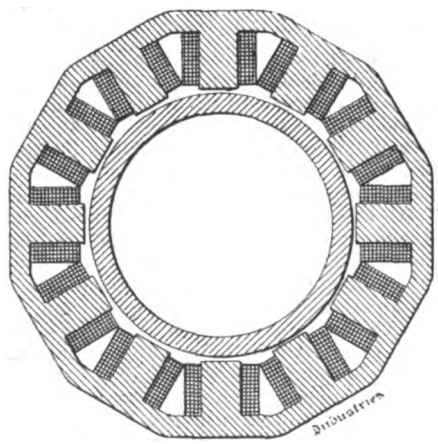


FIG. 2.

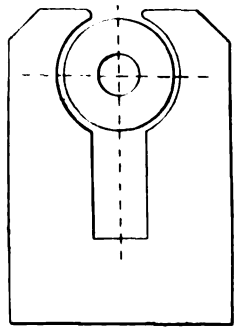


FIG. 3.

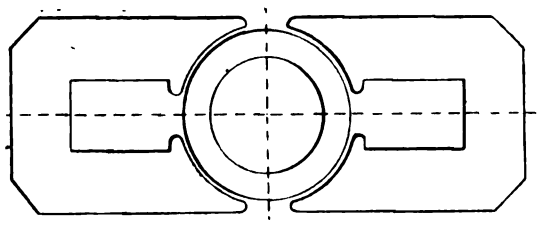


FIG. 4.

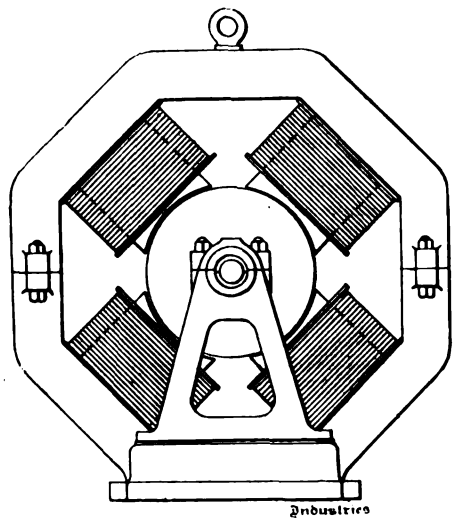


FIG. 5.

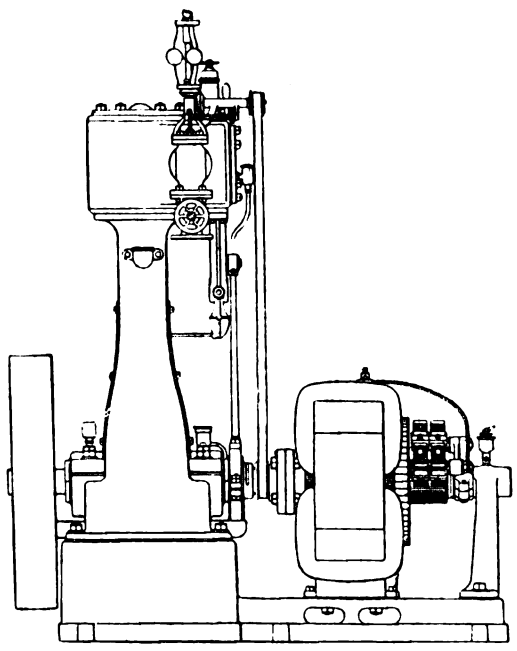


FIG. 6.

ELECTRIC CRANES.

MR. W. D. SANDWELL recently read a short but interesting paper on this subject before the South Staffordshire Institute of Iron and Steel Works' Managers. Electric cranes only want exploiting, like most electric motor work. With few exceptions nothing can be worse, from the point of view of cost and efficiency, than the ordinary form of travelling or overhead crane. In a works, such, for instance, as an erecting shop, the crane is generally driven by an endless rope or by shafting and bevel wheels, with more or less complicated bearing arrangements. Even when lifting a very heavy weight such an arrangement is very inefficient; but a crane is actually lifting heavy weights only a very small percentage of the whole time it is at work, and there is a great deal of power taken merely to keep the rope gear or shafting in motion during the whole of the time. Electricity at once sweeps away all complications and allows a perfect system. The power can be conveyed to a moving hoist without any complications; and it is needed only when work is actually being done. Where the crane is out of doors, and, as at present arranged, has a small engine and boiler of its own, the saving in first cost and in working is enormous. Mr. Sandwell mentions the case of Mr. Hermans, of Limehouse, who put in Crompton cranes, thus saving £250 a year in insurance alone, apart from the economy of working. We strongly recommend works managers to look into this matter. They will find a great deal of sound information in Mr. Sandwell's paper.

NOTES ON THE DESIGN OF MULTI-POLAR DYNAMOS.*

(*Concluded from page* 354.)

OUTPUT OF ALTERNATING CURRENT ARMATURES.

THE armature loads for alternators, though producing a cross magnetisation, as in direct-current machines, raise no considerations, of course, as regards sparking. But on account of the greater proximity of the poles, and the greater stray field resulting, it is desirable to make the layer of copper on the armature core as thin, and the air gaps as short, as possible. As a consequence, probably, of the increased ratio of stray to useful field, the induction is less in the gaps of alternating than in those of direct-current machines. Some comparisons have been made of the output of direct and alternating machines of the same weight, but these, in the nature of things, must be misleading. The two types are quite unlike in their proportions, as Figs. 1 and 2 show, and no one would think of making them the same. Fig. 1 represents the magnetic system of a four-pole direct and Fig. 2 that of a twelve-pole alternating machine of the same output; and while it will be observed that the iron parts—core and yoke-rings—are much heavier in the former, it will be noticed that the copper in the magnet coils is much heavier in the latter. In fact, though the iron in the alternator is only 55 per cent. of that in the direct-current machine, the copper required is no less than 250 per cent. It is difficult, then, to understand what useful purpose is served by comparisons such as I have alluded to.

RELATION OF AIR GAP TO DIAMETER OF ARMATURE AND NUMBER OF POLES IN DIRECT-CURRENT MACHINES.

Having established the proportionality of the volume and diameter, it is easy to find the relation which must exist between the diameter and length of air gap for any particular angle of embrace in order that sparking may not occur.

But, as is also seen from the equation, the gap required for any particular volume is proportional to the angle of embrace, and if we substitute for two poles a greater number, of correspondingly less angular width, working with an increased diameter and volume without a proportionally increased gap is made possible. This is where the advantage of the four, six, or even eight pole machine comes in.

DIMENSIONS OF THE ARMATURE.

It has been observed that the output of an armature is proportional to d^2 L; and the induction being the same, the weight of the core for a given number of poles must be proportional to the output, the radial depth increasing directly as the diameter, so that a proportionally increased field may be carried. The number of poles being fixed, the weight of the core for a given output may be taken, therefore, as approximately constant, whatever the ratio of L to d.

The power wasted in hysteresis is proportional to the weight of iron magnetised, and to the number of reversals per second. The weight being inversely, and the reversals directly, as the number of poles, the power wasted is for a given output the same.

So much for the core; let us now consider the copper part. Taking Gramme-wound armatures having an interior opening equal to ·66, or two-thirds of the core diameter, it is found—the output, speed, and temperature being predetermined—that the ratio of L to d may vary through a considerable range without making any great difference in the weight of copper or efficiency.

All the above facts go to prove that if there is anything to be gained, as regards the production of the field, by increasing the diameter of the armature and the number of poles, there is nothing, considering the armature by itself, to be lost by it. It may, in fact, be rather an advantage, because the weight of the iron core is reduced. It is true the peripheral velocity is increased; but this does not matter in the least, provided a certain limit is not exceeded. Opinions differ as to what the limit should be, some machines working at 50ft. per second, others at 100ft., and a few as high as 125ft.

DIMENSIONS OF THE FIELD MAGNETS.

It will be apparent, from the foregoing considerations, that the employment of two or more than two poles for direct-current machines of moderate dimensions resolves itself mainly into a deliberation regarding the most economical shape to give to the field magnets.

I have said that for the prevention of sparking it is necessary that, the induction per square centimetre remaining the same, the air gap increases proportionally to the diameter, whether the space is necessary for conductors and clearance or not, but that the coefficient by which the diameter has to be multiplied to

* Abstract of a paper read by Mr. W. B. Esson before the Institution of Electrical Engineers on the 9th inst.

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NOTES ON THE DESIGN OF MULTIPOLAR DYNAMOS.

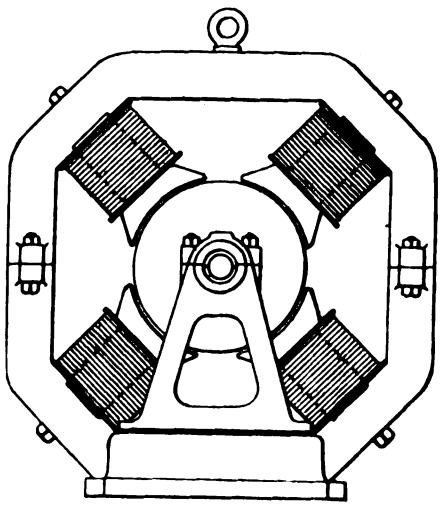


FIG. 7.

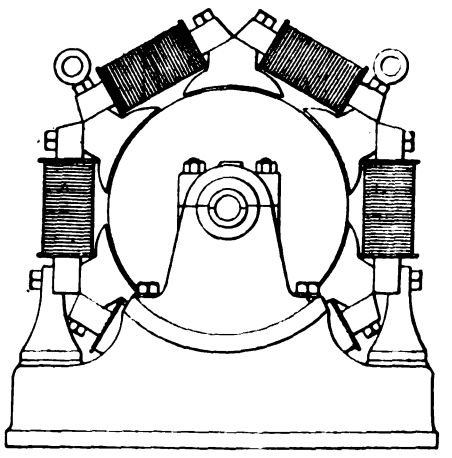


FIG. 8.

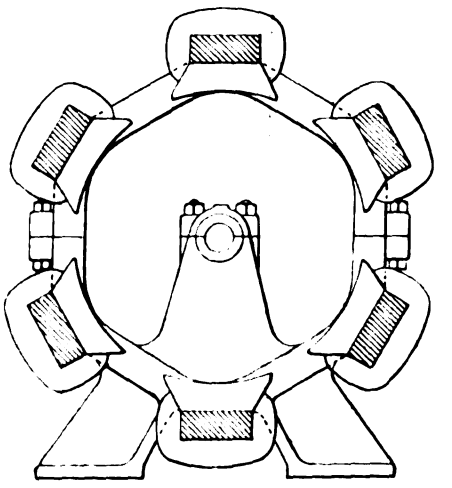


FIG. 9.

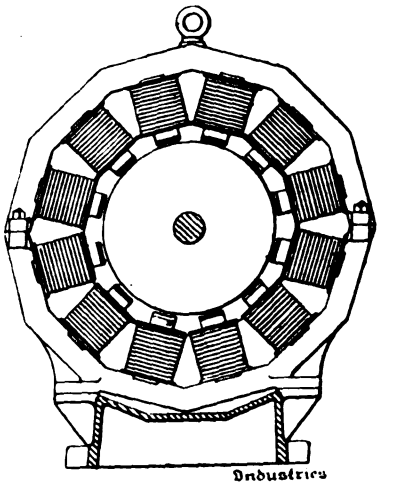


FIG. 10.

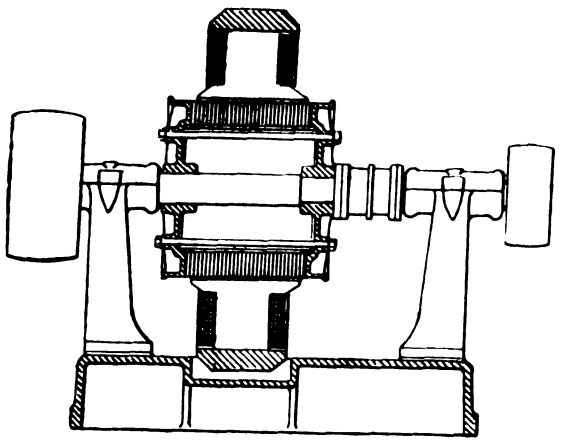


FIG. 11.

give the length of the gap necessary to prevent sparking diminishes directly as the pole angle. In comparing the magnetic system of a four or six-pole machine with that of a two-pole one, it is necessary to adopt dimensions for the armature in accordance with the considerations already mentioned; hence, if the two-pole armature had a length of core equal to one and a half times its diameter, in a four-pole one the length should be about half the diameter. The diagrams (Figs. 3 and 4) show the cross sections of two such machines. The diameter of the four-pole armature is 1·4, and its length ·5 times that of the two-pole one, consequently both machines give the same output. The weight of the two horse-shoe magnets in the four-pole machine comes to 56 per cent. of the weight of the single horse-shoe magnet, which indicates in this particular case a considerable saving in wrought iron. In taking the copper weight it is necessary to bear in mind that this does not vary simply as the length of the wire if the machines are of the same efficiency, but as the square of the length; so in this particular comparison the copper on the two horse-shoes would be, roughly, 30 per cent. more than on the single horse-shoe, assuming the length of the air gaps to be the same.

When we come to machines of a certain size there is undoubtedly a gain in employing more than two poles, while very large machines become impossible of construction with two poles only. But to go beyond four poles in many cases would be a mistake. Increasing the poles always results in an actual increase of copper, unless at the same time the power spent in the gap is reduced, and this latter must be effected without reducing the thickness of the armature winding.

Having discussed the design of multipolar machines as influenced by both theory and practice, it remains to conclude this communication by calling attention to some of the ordinary forms of multipolar fields. The double wrought iron horse-shoe (Fig. 4) is not very frequently used, being rather costly; but a similar machine with magnets of cast iron, lately made by my firm for the National Line s.s. "America," is shown in Fig. 6. This design, introduced by Gramme in 1869, generally gives place to the arrangement shown in Fig. 5, a form designed by the same inventor in 1885, and since adopted for cylinder-wound armatures by many makers, including Mr. Jaspar, in Belgium; Mr. Brown, of the Oërlikon Works, in Switzerland; and Messrs. Paterson & Cooper, in England. Fig. 7 represents a similar field in which the magnet cores are of wrought iron, fitted with cast-iron pole-pieces, as used by Mr. Kapp. The decision as to whether cast iron or wrought iron should be used is arrived at in a very simple manner—by comparing the excess of copper required on one hand with the extra machining required on the other.

All these are examples of single magnetic circuits, where the lines of force from each pole remain undivided in their paths through the magnetising coils; but in Figs. 8 and 9 are shown examples of double magnetic circuits, in which the lines from each pole take two paths through separate coils. Fig. 8 is a type of magnet used by Sautter-Lemmonier, of Paris, for Gramme-wound armatures, and by Cuenod-Sautter, of Geneva, for armatures having a Siemens winding as modified by Thury. It looks at first sight as if the weight of copper were not very different in the two types, but in this respect appearances are deceptive, for, as a matter of fact, the field of a four-pole machine made to Fig. 8 would require about 125 per cent. more copper than if made according to Fig. 7. It will be observed, however, that the magnet cores and pole pieces, which are made throughout of the softest wrought iron, are very light. In Fig. 9 the magnets are a series of wrought-iron bars lying parallel to the armature, each fitted with a cast pole-piece in the middle of its length, and having two magnetising coils, one on each side of this piece. It is a structure which may be frequently met with, though not precisely in the form shown, and the observations regarding the copper made with reference to Fig. 8 apply equally here.

The fields of alternators may be similarly divided into those having single and those having double magnetic circuits; the former requiring, as in the fields of direct-current machines, much less copper than the latter. Amongst those having single magnetic circuits are the machines of Siemens, Ferranti, Mordey, Westinghouse, Elwell-Parker, and Paterson & Cooper. Mr. Kapp possesses the distinction of having the only alternator with double magnetic circuits. The "Phœnix" alternator, shown in Figs. 10 and 11, possesses some features which may be of interest as illustrating the way in which the commercial aspect of designing has to be considered.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

(*Continued from page* 355.)

IV.

After the contents of the boiling pan have remained at rest for some time (usually during the night), the supernatant spent lye is withdrawn from under the soap by means of a pipe at the bottom of the pan, and is then dealt with, in a manner to be subsequently described, for the recovery of the glycerine. As the lye is withdrawn the soap sinks down in the pan, until the escape of a small quantity from the lye pipe is the signal for shutting the tap, showing that all the lye has been drawn off and only soap remains in the pan. A little water is now poured in, and the steam turned on for the second or rosin "boil."

The rosin barrels are usually raised to the boiling house by a hydraulic or steam lift, and brought to the pan side, where they are broken open and the block of rosin smashed into small pieces, which are shovelled into the pan. At the same time, caustic lye is gradually allowed to run in until the whole of the rosin is completely saponified, and a slight taste of caustic remains in the separated lye. Salt is then thrown into the pan and the boiling continued until the soap is cut open and perfectly separated from the excess of spent lye, when the steam is shut off and the contents left to settle as before. The amount of rosin used in the manufacture of household yellow soaps varies, but usually it is about 5 cwt. to 7 cwt. to each ton of fat employed. When much oil is used, such as cocoanut, palmnut, cotton seed, or palm oils, the quantity of rosin must be reduced below that which could be safely added to a tallow soap.

After drawing off the spent lye from the rosin boil, the soap is ready for the third operation, or "boiling on strength." This consists in boiling the soap with a strong solution of caustic soda, in order to ensure the complete saponification of the fat, oil, or rosin used, and to free the soap still further from impurities which have escaped being carried away with the spent lye of the preceding operations. For this purpose it is not sufficient to add a quantity of strong lye to the soap at once, and to boil for four or five hours, as is commonly done, because the strong caustic often fails, under those conditions, to combine with small quantities of unsaponified fat, and, furthermore, the finished soap is very likely to contain an objectionable amount of free caustic soda. The grain soap should, in this operation, be first "closed," by boiling with water alone, and then the strong lye be run gradually in, until the soap is well cut open by the excess of caustic soda. The boiling is then continued for two or three hours longer, and, finally, the contents of the pan are left at rest to allow the curd soap to separate from the strongly alkaline lye.

If the object of the manufacture be a curd soap, the pan is at once covered with a lid, and felt or sacking placed upon it, to retain the heat, and it is left at rest for a length of time varying from about thirty-six hours to several days, according to the size of the pan, when the soap is either skimmed off the surface of the lye by means of ladles, or drawn off, or pumped through a pipe, which can be lowered into the soap in such manner as to remove it without disturbing the supernatant lye, whereupon it is placed in the frames to cool.

Ordinary household soap, other than curd, passes through a further operation before it is ready for running into the frames. The object of this finishing boil—technically called "fitting"—is to combine the curd soap with water, and so obtain a close homogeneous product, as well as to improve the colour.

The alkaline lye, after boiling on strength—called "half-spent lye"—is drawn out of the pan, and stored separately from the spent lye, to be used again in a first or rosin operation, or for the manufacture of brown soap; and the soap remaining in the pan is melted and boiled by means of the steam coils. Sometimes the water condensed from the steam itself is sufficient to close the soap, but generally a little water must be added. The addition of water (preferably sprinkled all over the soap as fine rain) is continued until the opaque, thick soap becomes comparatively thin, smooth, glossy, and semi-transparent, and falls at once from the trowel, in two or three large flakes. There are several signs of the soap being in the right condition, but which can only be learned by experience. On continuation of the boiling from this point, the soap expands and swells up considerably, on which the steam is shut off, the pan covered closely, and left at rest from two to five days, the exact time depending on the bulk of the charge.

At the end of that period the soap is found to have separated into three well-defined layers or strata. The uppermost one, called "fob," consists of light frothy scum, or soap impregnated with such, which varies in thickness from ½in. to 6in. or more, depending largely on the amount of water added in the "fitting" operation, and on the character of the soap. The second layer forms the bulk of the pan's contents, and is composed of the good soap, while the bottom layer consists of inferior, dark-coloured, thin soap, containing an excess of water, and technically called "nigre" or "niger." This last is left in the pan, while, after skimming off the "fob," the neat soap is drawn or pumped out and conveyed to the crutching machine, or direct to the frames, where it is allowed to cool.

Many household soaps, not made principally from oil, are what is called "run" with substances more or less detergent in character, to increase the yield, and so

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cheapen the product. Among these, silicate of soda is the most important, and commonly used; but the carbonates and sulphates of soda and potash, silicate of magnesia, or French chalk, gypsum, starch, and many other materials, are also used, a large number of which must be regarded merely as so much adulteration, many being added to the soap solely with the object of increasing its weight; and with all of them a considerable proportion of water is introduced.

Silicate of soda, or soluble glass, is prepared by fusing together fine sand and soda ash in suitable furnaces, and is obtained in the form of irregular lumps of transparent glass-like material. In some soap works the solid pieces are prepared, or obtained from regular makers, and dissolved in water to form the required strength of solution. This is usually effected by placing the lumps of silicate on a perforated false bottom or tray, which is suspended in a tank of boiling water. The silicate dissolves in the water, and the heavy solution sinks through the perforated tray and is drawn out by a tap at the bottom of the tank. In the majority of soap works, however, the silicate is obtained, from regular makers, in a convenient form, as a strong solution, packed in barrels. This solution is thick and viscous, of a specific gravity, in some makes, of about 1·70° or 140° Tw.; in others, of 1·50° or 100° Tw., the former containing about 53 per cent. of solid matter. On diluting with hot water, the solution has a tendency to deposit silica on cooling, the larger quantity being deposited from the stronger solutions.

The following analysis gives the composition of a sample of thick silicate of soda solution:—

SILICATE OF SODA SOLUTION—140° Tw.

	Per Cent.
Silica	34·29
Soda (Na_2O)	18·01
Sulphate of soda	·29
Sodium chloride	·37
Carbon dioxide	·17
Oxide of iron and alumina	·27
Water	46·60
	100·00

For running the soap, the thick solution of silicate is diluted with boiling water, in suitable tanks provided with steam coils, to the requisite strength, which varies very greatly for different soaps, and according to the proportion of solution added to them.

(To be continued.)

THE "DONALD" PROCESS FOR THE MANUFACTURE OF CHLORINE.

RUMOURS of new processes which were to revolutionise the business of the chlorine manufactories have from time to time awakened the interest of those concerned in the chemical industries, and, at the present time, when nitrate is so cheap, nitric acid is apparently a more economical oxidising agent than manganese, which has hitherto almost universally been employed.

The "Donald" process is the same as that by Weldon in the first and last stages—viz., the saltcake furnace and the bleach chambers. It is in the second stage, and in dealing with the hydrochloric acid in the gaseous state, that the Donald process seeks to effect improvements, combining economy with efficiency. The hydrochloric acid gas as it issues from the saltcake furnace is not liquefied as in the Weldon process, but is conveyed in a gaseous state through a series of tanks containing nitric acid, by which the chlorine (the whole of it) is eliminated, and passes on pure and dry direct to the bleach chambers. There is, therefore, practically no loss of chlorine, and consequently, for the present make of bleaching powder, less than one-third of the present consumption of raw material will be required. The acids employed are not deteriorated by use, and can be used over and over again with only a small percentage of loss. The plant required is simple and inexpensive, and, the action of the nitric acid being speedy and direct, the process may be arranged to give a continuous yield. The Donald process has been favourably reported on by Professor Mills, and has likewise been examined and commended by Messrs. Tatlock, Garman, and Rawan. Estimates have been made of the cost of working the new process, which, after ample allowance for all necessary expenditure and a wide margin for contingencies, indicate a substantial return on the outlay. A limited company was accordingly started in Glasgow at the close of last year to carry out the new process. Works will be built forthwith capable of manufacturing 100 tons of bleaching powder weekly, the plans being so arranged that a portion of the buildings and plant will first be erected without expending more than half the estimated cost of the works, ample provision being made for extension when required.

Notes.

EXHIBITION AT RHODE ISLAND, U.S.A.

THE movement to open in Providence an exposition of Rhode Island products seems at last in a fair way to assume definite form, as steps have been taken by energetic business men to awaken general interest. There has never been anything of the kind in Rhode Island, and yet it is one of the leading manufacturing communities of the United States. It has been suggested to have as one feature an exhibition of all the processes of manufacture, from the raw state to the finished product. Some of the processes of worsted, iron, steel, rubber, leather, and jewellery manufacture could be shown in this manner, and would make the Exhibition a powerful educational influence, as well as a success financially.

PORT MELBOURNE DRAINAGE.

ALTHOUGH the plant is not yet complete, a trial of the Port Melbourne drainage pumping scheme has been made with satisfactory results. The machinery includes five engines, working powerful centrifugal pumps, two of the sets being equal to a discharge of 2,600 gallons per minute, while the other three can work up to 5,500 gallons. The sewerage is collected, states the *Australasian Builder*, at the pumps by a large sewer and lifted into an outlet sewer which discharges it into the bay. During the trial of one of the smaller sets, a quantity of between 30,000 and 40,000 gallons was put through in a quarter of an hour, and it is calculated that the capacity of the whole plant will more than deal with the drainage of Port Melbourne.

RAILWAYS IN GREECE.

THE contract for the Piræus-Larissa Railway, given out in July, 1889, allowed of a period of twelve months for the preparation of the necessary plans. Owing, however, to the French engineers attached to the Greek Government insisting upon a deviation from the route originally fixed upon, the period was found too short for a line, which, with the Chalchis and Lamia branches, is 390 kilometres in length. The line starts from the Piræus, where it will be in direct communication with the harbour and with the vessels lying along the quay close to the railway siding; passes through Athens, Boyáti, Thebes, Livadia, Dádi Scarmitza, Ofana to Larissa. The branch from Chalchis joins the main line 30 kilometres south of Thebes, and that from Lamia at Liano Kládhi. The rails and locomotives are being supplied from England, but the carriages are being built in Belgium.

A NEW DOCK AT BOMBAY.

THE new graving dock constructed by the Bombay Port Trust, and called the Merewether Dock, was opened last month by Lord Harris. The dock, which communicates directly with Prince's Dock, was to have been completed within two years from the commencement, but the work has been done in far less time. It measures 500ft. on the floor, but the length available for docking is 530ft. The width at the coping is 90ft., and on the floor 62ft. The depth at the head is 33ft., at the stern 34ft., and the available depth of water for docking at high water of spring tides is 28ft. 7in. A sill at the entrance has been determined on at an extra low level to accommodate ships of the Royal Navy up to the second class. The dock is fitted with three 36in. centrifugal pumps, capable of pumping 60,000 gallons per minute, so that the dock can be pumped dry in three hours. The average number of men employed in the construction was 2,000.

A NEW LIQUID FUEL GAS PROCESS.

AT the gasworks of Saratoga, U.S.A., a plant has recently been erected by Mr. Andrews for the manufacture of gas from liquid fuel. By the Andrews process the oil (crude or Lima being used) is heated in two superheaters in each bench, which subject it to great heat and gasify it previous to its introduction to the pipe retorts, thus obviating the deposition of graphite in them and preventing the possibility of their clogging, at the same time steam is superheated to about 1,700 degrees before it reaches the retorts. The retorts, states the *American Manufacturer*, consist of double pipes, the outer one of cast iron and the inner one of copper. Notwithstanding the fact that both oil and steam have practically been converted into the gaseous form before they reach the retorts, they are not permitted to mingle until they have travelled several times to and fro on the bench, when the inner pipe terminates and the two gases mingle. A fixed hydrocarbon gas is the result, which may be piped any distance, and when subjected to the greatest cold shows no condensation. The gas has great heating properties, and is a splendid illuminant, being used in the town of Saratoga for both lighting and heating. The gas has also been applied to a furnace specially built for heating and melting iron, in which connection it has given the most satisfactory results. Iron, steel, and copper have been heated and melted in remarkably quick time, the flame produced being mellow, but intensely hot. The illuminating gas is of 28 candle-power, and requires no purification after it leaves the retorts.

BORING WITH POWER DRILLS AT THE ST. ANDREASBERG MINES.

AT the St. Andreasberg silver mines in the Harz, rock drills worked by compressed air have recently been introduced. The air compressor is placed underground, and is driven by a Girard turbine. The special point of interest in connection with this installation is the regulator, which consists of an air reservoir hewn in the solid rock. By the employment of power drills, it is found that in driving levels there is a saving in cost of 58·2 per cent., whilst 4·04 times as much work is done as that accomplished by manual labour. The cost of stoping by hand was 16s. as compared with 8s. 6d. by machine per cubic metre of ore won. In the case of shaft sinking, the cost with machine, inclusive of explosives, was £4 per running metre, as compared with £7 10s. with manual labour.

A NEW MINERAL.

MR. H. A. MIERS, in the *Mineralogical Magazine*, describes a new mineral, which has been named "Sanguinite." It was observed on specimens of argentine from Chañarcillo, and is probably a hexagonal sulpharsenite silver, allied to proustite. To the naked eye the mineral appeared to be göthite, but examination with the microscope revealed its different character. It has lustre, like earthy hematite; colour, bronze-red by reflected light, and blood-red by transmitted light; streak, dark, purplish brown. No quantitative examination was made, on account of the small quantity of material; a qualitative analysis, however, showed the presence of silver, arsenic, and sulphur. The physical characters, as a whole, prevent the mineral from being referred to proustite or xanthoconite, the mineral being nearer like the former in its physical characters. The specific gravity and hardness have not been determined.

IRON AND HARDWARE IN AUSTRALIA.

THE total value, expressed in dollars, of iron and iron manufactures imported by Australia is over $30,000,000 per annum. Nearly all these imports are admitted free into New South Wales. Rich deposits of iron ores are diffused throughout that colony, but are almost wholly neglected. There are many iron foundries in the colony engaged in the manufacture of steam engines, railway material, and agricultural implements, for which material is imported. The great bulk of the iron imports comes from Great Britain. The value of iron and steel imported by New South Wales during 1889, excluding machinery and hardware, was $2,138,278, the leading items being:—Pig iron, $147,270; iron and steel pipes, $596,555; other castings, $65,975; bar, rod, plates, and sheet iron, $706,485 bolts, nuts, rivets, and screws, $102,630; other wrought iron, $401,345; iron and steel tanks, $67,945; safes and doors, $70,220; wire, $512,785; galvanised manufactures, $363,930; wire netting, $15,735. The value of hardware imported by New South Wales in 1889 was $2,382,205, against $2,142,290 for the preceding year. Great Britain shipped direct to the value of $1,82,005, besides a considerable quantity by way of Victoria. The United States furnished, direct, hardware valued at $396,980. There were 350 establishments in New South Wales, states *Hardware*, during 1889 engaged in various kinds of iron-work, giving employment to between 8,000 and 9,000 hands, with a larger number of establishments and hands in the colony of Victoria, where more attention is paid to manufactures of all kinds than in New South Wales.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

31st March, 1891.

5506. Weston, G. H. ..... Rotary engines.
5511. Brierley, W. ..... Carding engines (*Moog*).
5517. O'Connor, P. ..... Pipe couplings.
5520. Phillips, S. G. ..... Apparatus for drying bricks.
5522. Hollingworth, L. ..... Cloth guiding machines.
5524. Reeves, Stamp, & Houghton ..... Jacquard machines.
5527. Mallaband, T. H. ..... Melting furnaces.
5528. Tomlinson, J. D. ..... Flyers for spinning and twisting asbestos yarn.
5529. Sawrey & Collet..... Apparatus for separating liquids from solid matters.
5534. Grove, J. ..... Shaft couplings.
5535. Grove, J. ..... Couplings for shafts.
5536. Blakeney, W. H. ..... Pneumatic tube conveying apparatus.
5537. Thompson, W. B. ..... Fly wheels for motors.
5538. Blakeney, W. H ..... Water cock or valve.
5540. Hogg, Bowie, & Prentice ..... Steam boilers.
5543. Klatte, O. ..... Permanent way of railways.
5549. Whittaker, W. ..... Railway signalling apparatus.
5553. Pape & Henneberg ..... Centrifugal sorting machines.
5555. Haddan, R. ..... Evaporators (*Evans*).
5561. Gehre, M. ..... Apparatus for determining the quantity of liquid in steam.
5564. Thompson, W. P. ..... Shaft couplings (*Gaveron*).
5567. Lardeur, A. E. ..... Mitreing machines.
5568. Skinner & Connolly ... Looms.
5569. Rapieff, J. ..... Pneumatic ordnance.
5575. Donnelly & The Patent Stamped Steel Railway Axle Box Company, Ld. ..... Axle boxes.
5578. Clinton, McNamara, McIntire, Smith, & Livermore ..... Typewriting machines.
5581. Edwards, E. ..... Pumps (*Roessler*).
5587. Naylor, W. ..... Railway vehicle couplings.
5589. Smyser, H. E..... Weighing, package making, and filling machinery.
5593. Lake, H. H..... Projectiles (*Roth*).
5594. Lake, H. H..... Pipe couplings (*Linzee, Jun.*).
5597. Selkirk, A..... Apparatus for disintegrating fibrous materials.

1st April, 1891.

5600. Hart, G. W..... Steam boilers.
5601. Ormerod, Crook, & Galloway ..... Looms.
5607. Higgins, C. P. ..... Riveting machines.
5612. Hook, G. ..... Folding machines.
5614. Pratt, C. T. ..... Drill chucks.
5618. Wrigley, M. H..... Rotary engines.
5620. Kirby, J..... Fluid pressure engines.
5621. Lockwood & Storey ... Looms.
5625. Davey, H. ..... Steam boiler feed apparatus.
5628. Woodhouse, J. H..... Drilling machines.
5631. Blakeney, W. H. ..... Engines and pumping apparatus.
5640. Griffiths, W. B. ..... Bottle washing machines.
5645. Munns, W. H. ..... Automatic car brake and brake governor (*Kellog*).
5649. Munns, W. H. ..... Pumps (*Frost*).
5654. Walsworth, J. B..... Apparatus for clearing, lowering, and disengaging ships' boats.
5658. Moncrieff, R. W..... Jacquard design, reading, and card punching machines.
5659. John Brinton & Co., Ld., Bedford, & Pearse... Machinery for the manufacture of chenille or chenille fur.
5660. Jacométy & Lenicque... Apparatus for treating ores.
5663. Fachris, J. B..... Motive power engine.

2nd April, 1891.

5668. Rose, B..... Manufacture of metallic tubes.
5672. Mann, Smith, & Read... Differential speed gearing.
5674. Roots, J. ..... Gas engines.
5677. Holt, J. ..... Looms.
5697. Schmidt, W. ..... Apparatus for superheating steam.
5701. Ketchum, O. W..... Gas producers.
5705. Warrington & Warrington ..... Puddling furnaces.
5710. Mills, C. K. ..... Tubing steam boilers and tools therefor (*Caraman Vassel & Cie.*).
5711. Thame, J. R. ..... Manufacture of seamless tubes or conduits.
5724. Schwörer, E..... Apparatus for superheating steam.

3rd April, 1891.

5728. Brindle, Reade, & Taylor ..... Apparatus for washing, bleaching, dyeing, and drying yarn in the cop.
5730. Watmough, T. ..... Steam boiler furnaces.
5738. Newton, C. B. ..... Differential pump gearing.
5739. Benyon, G. W. ..... Interlocking railway signals, points, and block telegraph instruments.
5742. Judson, Longbottom, & Hudson ..... Steam engine valve gear.
5747. Skene, R..... Gas engine governor.
5757. Fairbrother & Damon Machine for bending wire wall ties.
5768. Stuart, C. ..... Air compressors.
5772. Huelser, C..... Clay presses for making tiles (*Fröhlich, Sen.*).
5775. Johnston, D. ..... Water heaters.
5776. Hagaus, C. ..... Locomotives.
5783. Mudd, T..... Apparatus for superheating steam.

4th April, 1891.

5793. Holgate, J..... Looms.
5796. Williams & Morris..... Machinery for cleaning tin or terne plates.
5798. Bersin, N. ..... Axle and shaft bearings.
5808. Wotherspoon & A. & J. Stewart & Clydesdale, Ld..... Machines for the manufacture of tubes.
5814. Oldfield, T. ..... Lathe beds.
5817. Earsdon, Day, & Day... Lathes.
5820. Morton, A. ..... Steam engines.
5826. Taylor, G. H. ..... Manufacture of chains and machinery therefor.
5848. Rauser, Wieber, & Sokoloff ..... Apparatus for automatically controlling the supply of water to steam boilers.

ELECTRICITY.

31st March, 1891.

5508. Hemming, T. L. ..... Method of electro-plating wire.
5518. Ayrton & Ayrton ..... Electric meters.
5539. Stuart, F. E..... Street fire alarms and their combination with telephones.
5547. Kellner, C..... Apparatus for electrolytic decomposition.
5548. Bishop, J. D. ..... Electric conductors.
5580. McEvoy, C. A. ..... Circuit closers for torpedoes and submarine mining apparatus.
5595. Dewey, M. W. ..... Electric heating apparatus.

1st April, 1891.

5617. McGeoch, Jun., & McGeoch ..... Electrical meters.
5637. Barker, R. W. ..... Converters (*Farmer*).
5638. Crowdus, W. A. ..... Batteries. (7th October, 1890.)
5641. Angold, A. E. ..... Arc lamps.

2nd April, 1891.

5679. Strenberg, R. ..... Telephones.
5690. Bull, H. C..... Batteries.
5712-13-14-15. Pitt, S. ..... Insulating electrical conductors (*Davidson*).

3rd April, 1891.

5766. Philpott & Hammond... Apparatus for use as a current meter or as a motor.
5780. McMahan, J. M. ..... Cut-out for electric circuits.
5790. Boehm & Bailey ..... Incandescent lamps.

4th April, 1891.

5802. McGeoch, Jun., & McGeoch ..... Incandescent lamps.
5824. Pitkin, J..... Filaments for incandescent lamps.
5834. Wilkinson, G. ..... Measuring instruments.
5835 Jones, A. D. ..... Measuring or indicating instruments.

CHEMISTRY.

31st March, 1891.

5519. Beylikgy, Everett, & Collins ..... Alkalino-magnesian silicate compound.

3rd April, 1891.

5748. Moss & Newton..... Production of carbonic acid gas.
5777. Bruce, W. T. ..... Manufacture of sulphuric acid and apparatus therefor.
5788. Feld, W. ..... Manufacture of sodium and potassium carbonates, sulphur, and sulphuric acid.

4th April, 1891.

5821. Curtis & André ..... Explosives.

MISCELLANEOUS.

31st March, 1891.

5513. Fenton & Fenton..... Joining woven and other machine bands.
5551. Tresidder, T. J. ..... Armour plates.
5574. Haire & Turner ..... Wrenches.

1st April, 1891.

5623. Thompson, W. P. ..... Packing rings for flange joints (*Schonleber & Knauss*).
5629. Lucas, Lucas, & Bishop Adjustable spanners.
5642. Sowerby & Casper ..... Casting metals.

3rd April, 1891.

5749. Johnson, J..... Refractory linings for furnaces (*Blair, Jun.*).

4th April, 1891.

5828. Poole, W. H. ..... Metallic packings for piston rods, &c.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

8267. Marsden.
4999. Bayley & Cooper.
5100. Morfitt.
5239. Blum.
5330. Anderson.
5733. Imray (*Hogan Engineering Company*).
6502. Lake (*Swift*).
6647. Hawes.
6749. Cochrane.
6840. Rigby.
7253. Hodge.
7264. Stones & Stones.
7564. Bachmann & Pieper.
7666. Thorne.
7846. Byers.
7901. Hoffmann.
7984. Cooke.
8038. Kelly.
8212. Muir.
8290. Mills.
8337. Simon.
8368. Price.
8418. Barnes.
8474. McEvoy.
8510. Broadhead, Bessley, & Evans.
8520. Favier.
8531. Neate.
8534. De Benardos, Howard, & Lloyd.
8550. Dorman.
8558. Coulson.
8575. Vialet-Chabrand.
8586. Egleton.
8626. Clarke, Clarke, & Clarke.
8680. Parini.
8688. Keith (*Bartlett, Hayward, & Co.*).
8748. Jobling.
8817. Radler.
9084. Thompson.
9338. Matthewson.
9494. Browett.
9769. Butterfield & Fox.
9805. Wever.
10949. Cook (*Ward*).
12169. Desruelles & Chauvin.
13163. Marie.
13424. Odell.
13761. Allan & Lakin.
14713. Horn (*Yeager*).
15552. Thompson (*Guntermann*).
16391. Dillberg & Philp.
17159. Springer.
17398. Peckham.
17643. Mally.
19216. Lawrence.
19745. Ladds.
20461. Crow.
20858. Thompson (*Wait*).
3461. Fournier.
5068. Sleeman.
5192. Melhuish.
5280. Stamp & Brown.
5376. De Chardonnet.
5831. Nelson.
6141. Hopkinson & Hopkinson.
6724. Dickson.
6829. Adey.
6875. Johnson (*Badische Anilin & Soda Fabrik*).
7325. Muirhead.
7597. Locking (*Kindermann*).
7807. Davis.
7896. Lawrence.
7928. Vincent & Boroughs.
8020. Lister & Pedersen.
8079. Hartmann.
8289. Clement.
8334. Baillie.
8345. Ross & Atkins.
8372. Dines.
8449. Johnston.
8506. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
8580. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8549. Holland.
8556. Paul.
8566. Thompson (*Wood*).
8580. Molison.
8596. Webb.
8634. Cockburn.
8649. Paxman. (13th November, 1889).
8702. Pike.
8720. Walter.
8814. Mallalieu.
8983. English.
9264. Thomas.
9487. Burn.
9602. Siemens Bros. & Co., Ld. (*Siemens & Halske*).
9952. Molloy.
11836. Wordsworth.
13052. Zimer.
13185. Axford.
13538. Morris.
14248. Hering & Helbig.
14907. Scott.
15687. Valentiner.
16168. Crawford.
16903. Hertz.
17186. Evans.
17512. Asquith & Flitcroft.
19102. Anderson.
19235. Todd.
20115. Barrett & Barrett.
20551. Stager. (2nd June, 1890.)
21087. Sepulchre.

1891.

842. Kämmerer.
1033. Bohls.
1280. Elmendorf. (23rd June, 1890.)
1692. Berges.
2261. Walls.
2265. King & King.
2634. Edwards (*Willmann*).
2679. Burman Fire Lighter.
2751. Fell.
2795. Barber.
2871. Newton (*Worthington*).
2894. Claussen.
3050. Tyler.
3191. Von Dolive-Dobrowolsky & Allgemeine Elektricitäts Gesellschaft.
3860. Rothschild.
3616. Lawrence & Lawrence.
3697. Laidlaw.
3724. Hermanns.
3763. Zander.
3786. Hall.
3791. Macdonough.
3808. Tooth, Harris, & Harris.
3819. Pollard.
3834. Bradbury (*Messrs. Grimme Natalis & Co.*).
990. Jeeves & Gillmore.
1258. Ingraham.
1479. Thompson (*Hart*).
1682. Bowing.
2224. Lake (*Massignon & Watel*).
2581. Cutter.
2685. Edwards (*Winkler*).
2733. Lake (*Hempel & Dingeus*).
2823. Gannaway.
2884. Van Vliet.
2898. Williams.
3165. Ferguson & Fleming.
3215. Grenfell & Baron.
3250. Thompson (*Land & Van Buskirk*).
3351. Coursen.
3513. Marr.
3639. Bray.
3644. Wootton & Rushbury.
3699. Moore.
3741. Barker.
3775. Hild.
3788. Robinson.
3802. Oliver.
3816. Lake (*The Wilson Manufacturing Company*).
3820. Boult (*Turner*).
3841. Hult & Hult.
3846. England.

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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

CRUSHING AND GRINDING MACHINES.—*M. H. Simonet, Quintin (Cotes-du-Nord), France.*—The machine embraced by this invention is constructed as follows:—A double cylindrical casing has journaled in each end of it the spindles of two cylinders which revolve inside the casing, and have formed on their periphery helical projecting ribs, the number of which increase towards the delivery end of the machine. Inside the double cylindrical casing are arranged two cylindrical shells concentrically with the revolving cylinders, and provided on their inner surfaces with concentric projecting ribs. At the point of intersection of the double casing containing the cylinders is a groove, which contains a longitudinal adjustable blade forming a knife, which bears against the whole length of the two cylinders, and cuts the substance introduced into the machine. Claims: (1) A crushing, grinding, or mixing machine, comprising a double cylindrical box or case provided with two movable adjustable shells having ribs on their inner sides for crushing or grinding the material in connection with two cylinders, also provided with ribs; (2) in a machine as above claimed the use of a longitudinal knife or blade for cutting and separating the substance drawn through the cylinders; (3) the machine substantially as described.—No. 4153. March 17th, 1890. 6*d*.

CAR COUPLINGS.—*A. C. McCord, Minneapolis, Minnesota, U.S.A.*—Fig. 1 in the annexed illustrations is a perspective view of a car coupling embraced by the invention, Fig. 2 is a sectional plan, and Fig. 3 shows the swinging jaw. Pivoted in two projecting arms of the main body A formed with an inclined face, as shown, is the swinging jaw B, in the front part of which is pivoted the locking pin actuating plate C, the front end of which projects slightly beyond the end of B. The jaw B is provided with two arms B^1 (Fig. 3) adapted to slide respectively under and over a projecting tongue (Fig. 2) in the slot in A. Pivoted at E in the upper arm of B is the locking bolt F, the lower end of which is connected to the inner end of C, and is arranged to swing in a slot in the second arm of B. A tail on B limits the outward

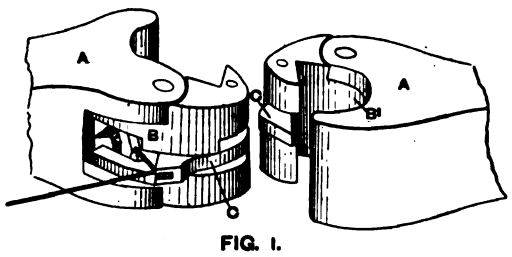


FIG. 1.

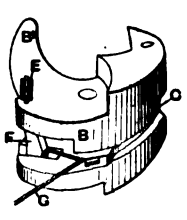


FIG. 3.

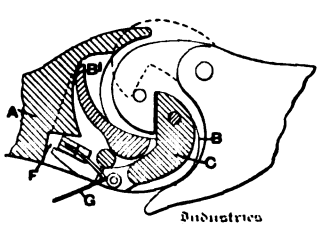


FIG. 2.

swing of the latter. It will thus be seen that when the jaws are brought together into the coupling position, they will be locked by the bolt F, owing to its tendency to regain the vertical position, swinging forward and locking the swing jaws. When, however, one or both of the swing jaws is already locked, they will be released to allow of their being brought into the coupling position by the forward end of C being struck by the opposite jaw, so drawing F out of engagement with D. A rod G connected to C allows of the unlocking of the jaws from the side of the car. Nine claims are made.—No. 18373. November 4th, 1890. 8*d*.

BRICK MOULDS.—*E. Cammiss, Cowpen, Bewley, Durham.*—The invention embraces a method of forming the interior of the dies so as to avoid roughened edges of the bricks pressed, and to ensure a more perfect lubrication thereof. The die is made with a casing of wood, and is lined inside with narrow strips of metal secured to the casing only along their upper edges. These strips are arranged to overlap each other, so that the lubricant used may ooze out from behind them. A series of conduits are formed behind these strips in the casing to allow of the passage of the lubricant, said recesses or conduits being connected with a feed hole in one side of the mould. The die is constructed with tapered side and ends, the opening next the machine, which is constructed with its corners rounded, being of greater dimensions than that of the opening at the finishing side, which is constructed to form a true rectangle. Claim: In moulds or dies to be used in the manufacture of bricks the general construction and arrangement of parts for facilitating the moulding of the clay with smooth surfaces and sharp clean edges, and consisting of the internal shape or configuration of the mould combined with the means employed for lubricating the clay as described.—No. 3798. March 11th, 1890. 8*d*.

STEAM BOILER FURNACES.—*W. H. Wilson & J. Welsh, both of Hayfield, Derby.*—The invention embraces an arrangement for using oil or hydrocarbon fluids in connection with a coal fire. The oil is conveyed from a tank placed at a higher level than the boiler by a pipe into a chamber of brass. This chamber is in the form of a bulb on a steam pipe connected to the boiler, and leading to a number of perforated pipes placed above the coal fire in the furnace; the lower end of the oil pipe enters the steam pipe in the form of a nozzle just below the bulb or chamber, so that the steam acts as an injector, so carrying the oil with it through the perforations in the pipes into the furnace. Claims: The improved apparatus for burning oils or other hydrocarbon fluid in connection with a coal fire, by the combination of an oil supply pipe and a steam jet with branch pipes, and a curved perforated distributing pipe, substantially as described.—No. 5117. April 2nd, 1890. 8*d*.

APPARATUS FOR GRINDING CARDING ENGINE FLATS.—*S. H. Brooks, West Gorton, & J. Edge, Gorton, Manchester.*—The invention embraces improvements in apparatus for grinding revolving flats of carding engines without removing them. In the accompanying illustrations Fig. 2 is a side elevation of part of the bend of a carding engine and grinding bracket and roller with the apparatus embraced by the invention affixed thereto, and Fig. 1 is a front elevation of same with the "bend" in section. The

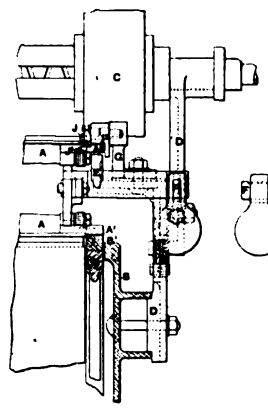


FIG. 1.

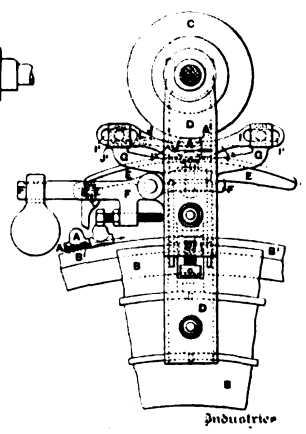


FIG. 2.

flats A, the bend B, the flexible bend B^1, the grinding roller C, the grinding bracket D, the horned bracket E, over which the flats travel, and the pivoted and weighted lever F, which successively lifts up each flat while being ground, may be of any ordinary construction. Fixed to D is a bracket G, which supports the grinding block I by means of two pins H carrying anti-friction rollers in the former, projecting into slot I^1 in the latter, said slots being inclined to a degree equivalent to the amount of "heel" required upon the flats. A planed surface I^2 is provided on the underside of I, against which the working surface A^1 of A is brought to bear as it is raised by F. On one side of I is pivoted a tumbler J, against the end of which the flat strikes as it is moved forward, so causing the flat and block I to move forward together until the bevelled end J^1 of J is sufficiently depressed by the stud H to release the flat, when I is forced back to its normal position by gravity or by means of a spring or weight. Claims: (1) An apparatus for grinding the revolving flats of carding engines when *in situ*, having a sliding grinding block, against which the working surface of the flat rests, and which on studs or slides moves along and carries the flat along a path inclined to the radius of the grinding roller, as described; (2) a sliding grinding block, against which the working surface of the flat rests, having inclined slots or inclined ends, which as it moves forward give the required inclination to the flat, as described; (3) the combination with a grinding roller C, grinding bracket D, horned bracket E, and pivoted lever F, each of ordinary construction, of the fixed and stationary bracket G and the sliding grinding block or bracket I, constructed as shown.—No. 4081. March 15th, 1890. 11*d*.

STEAM ENGINE REVERSING GEAR.—*D. A. Frazer & G. W. Cosford, both of Mancelona, Michigan State, U.S.A.*—In the annexed illustrations Fig. 1 is a longitudinal vertical section, Fig. 2 a sectional plan, and Fig. 3 a transverse section on line X X of Fig. 2 of a double-acting engine with the reversing gear embraced by this invention applied thereto. Beneath the steam chest A is placed a rotary valve B (Fig. 4) having an annular exhaust

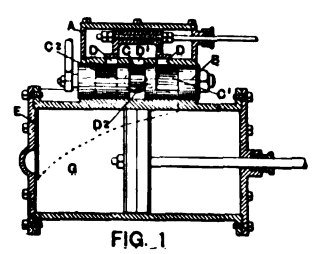


FIG. 1

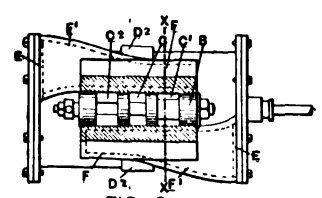


FIG. 2

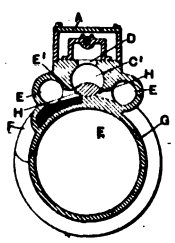


FIG. 3

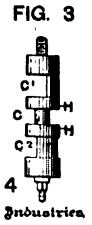
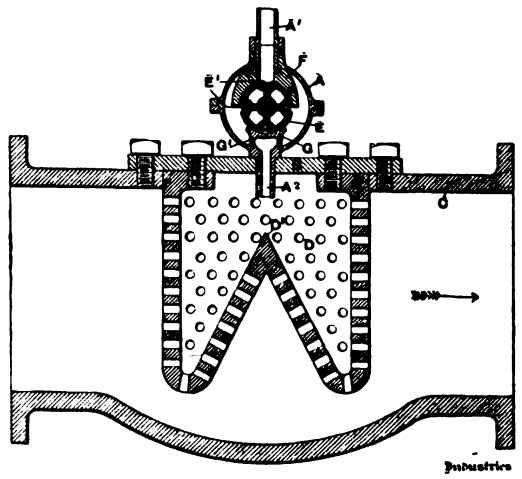


FIG. 4

passage C beneath and connecting the exhaust port D^1 with the exhaust pipe D^2. The openings C^1 C^2 serve to connect the live steam ports D with ports E^1 at each side of said passages which open into the chambers E. The latter are extended in opposite directions as shown at F F^1, and communicate with the respective ends of the cylinder G. H are air vents consisting of channels between the live steam and exhaust ports; these channels are cut part way in the valve chamber and the remainder in the valve, and are connected and open when in line, which occurs when all ports E are cut off. The operation of the device is as follows:—Live steam is alternately admitted to the ports D, and exhausted through D^1 in the usual manner. If, now, the upper side of the valve B is turned to the right, steam passing into C^1 will pass into the right hand chamber E, and thence into the forward end of G, and steam passing into C^2 will pass through the opening in the bottom into the left hand chamber E, and thence into the rear of G, and the engine will run in one direction. If, however, the upper side of the valve B be turned to the left, the steam will now pass in the opposite direction, the steam from G^1 passing into the left hand chamber E and to the rear end of G, and the steam from C^2 into the right hand chamber E and into the forward end of the cylinder G, thus causing the engine to run in the opposite direction; by turning the valve B toward the middle position the steam will be throttled and the air vents opened. Three claims are made.—No. 1436. January 27th, 1891. 6*d*.

METAL PRESSES.—*G. T. Aston, W. H. Aston, & C. T. Aston, all of London.*—The invention relates to presses in which the stamping die is actuated by an eccentric or crank and a connecting rod. For facilitating the adjustment of the stamping die the bearings of the crank shaft are fixed in eccentrics at each side working round in the solid framing. The eccentrics have each a projecting lever, by which they can be turned in the framing. These levers are connected by a cross-bar, in which is a swivelling nut. A screw, on which is a hand-wheel, runs in this nut, being attached to the framing below in a swivelling centre. Thus, by rotating the screw, the whole crank shaft may be raised or lowered. The clutch for governing the motion of the crank shaft is made with two horns opposite to each other, but working in exterior and interior circles. They can, therefore, only fall into gear when both are opposite their own catches, so that the strain is on both sides of this shaft. The treadle for actuating the clutch does not act directly upon it, but on a bell-crank lever through an intermediate shaft carrying two discs. From one of these discs proceeds a rod connected to the treadle, whilst from the second disc proceeds a second rod, connected to one arm of a second bell-crank lever, a projection on the other arm of which enters a hole in one arm of the first-mentioned bell-crank lever, and the other end of which actuates the clutch. Five claims are made.—No. 4516. March 22nd, 1890. 8*d*.

LUBRICATORS.—*F. Williamson, Tilbury, Essex.*—Referring to the annexed illustration, which is a vertical section of the improved lubricator applied to the steam pipe of a locomotive or other engine, the spherical box A is furnished with a supply pipe A^1 and a delivery pipe A^2, the pipe A^1 being connected to any suitable oil reservoir, while the pipe A^2 is screwed through



Industries

the plate B bolted to the pipe C and to the flanges of the perforated casing D having the shape shown in the figure, and the edges of which are raised inwardly to form a cone, the apex D^1 of which is in a line with the axis of the pipe A^2. The pipe C is inserted between two sections of the steam pipe of an engine in front of the stop valve. Journaled in A is the spindle of a disc E, one end of which spindle passes through A and is connected with suitable actuating mechanism (not shown). The disc E, which has formed in it recesses E^1, adjustable in size by means of screws, the heads of which form the bottoms of said recesses, revolves between bearings F G, the latter of which is made resilient by means of springs G^1. It will thus be seen that, as E revolves, the recesses will be filled with oil, which is then delivered to the interior of A, passes through A^2, and, falling on the apex D^1, is divided into a number of minute particles dashed into D, through which they are carried by the incoming steam to the parts to be lubricated. A modification of the lubricator as applied to marine engines is also described. In three claims the inventor includes the lubricator as described, together with modifications.—No. 6593. April 29th, 1890. 8*d*.

SLIDE VALVES.—*J. Marshall & R. Wigram, both of Leeds.*—The invention relates to expansion valves working in connection with main valves, and used in controlling the inlet and outlet of steam to and from the cylinders of any engine, the object being to relieve said main and expansion valve from friction caused by steam pressure. For this purpose the main valve is made of a box section. The steam ports on the back of the valve are made at right angles to, or at any angle relative to, the centre line of the spindle. The expansion valve is also of a box section. The steam ports of this valve are formed in one face only of the box. The balance or relief of this valve is obtained by admitting the steam used in working the engine through the valve between two larger faces either through the ends or sides of the box. The steam-chest cover has its inner base grooved, and into this groove is received a packing capable of adjustment. The inner face of the packing bears upon the back of the expansion valve. The space enclosed between the slide valve steam-chest cover and the packing is connected either with the condenser or receiver of the engine or with the atmosphere, to relieve the pressure on the back of the valve. Two claims are made embracing the construction of slide valve substantially as described.—No. 7141. May 7th, 1890. 8*d*.

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SHAPING MACHINES.—*H. Greenwood, Leeds.*—The machine embraced by this invention is especially designed for the purpose of shaping the teeth of bevel and spur wheels. Referring to the annexed illustrations, Fig. 1 is a plan, Fig. 2 a side elevation, and Figs. 3 and 4 views of details of the actuating mechanism for the automatic feed motion of a machine constructed on the principle of this invention. Sliding on a slide on the bed-plate A about a pivot B is a segmental plate C, shown partially in dotted lines (Fig. 2), on which is carried the work to be operated upon and the dividing mechanism. On the surface of C is fixed bracket D and an adjustable bracket D^1, operated from screw D^2. These brackets carry the shaft

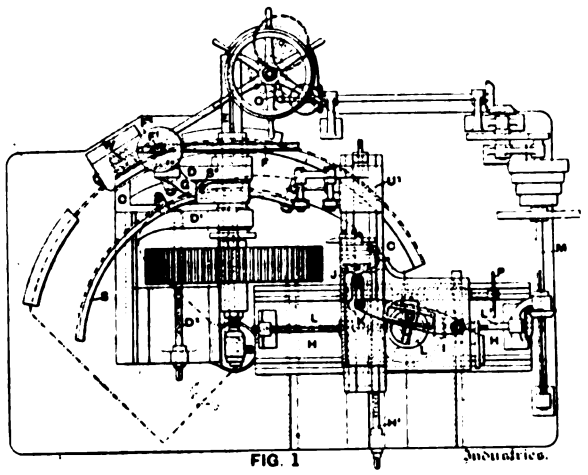


FIG. 1

E, on which is a dividing wheel F gearing with a worm on a shaft F^1, a spring arm on which is arranged to revolve over the surface of a dividing plate F^2. The shaft F^1 and plate F^2 are carried in a bracket G arranged to move in a vertical plane on a sleeve on shaft E capable of sliding and revolving therewith. One end of the spindle carrying the wheel to be operated upon is fixed to the end of E, the other end being pivoted at the axis of rotation of C. Moving in a slideway in A is a slide H, adjustable from screw H^1, on the face of which is a second slide I, adjustable at right angles to H, and on the slide moves the tool-holder J, which receives a reciprocating motion from a rocking lever K operated by eccentric L receiving its motion, by means of suitable bevel gearing and shaft L^1 from the driving shaft M. The feed of the tool towards the axis of the wheel to be operated upon is effected as follows, reference being made to Fig. 4. The actuating screw of slide I carries a ratchet wheel N, which is revolved by means of a pawl on a lever O actuated as shown from shaft L^1. A gear wheel (not shown) also on L^1 gears with a wheel P, a stop on which, when the tool has been advanced to the root of the tooth being shaped, strikes a catch Q, so allowing a spring to actuate a bell crank lever R, one arm of which then strikes a pin on the pawl on O, so disengaging it. The slide I is then moved back to its starting position by hand and the operation repeated. To cause the tool to follow the shape of the teeth being shaped, the wheel being operated on is rocked by the following mechanism:—Supported by and sliding in bracket G is a segmental rock bar S, operated by a pinion S^1 on the end of which is carried a "former" T (Fig. 2), of a shape similar to that of the teeth being shaped. This "former" is arranged to be pressed on to two contact pieces U U^1 (Fig. 3) carried by a bracket U^2 adjustable on slide of face I. Fixed to the end of S is a cord V carrying a suitable weight. When said cord is placed over pulleys, as shown, it causes T to press on the contact piece U, but if in the position shown by dotted lines (Fig. 2), T

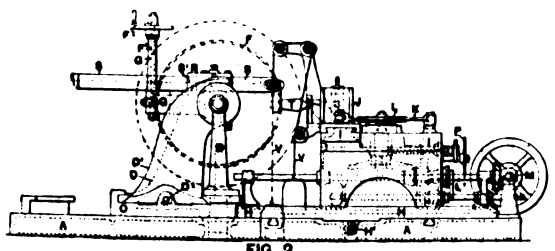


FIG. 2

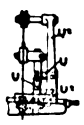


FIG. 3

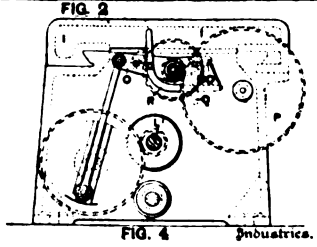


FIG. 4

will be pressed on U^1. It will thus be seen that as the tool and slide I is advanced the shaft E, and consequently the wheel, being operated upon will be rocked according to the shape of T. The above-described feed motion is used only when the teeth of spur wheels are being shaped. When, however, bevel wheels are shaped the work is fed to the tool by means of a worm W engaging rack teeth on the circumferential edge of C, the said worm being operated from shaft M by means of an automatic feed motion similar in all respects to that applied to slide I and suitable intermediate gearing. Claims: The arrangement of machinery above described for shaping the teeth of bevel and spur wheels, wherein an automatic feed and stop motion is provided for bringing the traversing tool to the work, or the work to the traversing tool, and arresting the action of the machine, and wherein also the axial motion of the work is controlled (independently of the dividing wheel control) by means of a "former" or "copy," for the purpose of giving the requisite profile form to the teeth.—No. 6669. April 30th, 1890. 1*s.* 1*d.*

WATER GAUGES FOR STEAM BOILERS.—*J. Dewrance & G. H. Wall, London.*—The invention embraces the use of a ball valve in the top arm of a water gauge to prevent the rush of steam should the gauge glass break. The valve is contained in a chamber connected to the screw plug which closes the opening through which the glass is introduced. The upper part of this valve box fits into a diaphragm formed in the body of the water gauge, and between the valve box and the end of the screw of the plug there are suitable openings for the passage of the steam to the valve box. The passage for the steam from the boiler is above the diaphragm and above the top of the valve box. Underneath the diaphragm is a circular cavity larger and deeper than the valve box communicating with the glass, and there is a hole in the side of the valve box below the diaphragm for the passage of the steam to the glass. The floor of the valve box is inclined so that the ball normally rests at the opposite side away from the hole in the side thereof. The ball is, however, forced against the hole in the side of the valve chamber when the rush of steam increases. Claims: The improved apparatus and arrangements whereby an automatic valve is put into and taken out of the top arm of a water gauge.—No. 4924. March 29th, 1890. 6*d.*

MULTITUBULAR BOILERS.—*P. E. J. & G. A. L. Niclausse, both of Paris, France.*—The invention has for its object a multitubular steam generator, the tubes of which can be separately removed, and are in equilibrium. In the annexed illustrations Fig. 1 is a

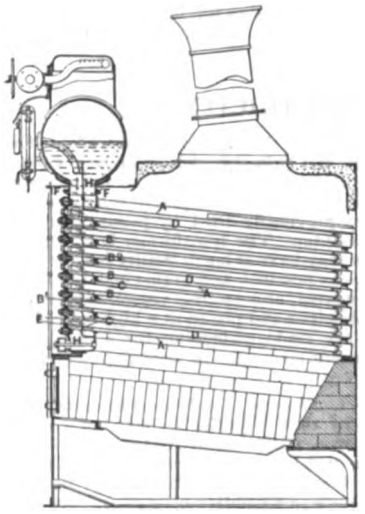


FIG. 1

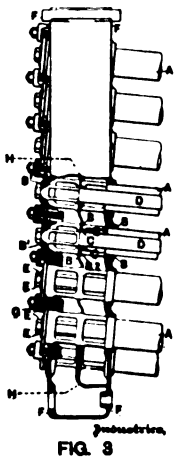


FIG. 3

side sectional elevation of such a boiler, Figs. 2 and 3 being enlarged details showing the connections of the tubes. This boiler is composed of one or more boiler tubes and circulating tubes substantially as shown, the connections of said tubes being as follows:—The boiler tube A is fixed upon a piece B of malleable iron of lantern-like form slightly conical on the outside and closed at B^1 and having a partition at B^2. Upon the part B^1 is fixed a piece C, which carries the circulating tube D. A plug E is screwed into the end of A, and, extending as far as the partition B^2, is connected to the end of D, the said extension having openings formed in it. These tubes are fixed in a collector F, in the opposite sides of which are made conical openings, which

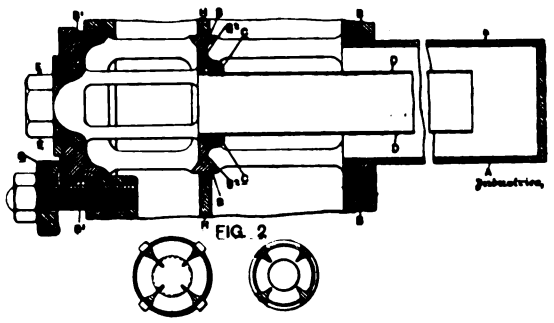


FIG. 2

correspond with the conical faces of the lantern-piece B, said pieces, and so the boiler and circulating tubes, being held in place by means of a safety fixing-bar G. The interior of F is divided longitudinally by partition H, so that the tubes are in equilibrium. Claims: (1) The new arrangement of steam boiler, substantially as described and shown; (2) the combination in a generator of two concentric tubes mounted on one or several collectors; (3) the arrangement, which permits each of these generators placed in a collector to be in perfect equilibrium and to be capable of being dismounted wholly or in part entirely at the front of the generator, all substantially as described and shown.—No. 1052. January 20th, 1891. 8*d.*

SHAPING MACHINE TABLES.—*J. R. Robinson & E. Rhodes, both of Leeds.*—The invention relates to an apparatus for holding the material to be operated upon. The apparatus is applicable to the jaws of parallel vices used for holding the metal whilst being cut, or it may be independent of the vice and secured to the machine table, and consists in forming on each vice jaw, or on separate blocks, a hinged jaw, centred on a pin acting as a fulcrum, the jaw being provided with a cut facing for holding the material to be operated upon. On nipping the material to some extent between the jaws by the vice screw, or placing it between the separate blocks secured to the table, the material is finally secured by tightening screws passing through some portion of the hinged jaw, by which the face of the screw is caused to grip the material, and at the same time press it downwards on to the table. Claims: A block or other support, to which is hinged on a fulcrum a vice jaw in such a manner that the material is secured between the jaws by a screw passing through a lug, all substantially as described.—No. 17588. November 1st, 1890. 6*d.*

PILE DRIVING MACHINES.—*W. Hood, Pernambuco, Brazil.*—To the chain is attached a frame carrying two or preferably three pawl levers with their lower ends latch-shaped, these levers being arranged radially round the centre of the frame and loaded so that their latch ends lie inwards towards the centre; the upper ends of the levers are curved a little inwards. To the top of the "monkey" is attached a stem carrying a cone, the base of which forms a shoulder round the stem. At or near the top of the frame of the machine is suspended a bell-shaped casing through which the chain passes, and this bell can be raised or lowered according as a greater or less descent of the "monkey" is desired. The operation is as follows:—On lowering the chain the pawl levers, encountering the cone of the "monkey," latch over it and catch under the shoulder at its base. On now raising the chain, the "monkey" is raised until the ends of the pawl levers enter the bell and are pressed inwards, thus withdrawing the lower ends from under the shoulder of the "monkey" cone, so allowing the latter to fall. Claims: In a pile driving machine the combination of the stem shoulder and conoidal head of the "monkey," the frame suspended from the chain with latch levers pivoted thereon, and the hollow cone to receive the upper ends of the latch lever substantially as described.—No. 7797. May 19th, 1890. 6*d.*

RAILS, FISH-PLATES, AND CHAIRS.—*J. Edwards, Folkestone, Kent.*—According to this invention the rail is made reversible, the groove between the two flanges on each side of the rail being rectangular. A projection on the upper end of the inside fixed jaw enters the rectangular slot on one side of the rail, whilst a similar projection in the form of a rabbit on a second and loose jaw partly enters the groove on the other side of the rail. This jaw, as well as the outside fixed jaw, is so formed that it can be held between the latter and the rail. One half of the fish-plate is made to fit the section of rails in use at present, the other half being made to fit the improved section of rail. Claims: (1) The use of a reversible rail; (2) a loose jaw shaped substantially as described.—No. 4722. March 26th, 1890. 6*d.*

DOUBLE-HEADED SPLIT BOLT.—*W. Marsh, London.*—The invention relates to bolts or pins for connecting together shackles of chains, &c., and is constructed as follows:—A bolt having a head at either end, one end of which is split in such a manner as to allow it to close while passing through the hole, the two parts of the split end of the bolt being pressed through the hole, but springing back to their normal position immediately after passing through, and the bolt being prevented passing back again. In modifications, the pin is tapered at the split end so that the head on that end is about the same diameter as the solid part of the pin, the two parts of the split being forced apart after it has been inserted by screwing a tapered pin into the slot. Four claims are made, embracing the double-headed split pin constructed substantially as described, with several modifications.—No. 7133. May 7th, 1890. 8*d.*

LOOMS.—*I. S. Lodge & G. Littlewood, both of Huddersfield.*—The invention embraces a method of preventing the breakage of picking sticks of looms when the shuttle box either becomes wedged while changing or does not complete a change. Fig. 1 of the accompanying illustrations is a front elevation, and Fig. 2 a side elevation partly in section of a picking stick bracket, a portion of the box-lifter rod and picking stick, to which the present improvements are applied. The picking stick bracket A, picking stick B, picking strap C, and box-lifter rod D are of the usual construction. Fixed to A is a box-shaped bracket E,

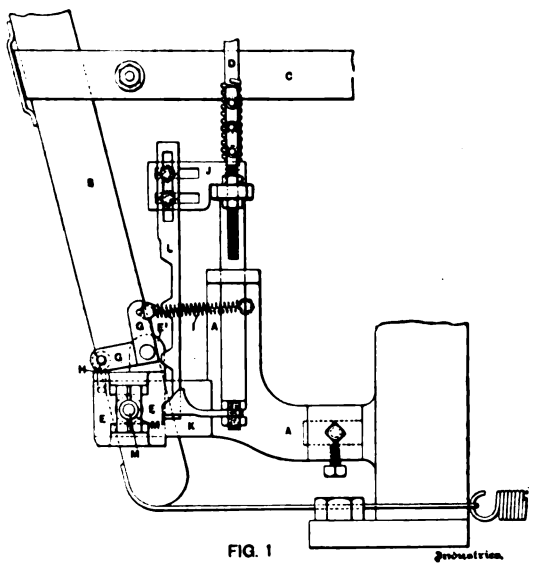
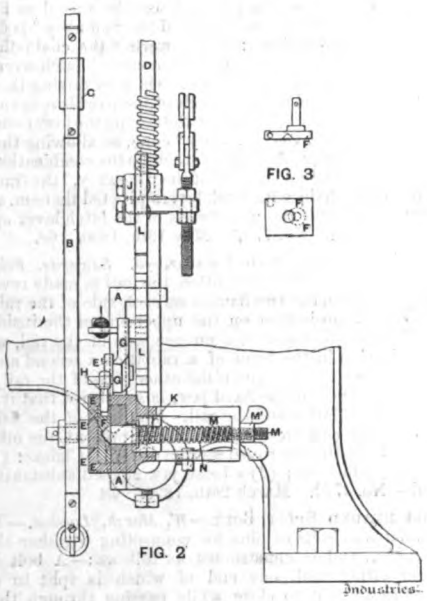


FIG. 1

within which slides a plate F (Fig. 3) carrying the picking stick stud projecting through a horizontal slot in E. Pivoted on a projection E^1 on E is a bell-crank lever G, on one end of which is suspended a pin H, whilst the other end is connected by a helical spring I to A. This pin, when the parts are in their normal positions, projects through a hole in E into a recess in the edge of F. Mounted on the box-lifter rod D, above the ordinary heavy sleeve, is a bracket J, and between the lock nuts is a forked bracket K, between which is mounted a bar L capable of horizontal and vertical adjustment, as shown. This bar is provided with V-shaped projections corresponding in number and distance apart from centre to centre to the number and distance apart of the shuttle boxes. Against the bar is pressed a V-shaped projection on the lever G by spring I. To prevent the accidental displacement of F a bolt M, supported by a bracket on E pressed forward by spring N, passes through E, and the point thereof enters a shallow counter-sink in F; said bolt is made adjustable by means of wing nut M^1. From the above, it will be seen that the plate F will be locked in position by pin H when each change of the shuttle box is complete, but will be free when the changes take place. Should the shuttle boxes be arrested therefore, in any intermediate position so that the pick cannot take place, the plate F, being unlocked, will be free to be thrown out by the pull

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of the picking strap and breakage of the picking stick will be thus prevented. Claims: (1) In a loom, the employment of a dislodgeable slide carrying the picking stick stud, which slide is locked when the shuttle boxes have completed a change but is unlocked when the shuttle boxes occupy an intermediate position, and is then free to be thrown out by the pull of the picking strap, as specified; (2) the means for locking and unlocking the said dislodgable slide by the up and down movement of the box-lifter rod,



applicable to looms with any number of shuttle boxes, as described; (3) the device for retaining the dislodgable slide in position when unlocked to prevent accidental displacement thereof,; (4) a modification of the locking device applicable for two-box looms; (5) the apparatus constructed and operated substantially as and for the purpose specified.—No. 7100. May 7th, 1890. 11*d*.

Apparatus for the Manufacture of Illuminating Gas.—*R. Mannesman, Landore, R. S. O., South Wales.*—The object of the invention is to effect the heating from within the retorts by burning a portion thereof, and storing up the heat generated in incandescent coke, the heat of which is transmitted by means of the produced gas itself to the fresh gaseous coal. Referring to the annexed illustrations, Fig. 1 is a vertical section and Fig. 2 a sectional plan of an apparatus for this purpose, in which two retorts A A¹ are employed in combination with one gas main B and one chimney flue C. The charging hopper D, for feeding fuel periodically into the producer, is closed by a valve E, and the upper end of the producer communicates by a branch tube F, with a tube G common to both producers, communicating at its lower end by two branches H with the ashpit of the producer. At I the producer has an annular cavity, which communicates by a tube J with a valve chamber K, communicating by a pipe C with a chimney flue, the openings of the tubes J in the valve chamber K being controlled by one and the same valve M, carried by an arm M¹, which in one position closes the communication between the producer A¹ and the chimney flue C, leaving the communication between A and the chimney open, while when in the opposite position said communications are reversed.

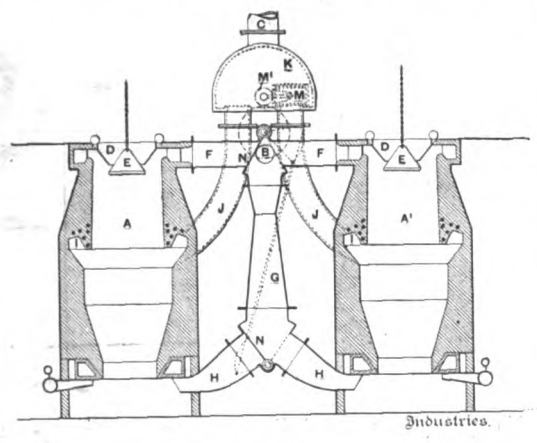


FIG. 1.

In the tube G are arranged two flap valves N, mounted on spindles, by turning which they are made alternately to open the communication between A¹ and the tube G, as also with the gas main B, and to close the communications with A, as shown in the illustration, while in the opposite position of the valves the said communications will be reversed. O are pipes for leading air under pressure to the lower ends of the producers. The action is as follows, reference being made, however, to only one of the retorts, the action of the second retort being similar, only in reverse order. After the retort is charged with coal and is ignited at the lower end, air is periodically admitted to the ashpit, and at the same time the flue leading to the chimney is opened. The fire so extends upwards, at the same time converting the lowest part of the charge into incandescent coke. The air supply to the ashpit is then closed, as is also the chimney flue, and the gas outlet and the communicating channel between the upper and lower ends of the producer are opened, whereupon a portion of the gas produced is caused to pass, by suitable means, from the top to the ashpit. A portion of the illuminating gas is thus forced to pass through the incandescent coke, so taking up heat therefrom, and in ascending it gives off such heat again to the upper cold part of the charge, thus heating the same, and eventually distilling off the volatile constituents. A portion of the gas thus produced is again drawn off, as before, for effecting a second circulation for the transmission of heat from the coke into the upper part of the charge, while the remaining

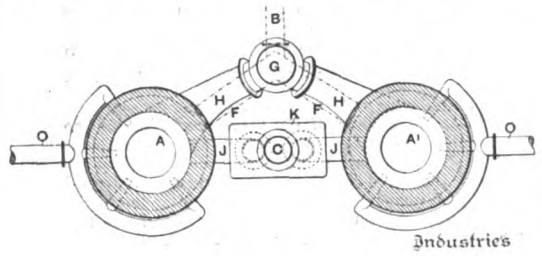


FIG. 2.

portion is led off into the gas main, and is there cooled, purified, or otherwise treated, in the usual manner. Three claims are made, embracing the method and apparatus for the production of illuminating gas substantially as described.—No. 1237. January 23rd, 1890. 8*d*.

ELECTRICITY.

Transformers.—*L. Pyke & H. T. Barnett, both of London.*—The different layers of the primary and secondary coils are separated by means of porous paper, and the whole is suspended in a glass vessel, in which circulates a liquid insulator, such as paraffin, which has been previously dried by passing through a filter of powdered potassium. The transformer is so arranged that the liquid insulator may have as much facility for circulating round and through same as possible, and to this end the surface of the container is corrugated, or a cooling vessel, connected to the container by suitable pipes and placed at a higher level, may be used. Five claims are made, embracing the method of insulating and cooling transformer coils as described.—No. 3900. March 12th, 1890. 6*d*.

Transformers.—*J. A. Kingdon, London.*—The cores of the transformers embraced by this invention are made of a number of thin plates of soft iron piled one above the other. These plates are of the same width, but at intervals one or two are longer than the rest. Insulating material is wrapt round the pile of plates, and primary and secondary coils of insulated wire wound outside said insulating material. The primary and secondary coils are preferably split up into a number of sections placed alternately and separated by insulating material. Outside the coils and separated from them by insulating material or an air space are wound a number of coils of thin iron strip. These coils are in contact with and wound round the projecting ends of the iron cores and are at right angles to the wire coil. Bolts pass through the ends of the longer plates and hold the whole together, which is then cemented in a metal box. Claims: (1) An electrical transformer having its core constructed of iron plates, some of which are longer than and project beyond the rest, and having its magnetic circuit completed by winding iron tape or wire outside the primary and secondary coils between the projecting iron plates as described; (2) the combination in a transformer of short iron plates with primary and secondary coils, long iron plates, and coils of iron tape; (3) the combination of short iron plates separated at intervals by long iron plates with coils of iron tape and coils of copper wire; (4) the core of a transformer as described; (5) cementing a transformer into a metal box; (6) the combination of a transformer and metal box as described.—No. 7624. May 16th, 1890. 8*d*.

Electric Meters.—*S. Z. de Ferranti, London.*—The invention relates to meters in which a bath of mercury is caused to rotate by a passing current, which rotation operates recording mechanism, as described in prior patents, No. 5926 of 1883 and No. 701 of 1887. A meter of this description is shown in the annexed illustrations, of which Fig. 1 is a vertical section, Fig. 2 a side

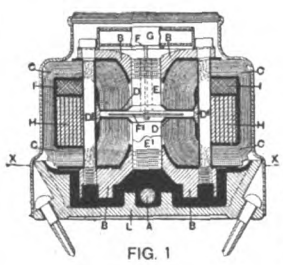


FIG. 1

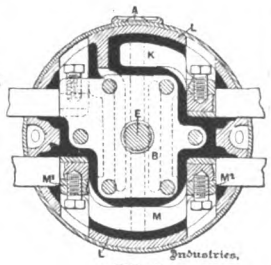


FIG. 3

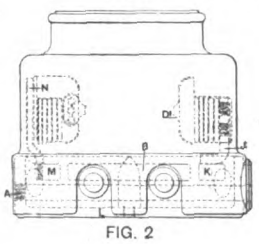


FIG. 2

elevation, and Fig. 3 a horizontal section on line X X, Fig. 1. Held together by means of bolts A and clamping plate B are two annular troughs C formed of a number of stamped sheets of tin plate, which when placed together are heated sufficiently to cause the tin coverings to unite. These troughs hold between them the mercury bath formed of two discs D connected together at their peripheries by clamping ring D¹. Screwed into the centre of the discs D are the ends of screws E E¹, the other ends of which are screwed into the centres of the plates B. The screw E is hollow, and the spindle F of the disc F¹ which is immersed in the mercury rises up through the hollow to the recording mechanism contained in a casing G. Between the troughs C are also held the main coil H, formed of strips of metal, and an additional coil I, through which a branch circuit from the mains is allowed to pass as described in patent No. 701 of 1887. A vertical division for preventing circular currents is formed across one side of the annular casing formed by the thin iron troughs. A vertical division is also formed partially through the opposite side of the trough. At one side the vertical division is utilised by placing in it the conductor J leading to the outer end of H. The conductor is led downwards and connected to a bar K, embedded in sulphur in the iron casing L of the meter, in which is formed a socket to receive one of the conducting wires leading to or from the meter. On the opposite side of the casing the conductor to the outer end of the shunt coil I is made to lie in the division. The bottom clip plate B is also embedded in sulphur in the centre of the cast-iron base L. It is formed with a socket in which the end of one of the pair of conductors of the supply main may be attached. The end of the other conductor of the supply main is similarly clamped in a socket M¹ formed in a conducting bar M which is also embedded in the sulphur. At the opposite end of the bar is another socket M² in which the end of one of the conductors of the main to be supplied is held. In this way when current passes to the bottom clamp plate B from the supply main it passes by the clamp screws A to the top clamp B, and from both clamp plates through the screws E, which pass to the centre of the mercury bath and through the mercury to the outer ring D¹ of the mercury bath and from there to the inner end of the main coil H and through the coil to the conductor bar J which is attached to it, and so to the bar K and the main to be supplied. The outer end of the additional or shunt coil I is connected by the conductor N to the conductor M, which has one end of the supply main and of the main to be supplied attached to it. The inner end of the shunt coil I is connected to the outer ring D¹ of the mercury bath. Twelve claims are made.—No. 3096. February 26th, 1890. 11*d*.

Dynamos.—*W. Emmott & J. H. Rider, both of Halifax.*—The improvements relate to the winding of armatures of alternate current dynamos, the core of the armature being of the drum or ring type. A number of conductors are laid side by side upon the outside of the armature in a direction parallel to the spindle. They are then bent under an insulating piece on the end plate of the armature and returned on the outside of the armature, and near to the first set. This process is continued until the winding is completed, the bands of conductors forming in plan a sinuous curve. The ends of the conductors are brought out near each other on one side of the armature, and are then connected, the final ends being carried to the collecting rings. The spaces between the windings on their periphery may be filled with non-conducting material and the whole secured by wire binding. Five claims are made.—No. 5562. April 12th, 1890. 8*d*.

CHEMISTRY.

Treatment of Metal Bearing Bodies.—*W. C. Loe, London*—This invention embraces a method of recovering metals from their matrices, especially of precious metals. In dealing with free milling matrices, or only gold-bearing materials pulverised, the bulk is calcined with about 1-40th part of potassium or any other suitable alkaline agent and 1-80th part of sulphur to a dull red even heat, and so maintained for two to four hours. By using sulphur and potassium, persulphide of potassium is formed, which takes up the metals. After the material has been washed in a slight solution of persulphide of potassium at about 200°, the solution is drawn off and the persulphide of gold precipitated and refined in the usual manner. In dealing with refractory or complex ores, the materials, pulverised, are mixed to pug consistency with a saturated solution of proto-sulphate of iron, dumped, calcined, and again saturated with a solution of sulphide of potassium, and allowed to remain about forty-eight or sixty hours. The metal-bearing materials now part with the iron and gold, which are taken up with the sulphur, and form sulphides of metals. The treated material is then washed in water at 200°, and, when settled, the solution is drawn off. The potassium acting on the silicious matter releases the metals, and they are then precipitated with a saturated solution of sulphide of lime, which takes up the metals and forms an intense black slime. This, on being washed, disengages all sulphurous gases, when the said slime may be fluxed and refined in the ordinary way. Claims: The described means and process for the extraction and recovery of metals from metal-bearing bodies (without the use of agents such as mercury, chlorine, or electricity) by regulating the necessary agents to set up chemical conception whereby the metals are released from their bodies and form sulphides.—No. 5937. April 18th, 1890. 6*d*.

MISCELLANEOUS.

Manufacture of Iron and Steel.—*A. Turner, Greenock, & A. & M. B. Baird, both of Glasgow.*—The process embraced by this invention is as follows:—A quantity of the crude metal is reduced to a molten state in a furnace and a quantity of pure metal reduced by electricity then added. The reduction of the pure metal is effected by placing it in proximity to the furnace containing the crude molten metal and the passing through it a current of electricity. Claims: The improved process of manufacturing iron and steel, substantially as described.—No. 5545. April 12th, 1890. 4*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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SIMPSON'S TRAIN INDICATOR.

We give illustrations herewith of a train indicator which has been very largely adopted by the Lancashire and Yorkshire and several other railway companies. As will be seen, it consists of a wooden frame, which is fitted with drums and oscillating shutters, to enable the names of the stations at which a train will stop and the time of its departure to be displayed. The aim of the invention is to provide a ready means by which a number of combinations of names can be easily shown, and there is hardly a limit to the number obtainable from a small-sized machine. At the upper portion of the frame a special compartment is formed, in which three drums are placed. One of these is numbered on its periphery with figures from 1 to 12, representing the hours; the second one is numbered 1 to 5, and the third from 0 to 9, the two latter representing minutes. By bringing any one of these series of figures behind an aperture cut in the front of the compartment containing the drums it becomes visible to intending travellers. The mode of setting these drums is as follows:—On the axis of each drum is a small pinion A gearing with a toothed rack B fastened at the upper end of a rod of timber C, which at its lower end has a ratchet D fixed. The teeth of the ratchet are so pitched that by moving the rod one tooth the drum is rotated a distance equal to the distance apart of the figures. When the rod is lifted, as it can be by hand, it is retained in position by the spring pawl E, shown. This arrangement of drums is shown in Fig. 1 in front elevation, in Fig. 2 in side elevation with the cover removed, in Fig. 3 in sectional plan through the line X X, and in Fig. 4 in sectional plan through Z Z.

Referring now to Fig. 2, each name board F is hinged on a centre, and is triangular in section, as shown. On one flat only of the board the name of a station is painted, and a pin or tail G projects backwards from the board. With this tail a pin H, which is fixed to one of the vertical rods J, engages, when thrust through the rod sufficiently far, and it is obvious that the number of boards which will be affected by any of the rods depends upon the number of pins in it which engage with the tails at the back of the boards. Thus it is possible to fix the pins in any of the bars or rods so that all the name boards will be affected, or only one may be engaged. To meet the need for several combinations a number of vertical rods, as shown in Fig. 4, are used, these corresponding in number to the combinations required. The pins are fixed as desired, access being obtained from the back of the case for this purpose. A rocking shaft M, in which a long key is fastened, is connected with the door L of the frame, shown open in Fig. 2, by the levers indicated, and sliding on the key is an adjustable arm or lever, which can be moved along under any of the rods according to the combination required. After this is done the mere closing of the door raises the rod and oscillates the name boards, making the names of the stations it is desired to show visible from the outside.

There are many methods of arranging this indicator. It can be made single or double faced, and two can be placed side by side so as to indicate the trains leaving adjacent platforms. We can testify to the convenience which the indicator affords to the travelling public, and to further this a full list of the trains departing from the platform can be placed in a glass-fronted case below the name boards, and a hand arranged to point to the departure platform. The inventor is Mr. D. K. Simpson, St. George's Crescent, Liverpool.

SIMPSON'S TRAIN INDICATOR.

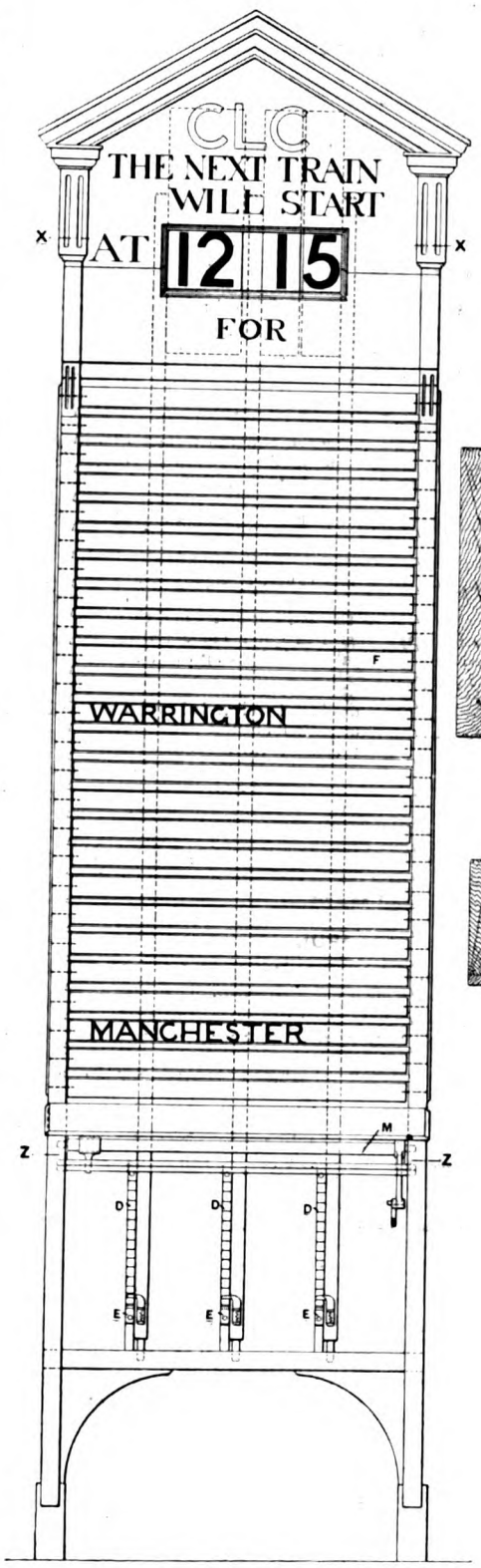


Fig. 1.

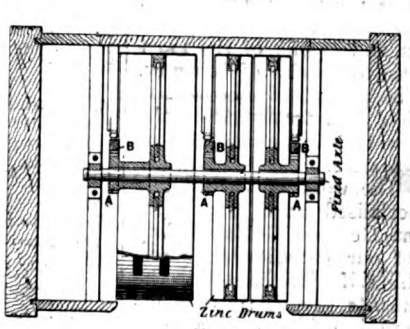


Fig. 3.

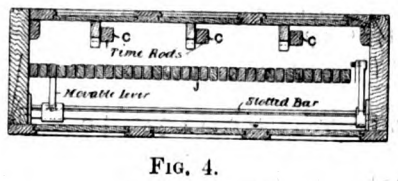


Fig. 4.

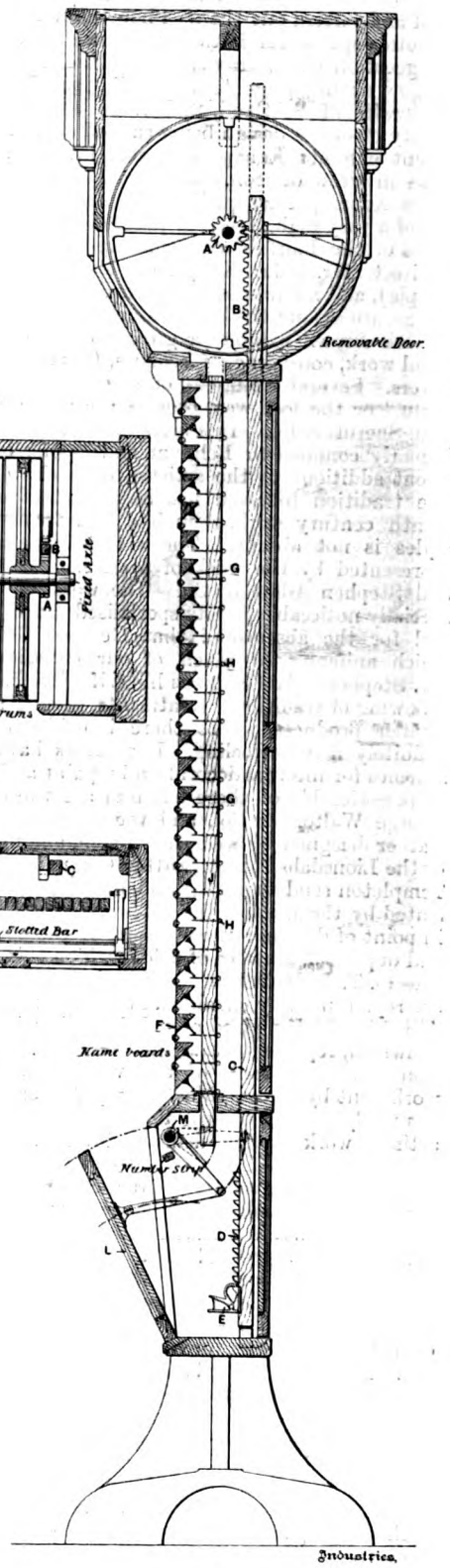


Fig. 2.

ARTS AND CRAFTS AT THE GLASGOW EAST END EXHIBITION.

The East End Exhibition at Glasgow has, throughout its course, been extremely successful in point of attendance. There are few exhibits of special novelty so far as mechanical interests are concerned, but there is one department upon which much care and thought have been expended, and which is exceptionally instructive and interesting. This is an Arts and Crafts Exhibition, somewhat on the model of the now well-known annual exhibitions held under that title in London. Although Glasgow is associated in the minds of most people with the heavier processes of manufacture—with iron smelting, steel making, shipbuilding, and the like—there is, nevertheless, great variety of the finer industries involving the exercise of artistic skill both in design and in craftsmanship. Thus, Glasgow divides with Manchester the trade of cotton printing, and with Kidderminster the trade of carpet weaving, and with London and Lancashire the trade of wall paper printing. All these industries involve the application of art to designs as well as of highly developed technical skill in the choice of materials. In all of these branches the products of the Glasgow factories bear a high reputation. In addition to these large industries are the relatively smaller, but still important, crafts of wrought iron and hammered metal work, artistic glass making, glass painting and staining. The remarkable and satisfactory feature about the development of these industries in Glasgow is that the lines upon which they have grown are not merely imitative. The artists and craftsmen who have been engaged in this development are really by degrees effecting an indigenous artistic growth. The Scottish artists and handicraftsmen are able to supply from their studios and workshops in Glasgow and Edinburgh native works of art which will bear comparison with the products of other cities whose artistic wares have a reputation of longer standing. Hitherto, examples of artistic work have for the most part been sent for exhibition to London. About two years ago a small exhibition of work was held at Edinburgh, and some objects appeared at all the recent international exhibitions; but the whole matter has been much more thoroughly developed at the East End Exhibition. Among Glasgow exhibits which have appeared in London may be mentioned the large designs in cast metal by Mr. Kellock Brown, a Glasgow sculptor, executed by him for the Savoy Hotel. Though the designs were made in Glasgow, the work was cast in London. As an example of an opposite course, the greater part of the metal work for the Church of the Holy Trinity at Chelsea, though designed in London, was cast by the Glasgow firm of Messrs. Wm. Sherriffs & Co.

A steady and increasing demand has been noticeable for some time for wrought iron, chiefly in the form of objects for domestic use and ornament. This industry has grown up in Glasgow during the last few years, and has effected somewhat of an attack upon the place previously occupied by cast iron. There is thus a chance of wrought iron resuming the position it held as a material in frequent use under the hands of the artist workmen in the Georgian period. Railings and gates are now being made in Glasgow quite as fine as one may find in cities like Bath, which have survived the change of fashion.

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The attempt made in the East End Exhibition to bring together a representative collection of work designed by Glasgow artists and executed by Glasgow workmen has been a conspicuous success. The success has, indeed, been so encouraging, that those who originated and carried out the idea hope soon to be able to promote a special Exhibition on a more extended scale. A suggestion has been made that the Corporation of Glasgow should promote an exhibition of the artistic handicrafts of Scotland, and there seems some probability of such a design being carried out. Among the present exhibits perhaps the most interesting are the works in wrought iron. The examples shown by Mr. James Adam possess qualities of design and workmanship of a very high order. A panel designed for the new offices of the Fairfield Shipbuilding Company by their architect, Mr. John Keppie (of Messrs. Honeyman & Keppie), and a flower stand, with delicate and intricate foliage, are among the best examples of this class. Mr. Kellock Brown exhibits a great variety of hammered metal work, consisting of sconces, friezes, plaques, and salvers. Several examples of metal casting by "cire perdu," or the lost wax, process are shown by Messrs. Wm. Sheriffs & Co. This method of bronze casting was formerly confined to Belgium, and is one of the most recent additions to the artistic industries of Glasgow. The tradition followed has been that of Scotch sixteenth century work, though a free treatment of the styles is not absent. The art of glass staining is represented by the work of Messrs. J. & W. Guthrie and Stephen Adam & Co. The work of the first is specially noticeable for its specialised colour treatment, and for the absence of that German Gothic feeling which animates so much of our ecclesiastical glass. Mr. Stephen Adam confines himself more closely to the following of traditional treatments, save in some of his smaller products, where there is evidence of a more definitely artistic feeling. Decorators have submitted schemes for internal decoration by paint and paper. The more noticeable of these exhibits are those of Messrs. George Walton & Co., and the examples of stamped leather designed by well-known men, and manufactured by the Lionsdale Patent Leather Company. The Messrs. Templeton send two rugs and one large carpet, all animated by the spirit of the old work of India and Persia in point of design, but restrained by the somewhat dull and depressed schemes of colour which this firm affects. Messrs. T. & D. Wilson & Co. and Inglis & Wakefield are represented by chenille and harness muslin curtains. A very complex piece of wood carving, by Mr. James Crawford, represents this class of work. Special mention should be made of the very remarkable plaster work sent by Messrs. MacGillvray & Ferris. This firm has really effected a revolution in the trade, their highly artistic work having demanded and secured general recognition.

Supplementing all these practical exhibits, and showing how a real link can be made between the work of design students in a school and their future work when acting in a commercial capacity, come the examples of students' works sent in by the Glasgow School of Art and Haldane Academy. The tendency shown in these studies seems to be the right one—namely, that of educating a designer for future rather than for present use. Acting upon the basis that no school should produce designs, but rather designers, a maximum amount of knowledge is imparted to the student, and thus, the largest future demand being met, all other demands naturally fall within the student's powers. The examples are designs for carpets and other textile fabrics, wall papers, metal work, stained glass, and pottery, together with the preparatory and coincident studies in painting work from the antique and life and modelling necessary for the purpose. Three gold medal studies—two for carpets and one for a printed hanging—are noticeable, together with other premiated works in modelling, textile fabrics, and stained glass, which, from the awards made them, seem to have taken a good place in the national competition. Just now, when the cry is all for technical education and practical utility in school work, these studies from the School of Art should prove that Glasgow at least is becoming alive to the real meaning of these terms.

THE PALERMO EXHIBITION.

In our issue of the 20th February last, we referred to the Exhibition which is to be held at Palermo from the 1st November next until the 31st May, 1892, and we mentioned the various sections which the Exhibition will comprise. We now give on the opposite page a general view of the buildings which are at present being constructed for this Exhibition, and which have been designed by Professor Ernesto Basile. In the grounds illuminated fountains are to be erected, while the tower shown in the illustration will be used as an astronomical observatory. The Exhibition and grounds will be lighted throughout electrically. No charge for space is being made in this Exhibition, and applications for space by intending English exhibitors should be sent to the Italian Chamber of Commerce in London, 4, St. Mary Axe, E.C., not later than the 30th inst. We are indebted to *Palermo e l'Esposizione Nazionale* for our illustration.

BOILER DEPOSITS.*

(*Concluded from page* 364.)

The next point I attempted to determine was the effect which these oily deposits had in allowing excessive heating of the plates to take place, and retarded the heating of the water. A clean iron vessel was taken, and a known volume of water placed in it, and heated by a carefully regulated Bunsen flame, the water being raised to the boiling point in ten minutes; this experiment was repeated a second time with the same result, and the vessel was then lined with a coating of deposit found in the bottom of the boilers which had collapsed, and rendered binding by admixture with a small trace more valvoline. This coating was laid on $\frac{1}{16}$in. in thickness, and the former experiment repeated, the same flame being used and the same volume of water taken, with the result that it took fifteen minutes before the boiling point was reached, showing that, even if no damage resulted to the plates from overheating, such a deposit would cause a large increase in the fuel used.

In attempting to ascertain to what extent extra heating of the plate took place from this cause, I employed a series of substances of known igniting and melting point, raised the water in the various vessels to the boiling point, and then brought the clean bottom of the vessel in quick contact with the test substance, and took the results as indicating the temperature of the exterior of the plates.

Clean vessel ...	Sulphur did not melt ...	below 115° C.	= 239° F.
Coated vessel...	Sulphur melted but did not inflame	above 115° C.	= 239° F.
		below 250° C.	= 482° F.
	Guncotton ignited	above 200° C.	= 392° F.

So that the $\frac{1}{16}$th of deposit caused with a slow heat a rise in temperature of the plate from under 115° C. or 239° F. to over 200° C. or 392° F. It is manifest, however, that the fiercer the heat the more marked will this overheating become, and in the next series of experiments the Bunsen flame was replaced by an atmospheric blowpipe, and the temperature attained, tested in the same way as before.

Clean vessel ...	Sulphur did not melt...	below 115° C.	= 239° F.
Coated vessel...	Guncotton ignites.....	above 200° C.	= 392° F.
	Tin melts	,, 228° C.	= 444·4° F.
	Sulphur ignites.....	,, 250° C.	= 482° F.
	Lead melts.....	,, 334° C.	= 633° F.
	Zinc melts (just)	,, 423° C.	= 793·4° F.

Whilst, on replacing the atmospheric burner by an oxy-coal gas flame, I found no difficulty in fusing a hole in the bottom of the vessel, which was made of thin wrought-iron plate, showing that a temperature of 1,500° C. = 2,732° F. had been attained, and it is therefore manifest that, with the fierce heat existing in the boiler furnaces, given an oily deposit only $\frac{1}{16}$in. in thickness, the plates will readily be heated to a temperature at which they are totally unable to withstand a pressure of 80lb. of steam, and collapse of the furnace crowns must follow.

The great points to be sought in a good lubricating oil are that it shall be a pure mineral oil, and that its boiling point shall be well above any temperature likely to be attained in the cylinder. Oils satisfying these requirements can readily be obtained, but users of lubricants must remember that, in order to obtain them free from any constituents of dangerously low boiling point, expensive processes have to be resorted to, which must of necessity increase the price of the oil, and that it is useless to expect to obtain a really good lubricant at a low figure. The great advantages of a good mineral oil cannot be too strongly insisted on, and any lubricant containing animal or vegetable oils to give it body should be unhesitatingly discarded. The mineral oils are not fats, but hydrocarbons—compounds of carbon and hydrogen—and the portions used for lubricants are those left after the more volatile constituents have been distilled off, and they differ widely from animal and vegetable oils, which contain so-called fatty acids, which are liberated from them by the action of superheated steam, and these acids attack iron, copper, and copper alloys with the greatest readiness, forming metallic soaps, which are compounds of the fatty acids with the oxides of the metals, and so cause serious damage to both boilers and fittings. The animal and vegetable oils, in contact with air, especially when heated, take up oxygen, and become gummy and resinous, and gradually so stiff that frequent cleaning becomes necessary, a trouble entirely avoided with mineral oils.

In dealing with the prevention of such deposits, it seems to me that the most feasible plan is to pass the feed water through a long tube filled with clean coke in pieces the size of walnuts, which would act as a scrubber, and would free the greasy water from the traces of oil, and prevent their going forward to the boiler. I have already pointed out that the collapse of furnaces from the presence of oily deposits almost invariably takes place in boilers fed with fresh water, and that oil, when it goes into the boiler, floats, because it is specifically lighter than water, until solid particles of calcium compounds coming in contact with it and imbedding themselves in it so increase its weight, that, reaching the same density as the water, it commences to circulate with the convection currents in the water, and is so drawn down, and attaches itself to tubes and furnace crowns, causing, eventually, damage. In the case of a transatlantic liner using fresh water only it takes at least four days' hard steaming to bring the density up to $\frac{1}{32}$nd, whilst if sea water had been used the density would have started at this and would never, after the first few days, have been much below $\frac{3}{32}$nds, and the oil would have remained as a scum, and have reached the furnace crowns.

In my last paper on boiler incrustations I pointed out that it was quite possible to prepare sea water in such a way as to practically prevent any serious deposit forming from it, and the same process would prevent the trouble I have now been describing to you. In the summer of last year Mr. Biles, who is always to the front when he thinks there is a chance of improving marine engineering, kindly gave me the opportunity of trying the effect of prepared sea water upon a crane boiler at the Naval Construction Works, at Southampton, and, after a few preliminary experiments to determine the best form in which to work the "precipitator," the boiler was worked continuously for a month with water drawn from the Itchen half an hour before high tide, at which period analysis showed that the water was to all intents and purposes sea water, plus a fair amount of suspended mud; this, after preparation in the "precipitator," was fed into the boiler, and on opening it in the presence of Mr. Milton, Mr. W. H. Riley, R.N., Mr. Biles, Mr. Gearing, and Mr. Dusantoy, it was found perfectly clean, the surfaces looking as if they had been given the thinnest possible coat of whitewash.

The process employed was to add to the sea water a known quantity of precipitator powder, consisting chiefly of soda ash, and, having done this in a closed vessel, to heat the mixture by blowing into it waste steam, until a pressure of from 5lb. to 10lb. was created, and under these circumstances practically all the magnesium and calcium salts separate from the water and are easily got rid of by filtering it under pressure into the hot well. I had proposed in the first case to heat the liquid by blowing the steam through a coil in the precipitator, but practical experiments soon showed that the heating surface was not nearly enough, and so the waste steam was simply blown in, allowance being made in the precipitator for the water due to the condensation. I also found it aided the reaction to heat the water first just to boiling point before adding the precipitator powder, as under these circumstances the deposit settled more quickly and threw less strain upon the filters. The precipitator was 6ft. 4in. high and 3ft. in diameter, and held a ton of water, and the time taken, from the first running the sea water in to its delivery into the hot well, was 1 hour 15 minutes, so that in practice, giving plenty of time between the makes, it would be perfectly easy to prepare 8 to 12 tons in the 24 hours with a small precipitator of the size used. The prepared water has a density of $\frac{1}{32}$nd, and may with safety be evaporated until its density is $\frac{5}{32}$nds, the salts present not crystallising out until a density of from $\frac{6}{32}$nds to $\frac{7}{32}$nds is reached.

Professor Doremus, of the College of the City of New York, proposes to use sodic fluoride as a precipitant for the scale-forming constituents of sea water, as a smaller weight is required, and the action is more rapid and more perfect. The great objection has, up to the present time, been its cost, but I am informed that this has now been so far reduced as to bring it within the scope of extended commercial use; and, should it be used on a larger scale, the price could be readily brought much lower. Professor Doremus claims that the precipitation of the calcium and magnesium salts takes place with very great rapidity, that the sediment shows no tendency to cake or adhere to the sides of a hot vessel, and that it is less bulky than the precipitate formed by soda ash. In preparing sea water in the way I have proposed, every precaution must be taken to add slightly less of the precipitant than is necessary to entirely throw down the calcium and magnesium salts, as it is manifestly impossible in practice to guard against small quantities of sea water finding their way into the boiler either from leaky condensers or else being fed in by the engineer during some emergency, and, if under these conditions any excess of the precipitant were present in the boiler, a bulky precipitate would be thrown down and cause trouble, although it would not bind into a solid scale. There is no doubt that, if Professor Doremus can so reduce the price of sodic fluoride as to enable it to be used for this purpose, it would be of great use, as the fluoride undoubtedly completes its action on the salts of magnesium and calcium more rapidly and thoroughly than the soda ash, and it would be easier therefore to so regulate the quantity added as to remove, say, five-sixths of the injurious constituents from the sea water without allowing any precipitant to enter the boiler.

In conclusion, I will briefly recapitulate the means which seem to me best adapted for preventing the formation of the dangerous organic and oily deposits I have considered in this paper, and these are:—

I.—Filtration of condenser water through a coke column.
II.—Free use of the scum cocks.
III.—The use of water of considerable density rather than of fresh water.
IV.—The use of pure mineral oil lubricants in the smallest possible quantity.

* Paper read by Professor Vivian B. Lewes before the Institution of Naval Architects on the 19th ult.

EXPERIMENTS ON THE FRICTION OF A PIVOT BEARING.*

The experiments on the friction of a footstep bearing, which form the subject of the present report, were tried in July, 1890, at Messrs. Simpson and Co.'s works, Pimlico.

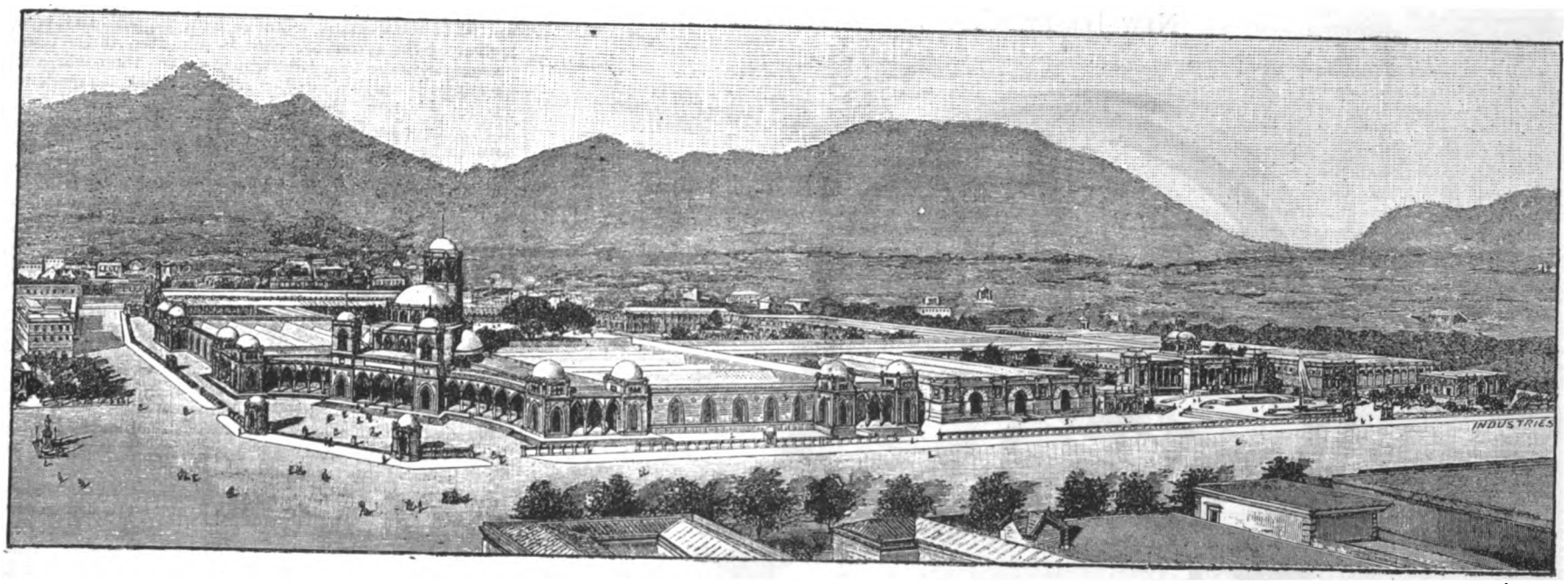
Description of the Apparatus.—The apparatus employed in these experiments is shown complete in the accompanying illustration, Fig. 1; and in enlarged detail in Figs. 2 to 4. The bearing experimented on was flat ended and 3in. diameter (Fig. 3). The vertical shaft carrying the footstep F was geared to a horizontal shaft (Fig. 1), which was driven by a belt from the shafting of the works. Variations of speed were obtained by keying pulleys of various diameters on the horizontal shaft. The bearing B was pressed upwards against the footstep by an oil press P with a plunger 6in. diameter. This plunger was made a good but perfectly free fit in its cylinder for a length of 9in., a number of grooves being turned in the cylinder throughout its whole length at close intervals. The pressure was applied by means of a small hand pump, provided with an air-vessel, pumping oil out of a tank into the press. It was found that the

* The Institution of Mechanical Engineers' fourth report of the Research Committee on Friction, read on the 19th ult. For previous reports see Proceedings 1883, p. 632; 1885, p. 58; and 1888, p. 173.

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THE PALERMO EXHIBITION.

(*For description see page* 386.)



General View of Exhibition Buildings.

leakage of the oil past the plunger, even with the highest pressures, was exceedingly slow, requiring only an occasional stroke of the pump to keep the pressure constant; and at the same time the friction was practically nil. Into the top of the plunger was let a piece of hard steel (Fig. 3) having a conical depression or centre pop, wherein rested a hard steel conical centre, which was formed on the bottom of the plate L that carried the bearing. This plate was circular (Fig. 2) and had a groove turned in its

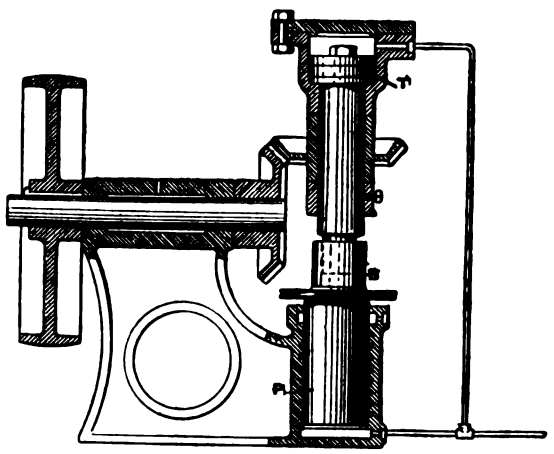
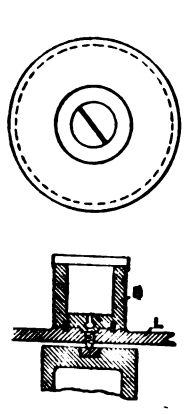


Fig. 1.



Figs. 2 and 3.

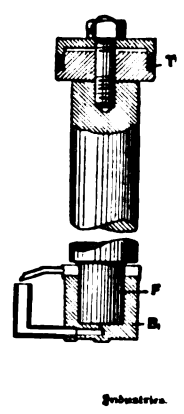


Fig. 4.

periphery; a small chain was fastened to the plate and lay in the groove round a portion of the circumference, from whence it led off to a spring balance attached to the fixed frame of the apparatus; so that the rotation of the plate stretched the spring balance, and the force tending to turn the plate was thereby indicated. The upper end of the vertical shaft that carried the footstep F had a piston T fixed on it (Fig. 4), which revolved in a cylinder 6in. diameter. This upper cylinder was connected by a pipe with the cylinder of the lower press P (Fig. 1), so that, whatever oil pressure there was in the lower cylinder pressing the bearing upwards, there was the same in the upper cylinder pressing the footstep downwards. This was a convenient way of providing for taking the upward thrust upon the experimental bearing. The footstep having been set running at the desired speed, the hand pump was worked until the pressure gauge on the oil press P indicated the desired pressure; and the friction was then read off the spring balance connected with the bearing plate L. The load could be quickly removed from the bearing by opening a cock for discharging the oil from the air vessel of the pump. This method of applying the load was found to be exceedingly convenient, and to be much superior in that respect to any of the methods used for this purpose in the former experiments made by the committee.

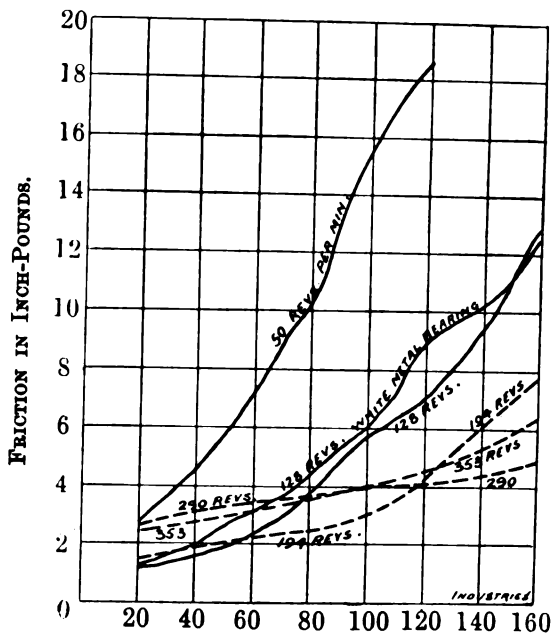


Fig. 5.—Load in Lbs. per Square Inch.

Lubrication.—The first method of lubrication tried was by introducing the oil through a hole in the centre of the bearing (Figs. 2 and 4), and distributing it through two radial grooves extending from the central hole to within $\frac{1}{8}$in. of the periphery of the bearing surface; these two radial grooves were opposite each other, so that they lay on the same diameter. A pipe and a passage drilled in the brass connected an ordinary lubricator with the central hole. When the experiments were started, it was found that the bearing took oil out of the lubricator pipe very fast, and delivered it out at the top of the bearing. This suggested the removal of the lubricator, and the soldering of a piece of sheet brass round the top of the bearing (Fig. 4) so as to collect the oil and return it by means of a small overflow pipe into the lubricating pipe. There was a sufficient space between these pipes to allow the dripping of the oil to be seen, so that the quantity passing could thereby be estimated. Thus the bearing proved to be a most efficient pump, causing a rapid circulation of oil through itself. At first, before the surfaces were worn down to a proper bearing, the oil was observed to be dirty, and charged with particles of brass; as long as this continued, the oil was diverted from the overflow pipe, and run to waste, while fresh clean oil was supplied to the lubricating pipe. When after running a few hours the oil from the overflow pipe was observed to be clean, it was turned into the lubricating pipe, and the bearing was then self-lubricating, and continued using the same oil over and over again.

TABLE I.—Experiments on the Friction of a Pivot Bearing. Steel Footstep on Manganese-Bronze Bearing.

The friction given is that of one face of the flat circular bearing surfaces, at the effective radius of the face—namely, 1in.

Speed.	Load.	Oil Drops per Minute.	Friction. Total.	Friction. Coefficient.
	Lbs. per Sq. In.		Inch-lbs.	
50 revolutions per minute.	20	20	2·77	0·0196
	40	26	4·61	0·0147
	60	40	7·07	0·0167
	80	50	10·25	0·0181
	100	54	15·48	0·0219
	120	56	18·72	0·0221
128 revolutions per minute.	20	79	1·13	0·0080
	40	82	1·54	0·0054
	60	80	2·26	0·0053
	80	83	3·59	0·0063
	100	98	5·48	0·0077
	120	84	7·02	0·0083
	140	90	9·23	0·0093
	160	84	12·82	0·0113
	260	—	heated and seized.	
	300	—	,,	,,
194 revolutions per minute.	20	196	1·44	0·0102
	40	stream	1·74	0·0061
	60	200	2·15	0·0051
	80	200	2·56	0·0045
	100	200	3·13	0·0044
	120	168	4·41	0·0052
	140	158	6·10	0·0062
	160	168	7·69	0·0068
290 revolutions per minute.	20	Continuous stream.	2·51	0·0178
	40		3·03	0·0107
	60		3·33	0·0078
	80		3·64	0·0064
	100		3·95	0·0056
	120		4·10	0·0048
	140		4·51	0 0046
	160	200	5·03	0·0044
353 revolutions per minute	20	Continuous stream.	2·36	0·0167
	40		2·72	0·0096
	60		3·08	0 0073
	80		3·59	0·0063
	100		4·00	0·0057
	120		4·51	0·0053
	140		5·23	0·0053
	160		6·15	0 0054

Results of the Experiments.—The arrangement for lubrication above described, with two radial grooves in a flat bearing of manganese-bronze with a steel footstep, was first tried at

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THE "BACKUS" GAS ENGINE.

CONSTRUCTED BY THE BACKUS WATER MOTOR COMPANY, NEWARK, NEW JERSEY, U.S.A.

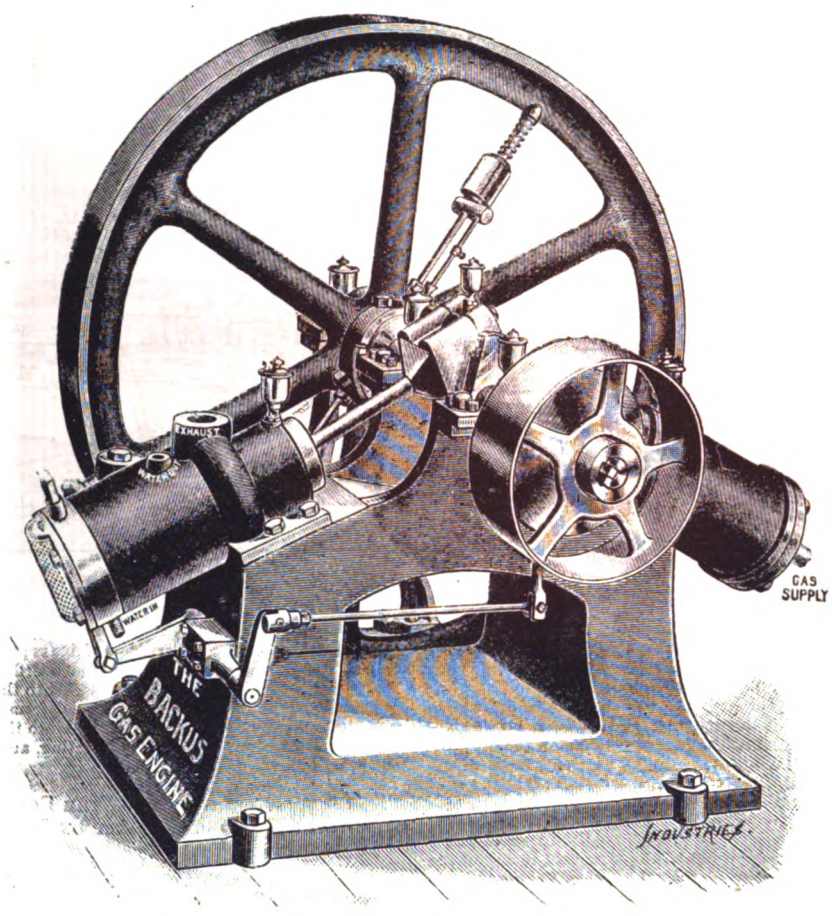


FIG. 1.

50, 128, 194, 290, and 353 revolutions per minute, as shown in Table I. (page 387), and in the diagram (Fig. 5) in which the load is given in lbs. per square inch of bearing surface, and the friction is in inch-lbs. The coefficient of friction is obtained by dividing the friction in inch-lbs. by the product of the load multiplied by the area of the bearing. The radius of 1in. is taken because it is two-thirds of the radius of the bearing. If the flat disc of bearing surface be imagined to be made up of a great number of sectors or triangles radiating from the centre of the circle, the centre of area of any one of these triangles or sectors is at two-thirds of the distance from the apex or centre to the base or circumference. Supposing any one of these triangles to be pulled along in a straight line over a plane surface, the line of force pulling it would pass through its centre of area, because it must be assumed that the friction per unit of surface is the same in all parts of the area of the triangle. It therefore seems reasonable to take two-thirds of the radius of the bearing as the radius at which the force of friction acts, for the purpose of calculating a coefficient of friction which will serve as a comparison between this and the other forms of bearings tried in previous experiments. Of course this view implies the assumption that the pressure is uniform over the entire surface, and that the friction is independent of the velocity. After these experiments with the steel footstep on manganese-bronze, a white-metal bearing surface was substituted for the manganese-bronze, the methods of grooving and lubrication being kept the same. A set of experiments were taken at 128 revolutions per minute, the results of which are shown in Table II., and in the diagram (Fig. 5). It will be seen that the coefficient of friction is a little larger with the white-metal than with the manganese-bronze, but the difference is so small that the results may be looked upon as practically identical; for when the friction is mainly between oil and metal, it should be independent of the nature of the metal. Probably the white-metal bearing was tried before it was worn down to quite as true a surface as the manganese-bronze.

An examination of the tables and of the diagram (Fig. 5) shows that at the higher speeds the coefficient of friction is less, owing to the more perfect lubrication, as shown by the more rapid circulation of the oil. That the lubrication and condition at the surfaces were fairly perfect is shown by the low coefficient of friction, which at the higher speeds with medium loads was in several cases under 0·0050 or $\frac{1}{200}$th.

After the completion of these experiments, the manganese-bronze and the white-metal bearings were tested for endurance at 128 revolutions per minute. The manganese-bronze bearing heated and seized on one occasion with a load of 260lb., and on another occasion with 300lb. per square inch. The white-metal bearing under similar conditions heated and seized with a load of 240lb. per square inch Besides the experiments of which the results are here given, the steel footstep on manganese-bronze was varied by lubricating with three and with four radial grooves; but the friction was from one and a half times to twice as great as with only the two grooves. This fact was carefully ascertained; and the plan shown in Fig. 2 of two opposite radial grooves—or, as they may be called, a single diametrical groove—was adopted for experiment as being decidedly the best.

GENERAL CONCLUSIONS.—These experiments show conclusively that a bearing of this character is capable of very perfect automatic lubrication, if provision is made for allowing the oil which overflows at the top of the brass to find its way back to the bearing surface at the bottom. Also that a single diametrical groove is better than any other plan. The perfection of the lubrication by this arrangement is proved by the low coefficient, which more nearly approaches the low values obtained in the first experiments, on a cylindrical journal running in an oil bath, than any since obtained.

TABLE II.—EXPERIMENTS ON THE FRICTION OF A PIVOT BEARING. STEEL FOOTSTEP ON WHITE-METAL BEARING.

The friction given is that of one face of the flat circular bearing surfaces, at the effective radius of the face—namely, 1in.

Speed.	Load.	Oil Drops per Minute.	Friction. Total.	Friction. Coefficient.
	Lbs. per Sq.In.		Inch-lbs.	
128 revolutions per minute.	20	60 to 70	1·23	0·0087
	40	,,	1·95	0·0069
	60	,,	2·92	0·0069
	80	,,	4·36	0·0077
	100	,,	6·15	0·0087
	120	,,	8·77	0·0103
	140	,,	10·25	0·0104
	160	,,	12·56	0·0111
	240	—	heated and seized.	

THE "BACKUS" GAS ENGINE.

THE accompanying illustrations, Figs. 1, 2, and 3, for which we are indebted to our contemporary, the *American Machinist*, represent a general view and longitudinal and transverse sections respectively of a new gas engine, which will be found to contain some points of interest. As will be seen by the engravings, the frame of the engine is of a modified A form, with the crank-shaft at the top, and there are two cylinders of equal size, which are inclined, the one at the left being the working cylinder, while the one at the right is a pump in which the mixture of gas and air is first received and compressed by the pump piston, after which it passes through a large pipe connecting the two cylinders, and is admitted to the working cylinder by a poppet valve, controlled by the governor. Gas is admitted to the compressing cylinder by a pipe which enters the cover, and air enters through a number of holes which are made in the cover around the pipe, as shown by the end view of this cover at the right of Fig. 3. The air holes are covered by a valve which is opened by atmospheric pressure, and seated by the pressure within the cylinder. The proportions of gas and air are controllable by a valve in the gas supply pipe. Near the working cylinder, and in the large pipe which joins the two cylinders, is a poppet valve, having a stem projecting through a stuffing-box below. This valve is kept seated by a spiral spring, and is lifted to admit the explosive mixture to the cylinder by a lever, which is pivoted to the side of the frame, and receives its motion from an eccentric placed inside the fly-wheel, as shown in section at Fig. 3. This eccentric is made in two parts joined together by a hinge-joint at one side, one of the parts being secured to the end of the hub of the fly-wheel by screws as shown, while the other is free to move upon the hinge-joint to give greater or less eccentricity, its tendency to fly outwards being resisted by a spiral spring.

The amount of eccentricity is controlled by the wedge seen under the eccentric in Fig. 3, and attached to one of the arms of the fly-wheel, and its distance from the centre of the shaft is controlled by the opposing forces of the spiral spring shown behind it, on the one hand, which tends to force it inwards and open the eccentric, while upon the other the centrifugal force of the weight under the spring tends to withdraw the wedge and allow the eccentric to close. A half strap fits in the groove of the eccentric below, from which, by suitable connections, the valve is moved, and admits more or less of the mixture to the cylinder, according to the power required, an explosion taking place at every revolution when necessary.

There is no exhaust valve; near the upper end of the cylinder has a narrow opening or port, which passes entirely around the inside of the cylinder, and connects with the large passage seen, which also extends around the cylinder, and at the top is connected with the exhaust pipe as shown. The piston passes over this port at the end of the stroke, and exhaust takes place. The igniter is seen at the left of the working cylinder (Fig. 1), and is operated by a cam placed on the crank-shaft just inside the belt pulley, shown in Fig. 1. A small jet of gas is kept burning, and a cylindrical valve operates to give communication with the contents of the cylinder at the beginning of the stroke. Provision is made for cooling the cylinder by circulation of water, as shown, and also for thorough lubrication.

It has been found by experiment that the regulation is satisfactory, and there is no trouble in starting this engine. It is built in various sizes by the Backus Water Motor Company, Newark, New Jersey, U.S.A.

THE ANNEALING OF COPPER.

IN an article on the Elmore copper process, in our issue of the 27th February, mention is made of the injury that may result from the exposure of copper to the complicated products of the combustion of gaseous or solid fuel in the process of annealing. In connection with this it is interesting to note that a new process of annealing copper and its alloys has been recently developed in America by Mr. G. Wyckoff Cummins, Ph.D., M.D., whereby copper during annealing is allowed to come in contact neither with products of combustion nor with the air. By this process the annealing is performed in upright annealers or horizontal retorts of cast iron, and the exclusion of furnace gases and air is effected by keeping the annealing vessel continually filled with steam at atmospheric pressure. The steam serves simply as a packing, and is to be considered in no sense as a heating agent. The retort with the contained copper is heated by any desired fuel, while, by present methods, carefully selected fuel must be used to prevent injurious gases from coming in contact with the heated copper.

As is well known, when copper is annealed in the ordinary manner in a muffle, the surface is oxidised to a greater or less extent, and if care be not taken in the heating, the copper is readily "burnt," to use the common expression. Burnt copper is so exceedingly brittle that it can scarcely be bent once at a right angle without breaking. When coarse copper wire is improperly heated in a muffle only the surface is burnt, while the interior

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THE "BACKUS" GAS ENGINE.

CONSTRUCTED BY THE BACKUS WATER MOTOR COMPANY, NEWARK, NEW JERSEY, U.S.A.

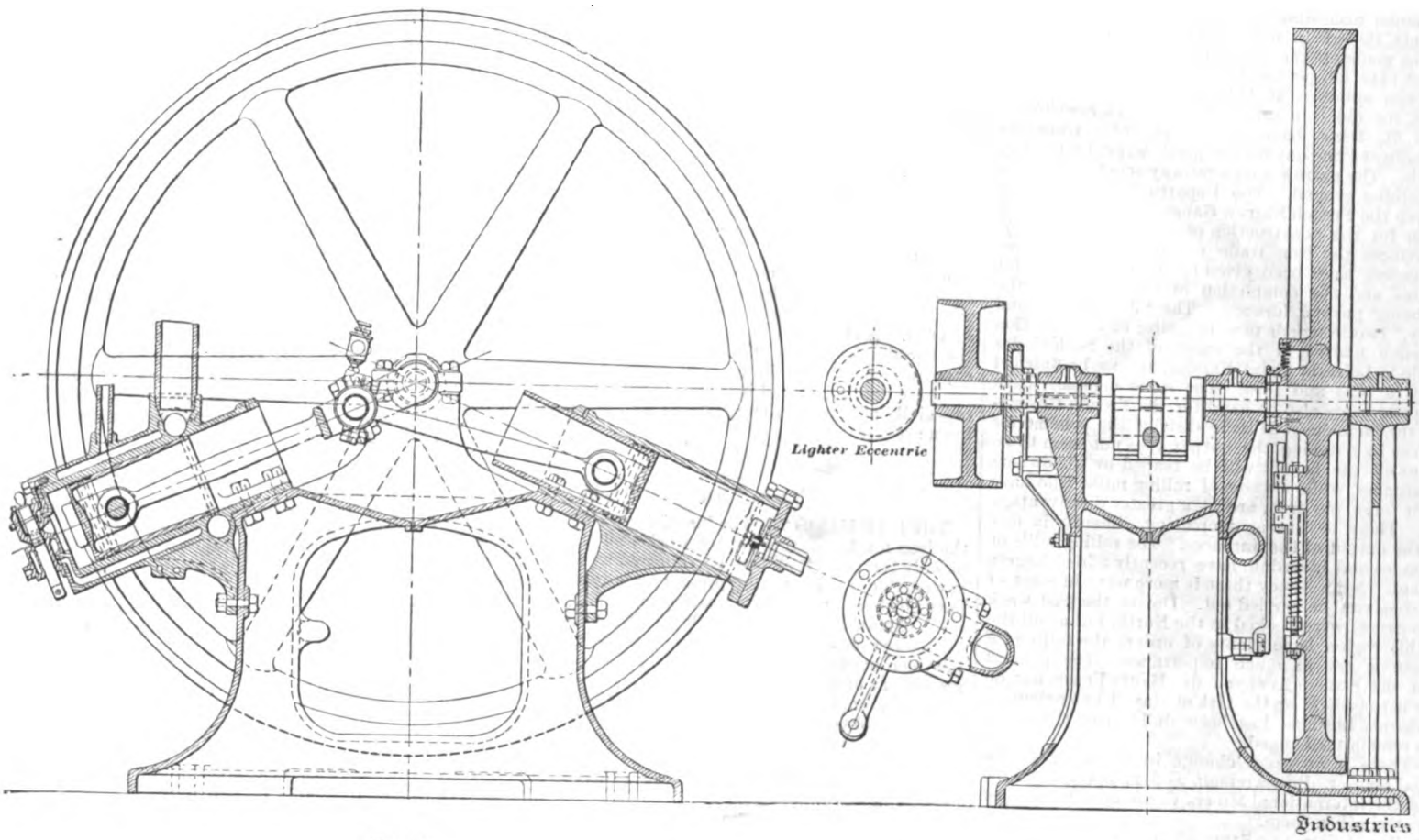


FIG. 2.

FIG. 3.

is damaged to a far less extent. This causes the exterior to crack and split loose from the interior on bending, thus giving the appearance of a brittle copper tube, with a wire neatly fitted into it. Burnt copper possesses decreased electrical conductivity, and it is quite possible to decrease this by 5 or more per cent. by burning copper wire to so slight a degree as scarcely to affect its other physical properties.

Various theories have been advanced to explain what occurs in the burning of copper. Carbon and carbon monoxide are known to combine with copper to the extent of a fraction of 1 per cent., and cause it to have some of the properties of burnt copper, and the presence of its suboxide causes copper to be quite brittle. But by far the most widely accepted view of burning is that the small amount of oxygen usually present in refined copper as oxide of some impurity is removed, and an impurity, such as arsenic, antimony, or lead, is left free to form a brittle alloy with the copper. It is probable that two or more of these reactions may occur simultaneously in the production of burnt copper. That the change is chemical, and not merely physical, is evidenced by the fact that if, by any means, chemical change is prevented ordinary heating will not produce burnt copper. The addition of oxygen, or the removal of the trace of oxygen usually present in even the highest grades of refined copper, causes copper so treated to suffer a deterioration of most of its desirable properties—viz., malleability, ductility, tensile strength, and electrical conductivity. It is apparent, therefore, that a perfect annealing process will allow neither oxidation nor deoxidation of copper to occur. Steam has no chemical action on copper at any temperature below its melting point, so that copper annealed in an atmosphere of steam does not suffer the loss of any desirable property. It has been found that the purer forms of copper are far less liable to be damaged during annealing than samples containing even a trace of impurity. When annealed in steam, this difference is not apparent. This enables a cheaper grade of copper to be used for purposes to which only the highest grades of refined copper have hitherto been suitable. The steam method of annealing copper, in addition, gives a perfectly bright product with no loss of metal as scale, and no necessity for "pickling" before further working, while the metal may be heated sufficiently to make it "dead soft" without danger of burning. The steam annealing process is, we understand, less expensive than the present method.

THE ATLANTIC RACE.

IN our issue of the 27th ult. we considered some of the probable characteristics of "The Ships of the Future," looking chiefly at the subject from the point of view of construction. There can be little doubt that the race across the Atlantic will be one of the most important factors in the production of the first-class passenger ship of the future, and in the development of its construction and increase of its speed. Since the first of the Atlantic "greyhounds" was built, and accomplished the voyage from Liverpool to New York in seven days, shipbuilders have always kept in view the problem which they were certain would soon be placed before them, of designing and building ships which would accomplish the voyage more quickly, and from time to time various designs were reported to have been made which were intended to be great advances on all that preceded them. But the British shipowner is naturally very cautious, and rightly so, and although each succeeding ship has been to a certain extent an improvement on all those which preceded it, there has been no great departure from ordinary practice. The following table shows the advance which has been made in size and power since the "Arizona" was launched:—

	Length in Feet.	Beam in Feet.	I.H.P.
Arizona	465	46	6,000
Servia	530	52	10,500
Alaska	520	50	10,500
Aurania	470	57	10,000
Umbria	520	57	12,500
Etruria	520	57	12,500
City of New York	560	63	18,000
Teutonic	582	57	16,000
City of Paris	560	63	18,000
Majestic	582	57	16,000

The newer of these are "six day" boats. When one of the earlier "greyhounds" was launched Sir William Pearce stated that, although these ships were great advances on their predecessors, he believed that the voyage could be made in very much less time, and he hoped that the owners of the leading lines would see it to be to their advantage to provide vessels of the newest style, each a distinct advance so far as speed was concerned on anything then afloat. This is precisely what has happened, but, as we have stated, in a very cautious and tentative manner, for the money invested in a first-class Atlantic steamer is not a trifle with which hasty and ill-considered experiments may be made.

But now it seems as if a greater step is about to be taken, and that both in this country and in America attempts are to be made to produce "five day" boats. The new Cunard liners and the vessels to be built by the Barrow Company are "dark horses," as no particulars have as yet been made public regarding them beyond the fact that they are to surpass their predecessors in size and speed. In America, however, the same reticence has not been kept with regard to the intentions, or rather the wishes, of the projectors of the lines which are beginning to spring up under the joint influence of the subsidy and the McKinley Act, but it is doubtful whether they have considered all the factors of the problem and the difficulties to be overcome. A "five days'" voyage means an average speed of 25 knots an hour, which is by far the largest step in advance which has yet been taken, and which will consequently require a very great increase in power. If the vessel were made an express boat, it would require to have engines indicating at least 25,000 horse-power, while, if it carry the usual amount of cargo for a first-class passenger ship, it will require about 5,000 horse-power more. The proper policy, in our opinion, to pursue in this matter is for shipowners to give up the idea of carrying cargo in these boats, so that they may be able to start on the return voyage after having sufficient time to coal and take in new passengers, but without the delay attendant on taking in cargo. The cost of such vessels would be very great, and, in order that they may be commercially successful, time must be economised to the very greatest extent possible. With regard to the construction of the hull and the engines, it is probable that there would not be much variation from those at present in use, although weight would be economised as much as possible, both in the design and by the greater use of alloys. From the paper read recently by Mr. Biles before the Institution of Naval Architects, we learn that American shipbuilders and engineers have made very great progress during late years, but we doubt if they are able to construct successfully such ships as we have been considering. To say the least, it would be a very risky experiment. The lead must, in any case, be taken by the managers of the British yards, and, having regard to recent progress we look forward with confidence to the near future, in the expectation of seeing vessels which will be capable of making the Atlantic passage in five days.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 21st April, 1891.

The Iron Market.—Prices during the past week have been maintained according to the tariff agreed upon by the merchants, though in most instances some reduction has had to be made on the quotations of 136s. 6d. per ton for bars, and 144s. 6d. per ton for joists. Orders for castings have been obtained at 114s. per ton, and there is a fair demand for old iron rails at 80s. 6d. La Société des Ateliers de St. Denis have secured an order from the Northern Railway Company for 600 goods waggons, to carry 15 tons each. The narrow gauge railway scheme seems to be slowly gaining ground. The Department of la Creuse has just given the French Narrow Gauge Railway Company a concession for the construction of 250 miles of railway. In the provinces the iron trade continues good. Some important orders have been given by the Government for armour plates, and the completion of vessels now on the stocks is being pushed forward. The "Jemmapes" and the "Valmy," two ironclads now in course of construction for the French marine, in the yards of the Société des Chantiers de la Loire at Saint-Nazaire, are to be finished respectively in 1893 and 1894. The same company have several torpedo boats also on hand for the French Government. In the Meurthe-et-Moselle district the scheme for raising prices by reducing the output does not seem to be a success, as all the benefit will be reaped by the owners of blast furnaces, while owners of rolling mills, who have to buy their forge pig iron, are at a greater disadvantage than ever. There is thus an increasing difficulty in disposing of the output of the furnaces. The rolling mills of Champigneules and Liverdun have recently added largely to their plant. Near Nancy there is more work in some of the shops than can be carried out. During the past week but few contracts were booked in the North, but as all the works in this region have plenty of orders the falling off in this case is not of much importance. The general meeting of the Scciété Anonyme des Hauts Fourneaux de Maubeuge is to be held on the 11th of May at Valenciennes. In the Ardennes business has been dull during the week, but prices remain unchanged.

Coal.—There is no great change in the state of the French coal market. Prices remain as firm as ever, and the decision of the International Miners' Conference has tended to further strengthen them.

Copper, Tin, Lead, and Zinc.—The copper market has not been so firm during the past week. Best Chilian bars were quoted at £57; ordinary Chilian bars at £55 5s.; and best selected at £59 5s. the ton. Tin has decreased slightly in value: Banca is at £98 10s., Billiton £96 5s., and Cornwall £100 12s. per ton. Lead is quoted at £13s. 5s., and zinc (Silesian) at £24 10s. per ton.

The Eiffel Pressure Column.—The "Manomètre" recently placed on the Eiffel Tower, being 300 metres in length, is capable of measuring a pressure of nearly 400 atmospheres. The tube, which is of mild steel, and is 4 millimetres in internal diameter, has been rolled out of old Chassepot rifle barrels. On this tube, at intervals, are placed cocks which lead into vertical graduated glass tubes, whose upper ends are connected by indiarubber joints with another down pipe leading to the receptacle for the mercury at the base of the tower, so that if one of the cocks should by accident be left open the mercury will not be wasted. M. Louis Cailletet, Member of the Institute, under whose direction the installation was made, hopes to be able to carry out some interesting experiments, which hitherto the want of a sufficiently long column has rendered impossible.

New Cotton Mill.—Messrs. E. & P. Sée, of Lille, have received the contract for the construction of a new cotton spinning mill at Euschedé. The mill will be built after the most modern designs, and will contain 25,000 spindles.

BERLIN, 20th April, 1891.

The Coal Market.—The condition of the coal market is unsatisfactory. The demand for coals for immediate delivery has considerably diminished, and there is a quieter development of traffic on the railways after the strain of the past few weeks. Orders for yearly supplies of coal have also largely decreased. The production fails to keep pace with the demand. It is expected, however, that the output will be increased by 10 per cent. if there are no further strikes in the coal districts, and the present deficiency of coal would then cease to exist. Some thick and productive seams of coal have been discovered between Bayreuth and Neuenmarkt in Bavaria. The coal, which has a rich black fracture, is an excellent pitch coal, and is not of inferior quality to the coal of Saxony or Stockheim.

Potassium Salts.—The Goslar-in-Harz Deep Boring Company has made some borings for potassium salts at Westerlieden, in Brunswick. The stratum has been proved to a depth of 4 metres, and the borings are to be continued, as further discoveries are expected.

The "Kosmos" Steamship Company.—This company has received a concession for the establishment of a regular service of steamers between Germany and Guatemala. The "Kosmos" Company will have a fleet of six vessels, of 1,500 tons each, which will touch at various European and American ports. The principal ports of call in Europe are London, Bremen, and Hamburg. The Government of Guatemala will pay a subsidy of $1,000 for every steamer which touches at the ports of the Republic in accordance with the terms of the concession, and the vessels are to be exempted from all taxes and harbour dues. Similar agreements have been made between the "Kosmos" Company and the Governments of Salvador, Nicaragua, and Costa Rica.

Textile Industries.—The weaving industry, which at one time was in a flourishing condition, has fallen off to an extent which is without parallel in the development of the industry. This falling off is indicated by the fact that the export from the Chemnitz district alone to the United States, which is the chief market for Saxon goods, shows a decrease of 7,122,792 marks. This decrease is almost entirely to be accounted for by the decreased orders for woven goods occasioned by the McKinley Act. The Chemnitz district has at present large stocks of staple articles; for the better class of goods there is very little demand, and cheaper sorts have been taken off the market for some months past. The prices of staple articles have fallen enormously. The McKinley Act is affecting other districts also which are employed in textile industries. The export trade from the district of Munich shows a large decrease in the first quarter of this year as compared with last year, the figures being £37,543, as compared with £54,849. A similar decrease is recorded in the district of the Dresden consulate and in the agency of Zittau. The exports amounted in the first quarter to £64,334 7s. 6d., as compared with £103,373 in the previous year. The decrease especially affects woollen goods, as well as linen and half-linen articles.

VIENNA, 20th April, 1891.

The Iron Market.—The inactivity which characterised the iron market during Easter week was thought likely to be only temporary, and to be followed by a period of renewed vigour. Up to the present time these expectations have not been realised, for trade is still confined within the same narrow limits, and sales have been unimportant, with the exception of iron for building purposes. Both wholesale merchants and consumers appear to be waiting for a settlement of the relations between Austria and Germany, since the continued introduction of wrought iron from Germany lowers prices, and consumers are compelled to adopt an expectant attitude. A rise in the market cannot be expected until the commercial treaty with Germany has been concluded. The assurance of peace, which was expressed in the Imperial address, should be advantageous to trade, and ought to lead to important results. During the past week large orders have been given by the city of Vienna for cast iron pipes to the value of 80,000fl.

The Coal Market.—The coal market still continues very lively, and this is shown by the large quantity despatched to the Elbe. In the week before last the Dux-Bodenbach line forwarded 46,752 tons of coal, and the Prague Dux line 20,622 tons. The Bremer Lloyd line of steamers, which has been bringing coals from America, has caused some uneasiness in the coal market here. A similar plan has been already tried by Austrian shipping companies, and was found to be effective against the syndicates.

Electrical Engineering.—The number of electrical installations in this kingdom is continually increasing. A new installation has been erected at Thexl, in Styria, by Messrs. Kremenitzky, Mayer, & Co. (The Brush Company), consisting of 4,000 incandescent lamps, and a smaller installation at the salt works at Ebensee. Water power is utilised in this case, and the salt works, baths, manufactories, and hotels, as well as the chief square, are lighted up by incandescent and arc lights. Electric lighting is making steady progress in Vienna. The International Electricity Company now supplies 15,000 lamps of 16 normal c.p. each from its central station, and it seems probable that this will be enlarged so as to supply 20,000 lamps next year. The central station belonging to this company at Fiume, which is used for the distribution of power by an alternating current, is also to be extended. Two motors of 12 h.p. each are being erected, and the elevators are being provided with electric light. The telephone system in Austria has just received an important extension by the laying of a line from Vienna to Trieste. The two provincial cities Graz and Laibach are already in the circuit, and the lines from Fiume and Görz are to be joined to the system.

BRUSSELS, 21st April, 1891.

The Iron Market.—The market shows little signs of briskness. Old orders are being worked off and there is a scarcity of new orders. Steel is being used increasingly in the place of iron, and Belgium seems likely to lose also her special trade in joists. Prices are weak, in spite of the action of the syndicate and the present quotations for raw material. The prospect of business in our centres of manufacture is rather gloomy, the home demand being very small, and competition for the foreign trade being keen.—The Liége Water Pipes Company, which has an order for 25 miles of pipes for Caraccas, is sending its first shipment by the steamer "Walford." The engineer in charge of the work has already started for Caraccas, and a large number of workmen specially qualified for the work are about to proceed thither. The plans of a direct railway from Antwerp to Brussels have been already approved by M. de Bruyn, the Minister.

The Coal Market.—The award of contracts on the 7th inst. has not thrown any light on the condition of the market, the quotations being regarded as abnormal. It is possible also that the Government will not ratify the award. Ironmasters prefer not to make arrangements for a longer period than three months in the expectation of a drop in prices. There is a renewed demand for patent fuel for Germany.

The Glass Trade.—A large quantity of Belgian glass has lately been objected to by buyers in the United States, and numerous urgent complaints have been addressed to the manufacturers. Buyers complain that the glass is burnt, and that the kilns are generally defective. This circumstance should be noted, as its consequences may be serious. Complaints are also made of the uneven cutting of Belgian glass. If our manufacturers do not wish to lose an important market, they should at once pay attention to their method of manufacture. Prices remain almost unchanged, and there is no large quantity of stocks. The demand is slowly improving, and an excellent season is expected. Much business is done from hand to hand.

Chambers of Commerce.—Most of the Chambers of Commerce have received notices from the Government to meet on the 3rd and 10th of next month. They have been requested to furnish information as to salaries, the price of food stuffs, and working expenses, in view of a discussion which has arisen with reference to commercial treaties. If France should carry out a Protectionist policy, it is proposed to counteract its effects by placing prohibitive tariffs on imports from France.

DÜSSELDORF, 21st April, 1891.

The Iron and Steel Market.—The general tone of the iron market is not encouraging, and consumption is decreasing in almost all branches. There is much complaint as to the state of trade in the Siegen district. The prices of the spathic ore have again been reduced, and all those mines which have no rich and easy workable deposits, or which are not situated favourably in regard to transport, have been laid idle. In spite of the low price of iron ore the cost of producing pig iron is very high, as coke is not sold below 12s. 9d. per ton, and there is a considerable freight charged for transport to Siegen. Many efforts have been made to form syndicates, but, with the exception of the Spiegeleisen Syndicate, as yet without success. On the 18th inst. a meeting was held for the purpose of forming a general pig iron syndicate in Siegen, but will probably have little practical result.

The Coal Market.—The coal market continues very brisk. Some partial strikes at the Sellerbeck and Eintracht pit, where about 500 miners have ceased to work, will rather improve the general situation. The public awards in Cologne and Magdeburg have shown that the Westphalian colliery owners are adhering steadily to the scale of prices, and there are really only a few works which have not entered into the various coal syndicates at Dortmund Bochum, or Essen. Consumers are still eager to complete their stores, and the daily railway transportation is about 10,500 cars, of 10 tons each.

Aluminium.—The works at Hemelingen, near Bremen, which were employed in the manufacture of aluminium and magnesium, have now ceased to manufacture the first-named metal. They were using a modified Graetzel-Castnez process, but the cost of working was too high, and they could not compete with the large plant at Neuhausen-on-the-Rhine, which works the electrolytic process and utilises the Schaffhausen water-power. This company has reduced its prices to about a third of what they were a year ago. Pure aluminium (from 98 to 99¾ per cent.) is quoted at 12s. 3d., and second quality (from 92 to 98 per cent.) at 10s. 4d. per kilogramme. Aluminium-bronze is at from 2s. 2d. to 3s. 2d., and aluminium-brass from 1s. 6d. to 1s. 8d. The company also manufactures castings, plates, wires, and tubes.

AMSTERDAM, 20th April, 1891.

Steamboat Companies.—It appears from the directors' report of the Rotterdam Lloyd Steam Navigation Company that its nine boats performed in 1890, 23 journeys between Rotterdam and Java. With the aid of two steamers, chartered from the Rotterdam Steam Navigation Company, a fortnightly service with Java was kept up. The said two steamers will be replaced by others, now being built at the yards of the Schelde Company in Flushing, the first thereof being ready in May, and the second in September of the present year. The directors remind the shareholders that the new mail contract with the Government fell through, and will require fresh negotiations. The profits last year amounted to £57,720, of which £22,408 were written off for depreciation. Deducting further payments, there remained £23,513 available for dividend, distributed at the rate of 7 per cent. on a capital of £330,000. The report of the directors of the Netherland-American Steam Navigation Company of Rotterdam confirms the preliminary announcement that the service yielded bad results in 1890. The usual amount being written off, the accounts close with a debt of £5,451, so that there is no dividend this year. The South American branch gave a heavy loss, owing to the crisis in the River Plate, which led to a serious shrinkage of the goods traffic, whilst the stoppage of assisted passages to emigrants by the Argentine Government affected the passenger traffic. After nine journeys, the company's boats

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were compelled to stop running to Buenos Ayres. The 59 journeys to and from New York yielded a fair profit in many instances; whilst in others there was a loss. The rise in the price of coals and of wages had a bad effect upon the results of the service in 1890. Fortunately, the company was spared any serious loss in ships last year. The Board is still of the opinion that the causes of depression in the South American trade are only temporary, and that there is yet a future for the company's operations in that direction. In order to find employment for the steamers that were running to South America, the directors propose opening shortly a new line to and from Baltimore.

THE ROYAL INSTITUTE OF CIVIL ENGINEERS.—The members at their last meeting approved the resolution of the Committee to invite the Société des Ingénieurs Civils in Paris to be their guests at the Hague for a few days in August and September next.

NEW COMPANY.—An important new company in Amsterdam has issued its prospectus—viz., the Commercial and Industrial Company of Curaçoa, formed with a capital of £41,666, in shares, and bonds, in equal moieties, to acquire wharves and other properties near the harbour of the capital of the island. This harbour is one of the best in the West Indies, and was visited by no less than 1,208 ships in 1889. Besides four wharves, the properties comprise an hotel, dwelling-houses, and various warehouses and sheds, the whole covering an area of 32,520 square metres. It is proposed to develop this estate and to build new jetties.

A TRAMCAR STARTER.—The invention of Mr. S. L. Huiser, for aiding the efforts of horses in bringing omnibuses, tramcars, and other heavy vehicles into motion, is kept a secret, but the experiments on the tramway at Haarlem appear to have been very successful. The apparatus, which weighs 100 kilogrammes, is worked by the driver with his foot, and by its use an empty tramcar, weighing 1,700 kilogrammes, could be easily moved by a child. Mr. Huiser says that the apparatus, manufactured wholesale, would only cost about £8 7s. each.

STOCKHOLM, 18TH APRIL, 1891.

THE PEAT INDUSTRY.—The Hörda estate at Annsberga has been taken over by an English syndicate under the management of Mr. A. R. Billit. The vast deposits of peat will now be utilised, and the manufacture of "artificial coal" commenced.

NEW HARBOUR AT GEFLE.—The Corporation of Gefle have decided to extend the harbour, for which purpose the Frederiksskaus will be purchased. The new works are expected to entail an expenditure of £37,462.

INSPECTION OF FACTORIES.—The official inspection of factories, which was introduced a year or two ago, is a much-needed institution, as there exists in some places a very unsatisfactory state of affairs. An illustration of this statement has just been afforded by the inspection of the Korndal Works, in the Gothenburg district. The inspector has, in his report, insisted upon the complete closing of the works until the boilers have been thoroughly examined by an expert. During the last twelve months six men lost their lives while at work, and twenty-six have suffered more or less severe injuries. The pressure gauges are out of order, and one safety valve was loaded with double weight. Several belts and pulleys are dangerous, arrangements for cooling and signalling faulty, and the elevators are not protected. It is evident, therefore, that the appointment of State factory inspectors with full authority was absolutely necessary.

SERIOUS STRIKE.—The strike, which has been going on for some time at the Kallmora Mine, has now assumed large dimensions, and from one to two thousand men are out on strike. This strike affects about twenty mines in the important Norberg mining district. The cause of the strike is the dispute at the Kallmora Mine, and it is in order to gain their point in that dispute that so many men have determined to strike. A conference will shortly take place between delegates of the masters and the men.

CHRISTIANIA, 18TH APRIL, 1891.

NEW WARSHIP.—The new gunboat "Viking," which was recently launched from the Horten Dockyard, will be the strongest ship in the Norwegian navy. It is built of steel, and the principal dimensions are:—Length, 62 metres; breadth, 9·3 metres; and the speed will be 15 knots. The cost is about £72,000. The hull is protected by an armour deck of 1⅛in. in thickness. The "Viking" is to carry two 15cm. guns, four quick-firing 65mm. guns, and six 37mm. machine guns. The ammunition is placed in two compartments, fore and aft, and there are three appliances for firing torpedoes. The "Viking" will have two propellers, each worked by independent horizontal triple-expansion engines, separated by a water-tight bulkhead, and with an aggregate power of 2,000 i.h.p.

MILK PRESERVING.—The milk preserving manufactory at Toten is now nearly completed. The installation has, however, proved more expensive than at first was estimated, and it will therefore be necessary to increase the share capital.

THE ELECTRIC LIGHT AT HAMMERFEST.—The electric light at Hammerfest, the northernmost town in Europe, is giving much satisfaction. The installation is to be extended, so as to comprise 550 incandescent lamps for house use instead of 300.

THE NATIONAL EXHIBITION AT SKIEN.—The works in connection with the Skien Exhibition are now being rapidly proceeded with, and the main building will be ready about June 1st. The Exhibition will comprise six sections, of which the first is the industrial one, and the fifth comprises agricultural machinery and implements.

MADRID, 20TH APRIL, 1891.

BILBAO AND PORTUGALETE RAILWAY.—At a general meeting of the shareholders held recently a dividend of 16 per cent. was announced. The traffic is steadily increasing, and the line is to be doubled. The credit of the company being very good, no new shares or debentures are to be issued for this purpose, but the money is to be raised by means of bills.

THE VISCAYA IRON WORKS.—The Viscaya Iron and Steel Works Company have made a profit of £52,000 during the past year; £38,000 has been deducted for depreciation and interest on debentures, and there is a net profit of £14.000, out of which a dividend of 6 per cent. is to be paid. A large quantity of puddled iron is still imported into the country, and the company have, therefore, determined to erect puddling furnaces. They are also erecting a Roberts converter for steel making.

SCHOOL OF ARTS AND MANUFACTURES.—About seven years ago a dispute arose between the contractor and the Administration with regard to the extensive building which was being erected for a school of arts and manufactures in Madrid. The work has now been resumed, and is to be pushed forward as rapidly as possible.

THE EIGHT HOURS MOVEMENT IN SPAIN.—Some anxiety is felt as to the manifestation which is announced to take place on the 1st of May. The labourers generally are in favour of an eight hours day, but they have little hope of obtaining such a law, and say that even if such a law was passed it would be inoperative except in the case of labourers paid by the Government or official authorities. In no other district, except Catalonia, have the workmen any serious hope of improving their condition, and they have little expectation that the meetings will have any practical result. The Government has decided not to allow any open air meetings, as they interfere with the circulation of traffic.

CULTIVATION OF CHINA GRASS.—An attempt to cultivate China grass is to be made on a large island, "La Isla Menor," on the shores of the River Guadalquivir. It is intended to plant 5,000 acres with the grass, and to erect a mill for the production of goods from the fibre. The scheme is to be carried out with English capital, and 100 acres are to be planted at first. A capital of £6,000 has been subscribed in order to make experiments, one-half of which has been furnished by the proprietor of the land, and the other half by an English capitalist, who represents a syndicate. The scheme excites much interest in Seville, as that city would be greatly benefited by the accomplishment of the project.

ROME, 20TH APRIL, 1891.

SHIPBUILDING.—On the 15th inst. Messrs. Gio. Ansaldo & Co. launched from their yard at Sestri Ponente a steel screw steamer of 4,200 tons, with triple-expansion engines of 1,350 indicated horse-power. This is the largest steamer that has been made entirely in Italy, and it has been named "Giulio Cesare." Another steamer will be launched for the same owner two months hence, and will be called "Michele Lazzaroni." The owner is Mr. Mazzino, who will thus have a fleet of four fine steamers, which will be used for long voyages, and especially for the Indian trade.

DUTY ON PETROLEUM.—On the 14th inst. Mr. Colombo, Minister of Finances, presented to Parliament a Bill relating to the Duties on Petroleum. The duty on paraffin oil is to be maintained at 37s. per 100 kilogs. A duty of 6s. 4d. per 100 kilogs. has been proposed on heavy oils, provided they are not adapted to be used for lighting purposes in ordinary lamps, whether alone or mixed. The refinement of oils can only be carried on with the permission of the Government, With regard to oils imported from abroad, the rules for the refinement are to be established by a Royal decree. With regard to petroleum imported in tin vessels, these will be allowed for at the rate of 12·50 per cent. The Government is also intending to create a monopoly of matches, as in France.

NEW YORK, 11TH APRIL, 1891.

ELECTRIC TRANSMISSION OF POWER.—A novel electric plant is being installed at Telluride, Colo., by the Gold King Milling and Mining Company. The gold ore at this place is abundant, but of such low grade that the operating expenses until recently were barely covered. The machinery was driven by steam engines, but fuel is now scarce, and the manager, Mr. L. L. Nunn, recently decided to utilise the water power in the vicinity. A dam was built across the San Miguel River, which falls 500ft. in less than a mile at this place, and from the headgate the water is taken through a pipe 4,000ft. long, gradually decreasing in diameter from 20in. to 12in., to the power station, where it is delivered to two 6ft. Pelton wheels. Westinghouse machinery is used, and the loss in transmission between generator and motor, over a 2½ mile circuit, is said to be barely 5 per cent.

NOVEL METHOD OF RUNNING ELECTRIC CARS.—At Seattle, Wash., there is about to be put into operation a novel method of running electric cars up steep inclines. The electric railway there has a very steep incline about 800ft. long, and it has been found that the motors on the cars are inadequate to surmount the hill. To correct the difficulty a small conduit about 2ft. square is constructed, and in this is to run a small car as a counter-balance. Two ropes will be attached to the counter-balance car at the top. When an ordinary car is attached to the rope the counter-balance car runs down the hill, but when the car reaches the top of the hill it runs down on the other side, and, aided by the motor, it pulls up the counter-balance car, which is now ready to bring up another car.

A NOVEL ELECTRIC ELEVATOR.—The Keystone Electric Company, of Erie, Pa., have just completed a novel and ingenious electric elevator. The details of the combination have all been worked out in the best and simplest manner, and possess many new and advantageous features. The operation is very perfect, the motor being entirely free from sparking, heating, or other undesirable features, which are a constant source of trouble when they exist. The motor drives the elevator by means of a belt from the pulley on the winding shaft to that of the motor, which only runs during the time that the platform is moving.

NEW OIL SEPARATOR.—Mr. C. I. Stock, of the North-West Natural Gas Company, Ohio, has recently brought out a new automatic separator, which is designed to separate oil or other fluids from gas. The separator is attached to the line that leads from the well, and is so constructed that no liquid passes in the gas line. It will work readily on any pressure from 1lb. to 500lb. Several of the separators are in use in the Dayton field; one by the City of Tiffin, at Bairdstown, and several in Hancock county. The one at Bairdstown was timed recently, when it separated and threw out 55 gallons of oil in 30 minutes.

NEW WIRE GUN.—The new wire gun invented by John Hamilton Brown, of New York, was tested recently at Fort Wadsworth, Staten Island, in the presence of army and navy officers. The gun withstood pressures respectively of 41,500lb. and 60,000lb.

NEW LIGHTHOUSE.—The Lighthouse Board have awarded the contract for the construction of a composite lightship for service at the Columbia River Bar to the Union Iron Works, of Francisco. The Board have awarded the contract for the construction of three lightships for service on Lake Michigan to the Craig Shipbuilding Company, of Toledo, Ohio.

PHILADELPHIA, 10TH APRIL, 1891.

THE STRIKE IN THE COKE REGIONS.—During the past week there has been much trouble in the coke regions, and the strike is as yet far from being settled. The men had become so riotous last week that it was necessary to call in the militia, and in a conflict which ensued between the latter and the men a number of Hungarian workmen were killed. The strikers are intensely excited over this affair, and more trouble is anticipated. The masters are now having the ten-day notices served on the strikers who occupy houses belonging to the company. It is stated that they are preparing to import men, and are, therefore, anxious to obtain possession of their houses. It is as yet impossible to predict how the strike will terminate, but it is expected that some decisive action will be taken before the end of the week.

TROUBLE AT THE PENCOYD IRON WORKS.—It has always been the custom at the Pencoyd Iron Works for the company and the employés to fix a scale on April 1st of each year, which would govern the wages during the ensuing year. This year the men have refused to adopt the firm's scale, and wanted the latter to accept that of the Amalgamated Association of Ironworkers. The two scales are practically the same, except that the firm's scale is a sliding one, while the association's is a fixed scale. The firm has refused to acknowledge the above association exclusively, and has denied the right of outside interference. As a consequence, the furnaces have been blown out since the 6th inst., and 200 puddlers are now idle. The finishing department has now also closed, so that the works have practically shut down. The men are perfectly quiet, and no violence is anticipated.

THE GUNBOAT "BENNINGTON."—According to the statement of the contractor, Mr. U. F. Palmer, the "Bennington" has, after several failures to develop the required horse-power, undergone a successful trial. The report of the last trial has not yet been received at the Navy Department, but the contractor's request that the vessel be received at the Brooklyn Navy Yard has been granted by the Navy Department. It is stated that the engines developed 3,450 h.p., which exceeds the requirements by 50 h.p., which, if true, will earn for the vessel a small premium.

THE WORLD'S FAIR.—The site is already being prepared for the buildings of the World's Columbian Exposition, and from the present outlook there seems to be no doubt that the work will go on satisfactorily. The finances are better than was expected. The popular subscription is £1,100,000, and the city gave £1,000,000, the Government's appropriation is £500,000, and the State appropriations are expected to amount to £800,000. There are to be nine main buildings, which will cover a total of 110¾ acres, which is exclusive of the State and private buildings. The largest building will be that of the manufactures and liberal arts, and will measure 800ft. by 1,700ft. It is also proposed to erect a gigantic tower, which will be 100ft. higher than the Eiffel Tower. The ceremonies of dedication will be held on October 12th, 1892, in order to preserve the historical feature of the commemoration of the discovery of America. The formal opening of the fair will take place on May 1st, 1893.

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STEAM ENGINE GOVERNORS.

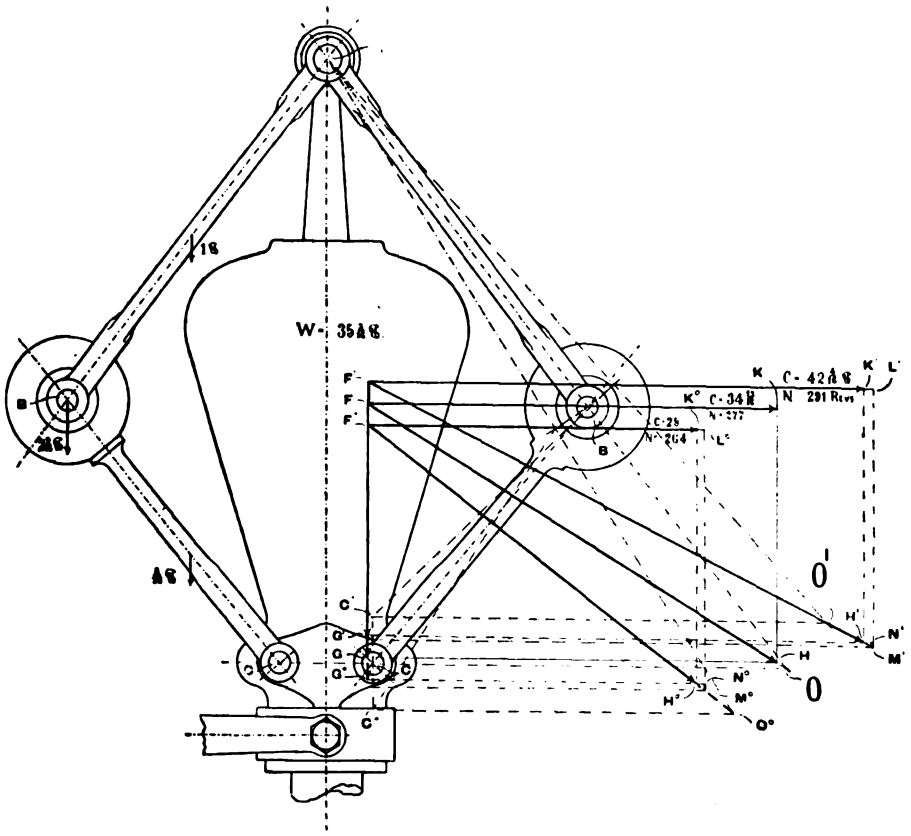
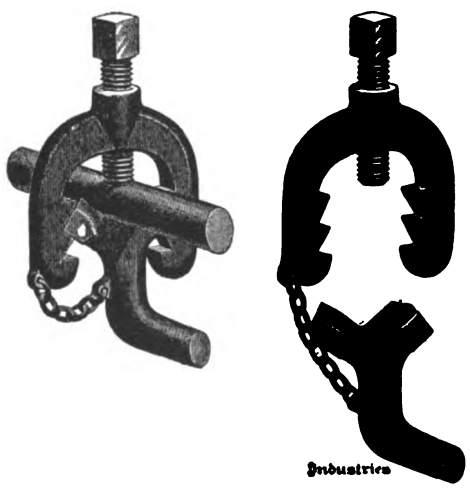


FIG. 1.—THE PORTER GOVERNOR.

A NOVEL LATHE DOG.

THE accompanying illustrations represent the "Indispensable" lathe dog, which can be attached to work resting in the centres of a lathe. The appliance is very simple, and will be readily understood from the illustrations, which are taken from our contemporary, the



Electrical Engineer, of New York. The dogs are forged from bar steel, and have set screws of similar material. They are made in four sizes, the smallest embracing from ¼in. to 1in., and the largest from 1in. to 3½in. The "Indispensable" Lathe Dog Company, of 1,209, Buttonwood Street, Philadelphia, U.S.A., are the makers.

STEAM ENGINE GOVERNORS.*

IN nearly all applications of the steam engine for manufacturing purposes uniformity of speed is a matter of primary importance to ensure a satisfactory product, and since an engine is usually employed to drive a great variety of machinery, any of which may be put into or out of action at any time, it becomes necessary to provide means for automatically regulating the power developed according to the work to be done at any moment, so as to maintain the speed constant or nearly so.

This object is effected by a governor, which serves to regulate the *pressure* or *volume* of steam admitted to the engine, so as to maintain a nearly constant speed. A governor can do no more than regulatate the *mean* speed of the engine, because the steam is only admitted to the engine periodically—*i.e.*, generally twice in every revolution, and the governor can only come into action at corresponding times, whilst it is the duty of the fly-wheel to equalise the speed between the periodic admissions of steam. The primary condition, therefore, of a uniform speed is that the fly-wheel must be sufficiently heavy to take up the variations of *load* and *power* in a revolution without any perceptible variation of speed, and it is the function of the governor to regulate the power in accordance with the more permanent variations in the load.

For the invention of the first steam engine governor we are said to be indebted to the same Watt to whose genius we owe the conception of nearly all the vital inventions connected with the steam engine, even as we know it at the present day, and although the steam engine governor—like many of Watt's productions—has been greatly improved since its invention, chiefly to meet the more exacting requirements of modern manufactures, yet the principle of Watt's governor still stands unassailed, and a very large proportion of the engines which are at work today are fitted with the identical governor invented by Watt.

The Watt governor—which, of course, is familiar to the members—consists essentially of a pair of rotating pendulums connected with the throttle valve or other regulator. Neglecting the weight of the arms, each revolving ball is in equilibrium under the weight of the ball W (Fig. 2), its centrifugal force C and the tension T in the arm, and since we know the value and direction of W, also the direction of C and T, we can at once determine the value in pounds of C by the aid of the parallelogram of forces. If h = vertical height from the plane of revolution to the point of suspension, in inches, and N = number of revolutions per minute, we then obtain $h = (188{\cdot}2/N)^2$. The altitude of the cone of revolution of a Watt governor, therefore, depends solely upon the number of revolutions per minute, and it is quite independent of the weight of the balls and of the length of the arms. Starting from a position of rest, the balls will commence to fly out when the speed begins to exceed that corresponding to the altitude of the governor at rest, and the altitude will vary inversely to the square of the speed of the governor. For most practical purposes the movement of the balls in a Watt governor corresponding to a certain variation of speed is insufficient, and the governor is therefore said not to be sufficiently sensitive. If in this governor we increase the effect of the weight without at the same time augmenting the centrifugal force, then a smaller proportionate variation of speed will be required to produce a certain variation of altitude, and the sensitiveness of the governor is therefore increased. This can be done by applying a weight or spring to the muff, and we have one example of this in the well-known "Porter" governor. Thus if we apply to the muff a weight equivalent to W^1 then the altitude for any given speed is increased in the ratio of $W^1 + W/W$, and the variation of altitude corresponding to any change of speed is increased in the same proportion.

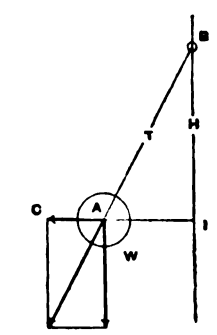


FIG. 2.

By increasing the weight of W^1 in proportion to W, the sensitiveness of this governor can be increased to any desired extent, but manifestly the governor cannot be made absolutely isochronous. Any increase of sensitiveness will also involve a corresponding increase of speed.

Fig. 1 shows a Porter governor (size No. 3) as made by Messrs. Tangyes, Limited, Birmingham, to whom I am indebted for the following particulars, upon which I will base an investigation of this governor. In the No. 3 governor, the weight W of each small ball is 2·9/16lb., and the weight W^1 of the load is 35·3/16lb. The weights of the upper and lower arms are 1lb. and ½lb. respectively, and the lift of the muff is 2in.

In the figure the governor is shown in its middle position, and the highest and lowest positions are indicated by dotted lines. In order that the system of weights may be in equilibrium in any position, the resultant of the forces acting on the weights must pass through the virtual centre of rotation of the system. This principle can be easily applied for calculating this or any other system of pendulum weight governors. Take, for example, the middle position shown and marked A B C. Continuing A B, until it meets a horizontal line drawn through C at O, then O represents the virtual centre of rotation of the system in the middle position, and, in order that the system may be in equilibrium, the resultant of the forces on one side of the governor must pass through this point. Combining the weights into one resultant F G (which, in the present instance, amounts to 21·6/16lb.), and drawing in the direction of the centrifugal force which must pass through the centre of the small balls, and the resultant which must pass through the virtual centre O, we can complete the parallelogram of forces F G H K, and find the value F K of the centrifugal force under which the system would be in equilibrium in this position. In the present example we find that this amounts to 34·13/16lb., and to develop this centrifugal force the speed must be 277 revolutions

$$(N = \sqrt{\frac{2{,}941C}{RW}}$$ where R = radius in feet, W = weight of ball

C = centrifugal force). We can thus determine the speed at which the system will be in equilibrium in any position, and we find that in this example the lowest and highest positions correspond to speeds of 264 and 281 revolutions per minute, showing a variation in speed of about 10 per cent., with a rise in the muff of nearly two inches. If the rise in the muff were made 1in. only, then the total variation of speed would be only 5 per cent. The sensitiveness is greatest in the lower portion of the lift, and becomes less as the muff rises. For many purposes the Porter governor can be made sufficiently sensitive, and it possesses the advantage of being extremely simple. The sensitiveness can also be further increased by increasing the length of the arms so as to place the point of suspension of each weight on the opposite side of the spindle.

The parabolic governor of Messrs. Galloways Limited is an interesting and ingenious modification of the loaded Watt governor. In this governor the place of the balls is taken by two cylindrical rollers suspended each by two arms, and the weight rests directly upon these rollers, the inside part of the weight in contact with the rollers being hollowed out to the form of a parabola. The weight is guided on the spindle and the muff forms a part of the weight. By the action of the component of the weight on the balls, in combination with the centrifugal force, and the tension in the arms, together with the weight of the balls, a governor is produced which can be made absolutely isochronous. The construction is also extremely compact, but —in common with all governors relying for their action on curved surfaces—it has the objection that its operation is modified by any wear on the parabolic guiding surface.

(To be continued.)

ROLLING MILL ENGINES.

ON page 396 we give an illustration of a pair of coupled rolling mill engines which Messrs. Duncan Stewart & Co., engineers, Glasgow, have erected at the Parkhead Rolling Mills, Glasgow, of Messrs. W. Beardmore & Co. The diameter of each cylinder is 42in., and the stroke 5ft. The piston rods are of steel, and are 6¼in. diameter at the front and 4½in. diameter at the back ends, where they are carried by guides. The connecting rods are of steel, and are 12ft. 6in. between centres in length, with a straight taper from 7½in. diameter at the crosshead end to 8¼in. diameter at the crank pin end. The steel crosshead pins are 8¼in. diameter and 9½in. long, and the steel crank pins are 9in. diameter and 10in. long. The cranks are of cast steel and balanced in an efficient manner. The crank shaft is of steel, and has journals 16in. diameter by 24in. long. The body of the shaft is 18in. in diameter, but is increased to 19in. diameter at the middle, where it receives a helical steel pinion 3ft. 7in. diameter, having eighteen teeth, 24in. broad and 7½in. pitch. The pinion gears with a spur wheel 8ft. 11½in. diameter, having forty-five teeth. The centre of the spur wheel is of cast iron, and is fixed to a steel rim by means of hardwood wedges. The large wheel is carried upon a steel shaft having journals 17in. diameter and 24in. long. The body of this shaft is 19in. diameter, but increased to 20in at the middle, where it receives the spur wheel.

* Paper read before the Manchester Association of Engineers on the 11th inst., by Mr. C. F. Budenberg, M.Sc.

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The engines are fitted with piston valves, which work in separate valve casings bolted to the side of the cylinders. The steel valve spindles are 3in. in diameter. The eccentric rods are flat, bolted to cast-iron eccentric straps. The eccentrics are of cast iron, and have ample bearing surfaces. The link motion is operated by means of a reversing engine, which is simple but efficient, and has been specially designed for the purpose by the makers. The sole-plate for each engine is cast in one piece, and is of a very strong design. These engines have been working for some time and are giving every satisfaction.

INTRODUCTION OF THE ZONE RAILWAY SYSTEM INTO IRELAND.

In our issue of 17th October last we gave a short account of the new system of charging railway fares which has been introduced in Austria-Hungary—namely, the zone system, by which travellers are charged a uniform fare within certain zones of equal mileage breadth. We directed the attention of the public and of the railway authorities to the system, so that they might consider whether it would not be possible to introduce it, or a modification of it, into this country. In some local circular lines which are about to be constructed in Glasgow, we understand that it is proposed to charge a uniform fare for all distances, and this, in a sense, may be considered a beginning, but as yet none of the large railway companies have shown any disposition to adopt the system. The first practical attempt in the United Kingdom to adopt the zone system has been made by the Cork, Blackrock, and Passage Railway Company. The railway runs from Cork to Passage, a distance of about nine miles, and thence by steamboat to Aghada and Crosshaven, altogether about twenty miles, and calling at all the seaside resorts round Cork Harbour. Between Cork and Passage the fare will be 3d. third class, 5d. first class. Between Passage, Queenstown, and other stations in the harbour similar rates will be charged, and no reduction will be made on return tickets. The reduction on the fares by these arrangements has been very great, in the case of the long journey being as much as 50 per cent., and it is admitted by those responsible for them that the traffic must be doubled to make the experiment profitable. It is, no doubt, a bold thing to do, and we hope that the results will justify what has been done, but we must confess we would have liked to have seen the system introduced under more favourable conditions. We trust that some of our large railway companies may be induced to make a beginning on a part of one of their main lines, which would enable them to form an opinion as to the advisability of extending the arrangements throughout their system.

SHIPBUILDING NOTES.

On the 11th inst. Messrs. John Readhead & Sons, South Shields, launched from their building yard the steel screw-steamer "Bjorgvin," of the following dimensions:—Length, over all, 312ft.; breadth, 41¼ft.; depth, moulded, 24ft. 4in. The vessel will have the highest class at Lloyd's, under special survey, and Norwegian Veritas. She will be fitted with all the latest improvements for general cargo trades, and will carry about 4,400 tons dead weight. The engines, which have also been constructed by Messrs. Readhead & Sons, are of the triple-expansion type, having cylinders 23in., 37½in., and 61½in. in diameter, by 39in. stroke. The steamer has been built to the order of Messrs. Bergh & Helland, of Bergen.

On the 14th inst. the second of the three steam hopper barges for the Corporation of Preston, recently launched from the yard of Messrs. Wm. Simons & Co., of Renfrew, was tried on the Clyde, with satisfactory results. The measured mile was run at Gareloch, where the vessel attained a speed of nearly 10 miles, which was considerably in excess of that contracted for.

On the 15th inst. the "Sinclair," of Hartlepool, took her trial trip. She has been built by Messrs. Short Brothers, Pallion, and engined by Messrs. Wm. Allan & Co., of the Scotia Engine Works, the whole of the work being done under the superintendence of Mr. G. N. Arnison, Jun. The vessel is 180ft. long, and 29ft. broad, and her hold is 12ft. deep. On the run the engines developed a speed of 9 knots per hour. The vessel is fitted with Mason's patent pivoted side-lights in the saloon and also in the engine-room.

On the 20th inst. a small steamer was launched from the yard of the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, for Messrs. Elder, Dempster, & Co., of Liverpool. Her dimensions are:—Length, 200ft.; breadth, 36ft.; and depth, moulded, 12ft. 9in. She was named the "Kevarra," and is intended for cargo-carrying purposes. She will be fitted with twin-screw triple-expansion engines, and is being built to class 90A at Lloyd's.

Notices of Meetings.

THIS WEEK.

Institution of Civil Engineers.—Friday, April 24th, at 7.30 p.m. Students' meeting. Papers to be read: "A New Type of Water Motor," by Mr. A. Sealy-Allin; "Hydraulic Power as Applied to Pressing Machinery," by Mr. H. Evington.

Balloon Society.—Friday, April 24th, at 8 p.m. Paper to be read: "The Indian Opium Question," by Mr. A. Rogers.

Royal Institution.—Saturday, April 25th, at 3 p.m. Lecture III., on "The Dynamo," by Professor S. P. Thompson.

North East Coast Institution of Engineers and Shipbuilders.—Saturday, April 25th, at 6 p.m. Resumed discussion on Mr. W. Hök's second paper on "The Unsinkability of Cargo-Carrying Vessels." Paper to be read: "Water Gauge Fittings for Steam Boilers," by Mr. H. Gray.

NEXT WEEK.

Institution of Civil Engineers.—Tuesday, April 28th, at 8 p.m. Ordinary meeting. Paper to be further discussed: "The Cost of the Generation and Distribution of Electrical Energy," by Mr. R. E. B. Crompton, M.Inst.C.E.

Society of Arts.—Wednesday, April 29th, at 8 p.m. Paper to be read: "The Use of Petroleum in Prime Motors," by Professor W. Robinson. Thursday, April 30th, at 4.30 p.m. Paper to be read: "The Perrier Irrigation Project, Madras Presidency," by Colonel J. O. Hasted, R.E.

Royal Institution.—Thursday, April 30th, at 3 p.m. Lecture on "Recent Spectroscopic Investigations," by Professor Dewar, F.R.S.

PRICES CURRENT, 22nd April, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	39/-	Cash.
Scotch Warrants, m/n	48/10½	„
Hematite Warrants, m/n	48/1½	„

Stocks in Stores.	Scotch	515,873—Dec. for week	4,116 Tons.
	Middlesbro'	118,142—Dec. „	1,161 „
	Hematite	169,575—Dec. „	4,116 „

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	65/-	.....	58/-	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	„ „
Summerlee	60/6	.....	56/-	„ „
Eglinton ex store	50/6	.....	50/-	„ „
G.M.B. „	44/6	.....	44/3	„ „

METALS.

Spelter:	Ordinary	£24	2	6	to	24	7	6
Copper:	British Cakes and Ingots	56	5	0	„	56	15	0
„	Chili Bars, G.O.B.'s	51	0	0	„	51	7	6
„	Other sorts, G.M.B.'s (equal to Chili Bars)	51	0	0	„	51	7	6
„	Manufactured (strong)	64	0	0	„	65	0	0
Lead:	Common Pig	18	10	0	„	18	15	0
„	English Sheet	14	5	0	„	14	10	0
Tin:	Straits	89	7	6	„	89	15	0
„	Australian	89	7	6	„	89	15	0
„	English Ingots	93	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: A weaker tone has been noticeable during the past few days, and prices are a shade lower. The total visible supply of copper increased about 1,170 tons during the first fortnight in April, and this has had an unfavourable influence on the market, values of Chili bars having declined. Prices to-day, however, are steadier, quotations being £51 to £51 7s. 6d. cash. Manufactured £64 to £65, according to order.

Tin: Foreign has declined about £1 per ton during the past week, but prices are again slightly firmer.

Lead: Weaker, with small demand.

Spelter: Slightly easier

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 8½	—	.....
„ Oxalic	„	0 0 8½	—	.....
„ Sulphuric	ton	1 15 0	—	.....
„ Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 8½	—	.....
„ Muriate (Grey)	ton	23 10 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 2 6	—	11 5 0
„ Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 0 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 4	—	.....
„ (50/90 %)	„	0 3 2	—	.....
Copper Sulphate	ton	16 10 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 10 0	—	.....
„ White Sugar	„	26 0 0	—	.....
„ Brown	„	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3½	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 10 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10½	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
„ White	„	0 3 6	—	.....
Salts: Epsom { Bags	ton	3 0 0	—	.....
Salts: Epsom { Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	10 10 0	—	.....
„ Recovered	„	7 0 0	—	.....
Soda: Ash	deg.	0 0 1¼	—	.....
„ Caustic (White 70%)	ton	10 17 6	—	.....
„ „ { „ 60%)	„	9 12 6	—	.....
„ „ { Cream 60%)	„	9 5 0	—	.....
„ Crystals	„	8 7 6	—	.....
„ Bicarbonate	„	7 0 0	—	.....
„ Hyposulphite	„	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 7	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: There is at present little fresh inquiry for carbolic acid crystals, but there is more disposition to buy the crude article. Benzoles are neglected, and prices are again lower. Sulphate of ammonia is steadier, but there is no large amount of business passing. Sulphate of copper is freely offered, values, however, not varying much. Green copperas is easing. Sulphur continues in demand and scarce.

OILS.

			£ s. d.
Cocoanut: Cochin	per tun		35 10 0
„ Ceylon	„		29 10 0
Cottonseed	„		21 10 0
Cod	„		24 0 0
Lard	„		35 10 0
Linseed	„		21 15 0
Olive, Spanish	„		45 0 0
Palm, Lagos	„		26 0 0
Rapeseed: English	„		30 10 0
Seal: Pale	„		26 0 0
„ Brown	„		.....
Sperm	„		50 0 0
Whale	„		22 0 0
Turpentine	per cwt.		1 10 0
Coal	per gal.		.....
Petroleum (Refined)	„		0 0 5¾
Spirit			0 0 7

We have received from Messrs. Rose, Downs, & Thompson, Old Foundry, Hull, a copy of the eighth edition of their Catalogue of Oil Mill Machinery, &c. In the catalogue, descriptions and illustrations of all the various plant required in an oil mill are found, such as hydraulic presses, hydraulic pumps, accumulators, edge stones, oil filters, &c.

Messrs. Thos. Fleming, Son, & Co., of Halifax, have sent us a copy of their new Price List of Leather Belting, Belt Fasteners, &c. In addition to prices, much useful information is contained in the price list, as, for example, "Hints to Users of Leather Belting," "Table of Horse-Power of Belts," and "Useful Rules, Information, and Mechanical Data."

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HOME INDUSTRIES.

LONDON, 23rd April, 1891.

The Money Market.—A more settled feeling has pervaded the money market since the Bank Rate was raised on the 16th inst., and, though outside rates have been well maintained, the improvement in the position generally has reconciled all interests to the higher values of money. London has been relieved from the drain of gold for the Continent, which, by the action of the large houses, has been diverted so as to fall on centres better provided with the metal or less sensitive to demands on their stocks of it. Inactivity has been the prevailing feature of the stock markets. The American department has shown some activity, a strong "bull" campaign in Wall Street having galvanised London into sympathetic movement. The advance in Americans has been fairly well kept up, though there have been sets-back and reactions due to speculators for the rise taking their profits. But each of these has simply encouraged fresh buying, and the general tone has been brisk and firm. This activity has failed to influence other departments, even Canadian railways, which usually follow in the wake of Americans, failing to do so this time. Home railways have been quite inactive. Foreign bonds have presented few points of interest, the fluctuating movements of Portuguese and Argentines excepted. Miscellaneous securities remain lifeless, but the mining market has become much brisker, though speculation there is restricted to one or two mines that have suddenly advanced into favour.

The Iron and Steel Institute.—The annual meeting of this Institute will be held at the rooms of the Institution of Civil Engineers, on the 6th, 7th, and 8th of next month. The proceedings will commence each day at 10 a.m., and will close not later than 2 p.m. The following is the list of papers, but the Council have not yet determined the order in which they shall be read:—"On the Ironmaking Resources of the Southern States," by Professor J. R. Procter; "On the Coke Industry of the United States," by Mr. J. D. Weeks; "On the Manufacture of War Material in the United States," by Mr. W. H. Jaques; "On Tests for Steel used in the Manufacture of Artillery," by Mr. Wm. Anderson; "On Certain Pyrometric Measurements and the Method of Recording Them," by Professor Roberts-Austen, F.R.S.; "On the Changes in Iron Produced by Thermal Treatment" (supplementary paper), by Dr. E. J. Ball; "On a Graphic Method of Calculating the Composition of Furnace Charges," by Mr. H. C. Jenkins; "On the Calorific Efficiency of the Puddling Furnace," by Major L. Cubillo; "On Economical Puddling and Puddling Cinder," by Mr. Thos. Turner; and "On the Micro-Structure of Steel," by M. Osmond.

Institute of Marine Engineers.—At a meeting of the Institute of Marine Engineers, held on the 14th inst., Mr. F. W. Wymer being in the chair, a paper on "Mean Pressure of the Compound Engine" was read by Mr. D. McMillan. The subject matter of the paper treated of the relative position of cranks, the different proportions of receivers, the ratios of expansion, economy at different rates of expansion, and methods of proportioning cylinders. The author, from long experience of the working of marine engines at sea, and taking the evidence of indicator diagrams, found that the practical results were from 20 to 38 per cent. below the calculations from the accepted theoretical powers. The author gave details of various types of engines working under different circumstances. Mr. Brown said he tried to get the same power from each cylinder as nearly as possible, except in the cylinder driving the pumps, which should have a larger share. Mr. McFarlane Gray illustrated by a diagram a simple method of arriving at the size of cylinders for any class of engine, whether compound, triple, or quadruple.

Royal Meteorological Society.—At a meeting of this Society, held on the 15th inst., Mr. A. Brewin, Vice-President, being in the chair, a paper on "Some Remarkable Features in the Winter of 1890-91" was read by Mr. F. J. Brodie. The author stated that the barometric pressure for the whole winter was about ⅛in. above the average; and that when the wind was not absolutely calm there was an undue prevalence of breezes from some cold quarter. The percentage of winds from the southward did not amount to one-half of the average, and the number of foggy days in London was no less than twice the average. The winter of 1890-91 might well be termed the "anticyclonic" winter. In a paper on "The Rainfall of February, 1891," Mr. H. S. Wallis said that last February was one of the driest months upon record; the mean rainfall over England, excluding the Lake District, being only 0·066in., or about one-fortieth of the average. Mr. H. F. Blandford read a paper on "The Variations of the Rainfall at Cherra Poonjee, in the Khasi Hills, Assam." The author stated that the mean annual rainfall at Cherra Poonjee was frequently given as about 600in., but it was probably only a little over 500in.

The "Centrifugal" Gold Process.—Messrs. T. B. Jordan & Son, of 15, George Street, London, E.C., have sent us some particulars of the above, showing the necessary machinery required for a complete plant for the "Centrifugal" gold process. The process requires two machines, the fine reducer and the amalgamator, which we described in *Industries*, Vol. XI., page 128. A plant of this kind has been for some time at work in South America with very good results upon ores containing arsenic, and a very fine float gold, exceedingly difficult to treat.

MANCHESTER, 23rd April, 1891.

The Fifty-three Hours Movement.—The movement for the reduction of the working hours is developing. Although officially the employers' association declines to accede to the request of the trade union, the point is being conceded by a number of the large firms. The firm of Messrs. Samuel Brooks, who employ more than 1,000 workpeople, have announced their intention to agree to the reduction, and their action is likely to influence several others. The joint committee of the various trade unions concerned has adopted a resolution threatening to withdraw the men from their employment in shops where the concession is not made by the 25th inst., but it is generally agreed that this course will not be necessary in many cases.

Business Announcement.—The business of the Union Engineering Company, which has hitherto been carried on as a private partnership, has been transferred to a limited liability company with the same title. The company has been engaged in constructing large fans for mine ventilation, and has recently taken up the manufacture of a special condenser.

An American Lathe.—We have recently seen a lathe made by the Brown & Sharpe Manufacturing Company, at the works of Messrs. Hutchinson, Hollingworth, & Co. The saddle is mounted upon a bed, one side of which has an inverted V, the other side being flat. The saddle has also a vertical working face at the back, which steadies it considerably. An ingenious and simple release motion is fitted for use in sliding and screw cutting, and the workmanship of the lathe is excellent. Although hardly fitted for rough work in a shop, it is admirably designed for accurate work, such as tool making.

The Ship Canal.—The first lock connected with the Ship Canal, that at Weston Marsh, which is to take the traffic between the River Weaver and the Ship Canal, was opened on the 16th inst. The lock, which is 315ft. long, 42ft. 6in. broad, and 16ft. deep, has three pairs of gates, the intermediate ones dividing the basin. The gates are worked by hydraulic power, obtained by using the water of the Weaver Canal, and are put into gear by friction cones. The machinery has been constructed by Messrs. Cleghorn & Wilson, Weaver Foundry, Northwich. Boats can pass through the locks in from three to four minutes. The gates, which are made of the finest greenheart, have been tested by the Weaver Trustees, and are perfectly tight.

The Linen and Jute Trades.—Forty-inch 10½oz. Hessians have fluctuated lately, but purchases during the week have been satisfactory. There is a steady demand for linens, and hopes are entertained that recent disappointments will be allayed between now and Whitsuntide. The demand for fancy goods has been one of the principal features of the week. German manufacturers have secured a large portion of the trade, and their connection increases from year to year. Irish and Scotch firms seem indisposed to compete for the trade, and confine their attention to ordinary Dunfermline and Belfast ranges. Some persons think that this is a source of serious loss, while others think that the branches of trade in which our manufacturers are engaged are those of chief importance. The shipping trade is rather dull. South American trade does not improve, and the prospect is unsatisfactory.

An Improved Paper.—Messrs. Crompton, of Bury, are introducing a new paper, which is intended to take the place of the ordinary makes of paper used for lamp shades and similar purposes. By a special process the paper is toughened, so as to be nearly untearable, and as it can be easily manipulated there appears to be a wide field for its application. The paper is called by the makers wrinkled or crêpe tissue paper.

GLASGOW, 23rd April, 1891.

The Recent Railway Strike.—The Glasgow and South-Western Railway has made further important concessions to the men employed on the system. The outcome of these concessions is that the goods and mineral guards have now practically a ten hours' day. Shunters and yardsmen in busy yards have had their hours reduced to eight. Signalmen also, in busy signal boxes, have been put upon eight-hour shifts. Hours have also been shortened in the locomotive departments. One of the most important of these re-arrangements is the abolition of the booking system. On the North British Railway matters are by no means going so smoothly. On the Fifeshire lines agitation against reduced wages is still going on, and complaints are being made that the terms of the arrangement between the directors of the company and the deputations from the men are not being adhered to.

Minerals.—The shipments of Scotch pig iron are still decreasing. The total decrease for the year is 67,547 tons, the decrease for last week having been over 6,000 tons. Coal shipments, on the other hand, have exhibited a remarkably rapid expansion. Should the rate of increase be maintained next week, the decrease on the four months of the year will have been almost altogether extinguished. The increase on last week was 24,604 tons, diminishing the decrease this year to 28,498 tons. This expansion, so far as the coal trade is concerned, recoups to some extent the losses due to the strike, although a large part of the increase is not entirely due to the deferred traffic of the strike, and it cannot therefore be said to be a complete set-off against the loss due to that cause. It is to be noted, however, that the whole of this increase occurs in the Scottish ports other than Glasgow, chiefly, in fact, in Ayr and in the ports of the East Coast. The Glasgow shipments show a decrease for the week of 3,000 tons.

New Ammonia Plant.—The Coltness Iron Company, Limited, have just erected a new set of plant for the recovery of ammonia. The plant is capable of treating the produce of six furnaces. The quantity of gas dealt with is, at 400° Fahr., about 100 million cubic feet, or in a cold dry state 60 million cubic feet daily. The chief novelty in the plant is the introduction of a dust chamber, a dome-shaped vessel of 40ft. in diameter by 65ft. high. The dust chamber, devised by Mr. Young, of Peebles, enables the dust to be separated from the gas, so that the latter may pass to the subsequent processes free from dust particles. The contractors for the plant were the Barrowfield Iron Company, Limited, the buildings having been erected by the Coltness Iron Company themselves.

The East End Exhibition.—The Glasgow East End Exhibition, which was opened on the 23rd December last, mainly with a view to provide an opportunity for artisans to exhibit their handicraft works, was closed on the 21st inst. by the Earl of Aberdeen. The Exhibition has been a decided financial success. During the seventeen weeks of its existence it has been visited by 746,107 persons, and the result is a surplus of about £3,500. Any surplus that may be realised from the Exhibition is to be devoted to a fund for the erection of a people's palace in the East End of the city.

Failure of an Engineering Firm.—It has been announced by Messrs. Arrol Brothers, of Germiston Iron Works, that, on account of the Provincial Government of Buenos Ayres having failed to meet its engagements to them in respect of a large contract which they had undertaken, they are unable to meet their own engagements. This result of the troubles in the Argentine is universally regretted in commercial circles, the firm, a comparatively young one, being well known and highly respected. The liabilities are estimated at about £50,000.

Shipbuilding.—H.M.S. "Indefatigable," second-class cruiser, is being rapidly pushed forward towards completion. The vessel is now moored alongside the yard of the London and Glasgow Engineering and Shipbuilding Company, Govan.

(From our own Correspondents.)

LIVERPOOL, 22nd April, 1891.

Liverpool Engineering Society.—At a meeting of this Society held to-day, under the presidency of Mr. J. T. Wood, a paper was read by Mr. George Farren, on "Denudations at Aber-Menai, Anglesea." The author said that on account of the natural bank at the Carnarvon entrance to the Menai Straits being gradually denuded, the former deep entrance is being changed into a wide and shallow one, so as to interfere with the navigation of the ships wishing to enter the port of Carnarvon or to pass through the Straits. Mr. Farren described the means adopted for arresting the danger.

The Canadian Mails.—The contract between the Canadian Government and the Allen Line for carrying the mails having terminated, and the Canadian Government having declined an offer by the company to continue carrying the mails at the same subsidy as in previous years, all mails for Canada will now have to pass through New York. This alters the date of posting and probably the amount of postage, and the Allen Liners will probably cease calling at Londonderry.

The Atlantic Cattle Trade.—The report of the Government Commission of Inquiry into the Carriage of Live Cattle by Sea, which is to be presented to Parliament in July, will be an interesting document. The members of the Commission yesterday inspected the new steamer "Nomadic," built for the White Star Company specially for the Atlantic cattle trade, and in accordance with the suggestions of the Commission.—In reply to the book published by Mr. Samuel Plimsoll, a digest of the evidence and statistics has been prepared by the Liverpool Steamship Owners' Association.

LEEDS, 22nd April, 1891.

The Iron and Steel Trades.—The quietness in the iron trade of this district will probably become more accentuated before any great improvement takes place. Slackness in placing orders is apparent in all branches of the trade, though possibly this feeling might be overcome by a lowering of prices both for pig and finished iron. Producers, however, can hardly be expected to do much in the direction of lessened quotations, for at the present time prices are practically unremunerative, owing to the heavy cost of fuel and the rate of wages paid. Work is now less brisk than it was a fortnight ago. Orders for railway material have fallen off considerably during the year. At the various foundries work is reported to be plentiful, some of the firms executing large castings. The steel trade is more brisk than the finished iron industry, and the Leeds Steel Works are tolerably busy. There is a fair amount of employment in the engineering shops. Builders of locomotives, especially the smaller descriptions, remain busy, and machine and tool makers have orders for some little time.

The Hull and District Institution of Engineers and Naval Architects.—At a meeting of this Institution, held on the 14th inst., under the presidency of Mr. C. F. Ames, a paper on "Forced Draught on Steamships" was read by Mr. A. E. Seaton. "Forced draught" was defined by the author as "any means whereby the products of

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combustion are caused to flow from the chimney at a greater velocity than that due to a column of air of different specific gravity from that of the surrounding air, or any means whereby the inflow of air to the furnace is greater than that due to the draw of the chimney from above cause." Mr. Seaton dwelt upon the influence which the relative dimensions of the funnel, furnace, firebars, and also the extent and character of the heating surface, had upon the results obtained, and he described the various systems which have been introduced for the purpose of obtaining increased combustion.

SHEFFIELD, 22nd April, 1891.

The Iron and Steel Trades.—There is a general decrease in the demand for iron and steel structures. Many of the large orders have been completed, and there are not many new orders. For steel castings orders are scarce. The high rate of wages now paid to the moulders and the heavy cost of fuel have made work almost unremunerative. Many engineers are going back to cast iron, or depending upon riveted plates, built up with angle, tee, and other sections of rolled steel, which can now be obtained at a reasonable price. It is much to be regretted that Sheffield cannot compete with German firms for the light steel castings used in agricultural implements.

Coal.—The coal trade is brisk, and local collieries are working full time. The demand for steam and household coal does not decrease, and the amount sent by rail to London is fully up to the average.

The Royal Naval Exhibition.—Local firms are to be well represented at the Chelsea Exhibition. Messrs. Vickers, Messrs. Cammell, Messrs. Firth, and Messrs. Brown will each show the progress made in recent years by metallurgists and naval engineers.

Cutlery.—The cutlery trades are not well employed, and there are some serious disputes pending between manufacturers and their workmen.

NORTH STAFFORDSHIRE, 22nd April, 1891.

The Iron Trade.—The improved tone of the Scotch warrant market, though probably only temporary, has imparted a firmer feeling to the iron trade generally, and buyers have no intentions of being found without stocks or forward contracts, in case of a reaction. It is generally recognised that prices at present are unremunerative. Unless the cost of production is reduced trade will be seriously affected. Contracts for finished material are now being entered at £3 per ton below the rates ruling for similar qualities in January of last year.

The North Staffordshire Chamber of Commerce.—At the meeting of the Chamber last week the subject of canal communication with Liverpool was again under consideration, and more particularly the scheme for widening the existing waterway by the North Staffordshire Railway Company—its owners. A deputation was appointed to wait upon the general manager of the company, to urge that the work should be thoroughly and efficiently carried out.

BIRMINGHAM, 22nd April, 1891.

The Iron Trade.—Since the quarterly meeting of the iron trade on the 8th inst. there has been rather more disposition to buy, and prices have been firmer. Slit rod makers have met and decided not to reduce "Crown" rods from the price of £7 10s. per ton. Strip makers reduced their price to £6 5s. on "quarter day." The marked bar firms have maintained their figure of £8 per ton, and there is a large demand for "Lion" bars for home and export. Common bars are still quoted at £6, cable bars £6 5s. Sheets are very low in price, at £7 per ton, and in some special cases orders are being taken at less prices. Galvanised sheets (24 G) are £11 15s. per ton.

Steel.—There is a good demand in the district for steel. Engineers are fairly busy, as also are hollowware makers and manufacturers of cycle fittings, who use little else than steel now. Steel boiler plates are sold at £8 per ton in the district. Bars are at £7, with £7 10s. for acid Siemens qualities. Sheets are about £7 15s. per ton for singles. There is a large demand for steel tube and hame strip at about £7 10s. per ton. One firm of tube makers are using electricity for welding their tubes.

Chains and Cables.—There is a better demand for chains and cables. The operatives have passed resolutions that they will work only four days per week, so as to restrict the output. The female workers generally object to the proposed interference of Parliament with their hours of labour.

Birmingham Water Suppply.—The scheme for a new water supply of 60,000,000 gallons per day, which was fully described in our last issue, was approved yesterday by the City Council by a unanimous vote.

LEICESTER, 22nd April, 1891.

Wool Spinning and Yarn Trades.—The local wool market remains very firm at the late small advance in price. The tendency appears to be upwards, especially in the leading descriptions. This aspect of the market makes consumers extremely cautious, and as they have liberally supplied their wants during the past fortnight, there is now not quite so much business doing. Spinners are on the whole well employed, but they complain much of the unremunerative prices at which business has to be done. There is a steady demand for lambswool and fancy yarns, and there is a small attempt to obtain better prices, but a movement in this direction soon checks business.

Hosiery Trade.—There is an improvement in this industry. The season orders are now being placed, and are for satisfactory amounts. But this kind of order is not greatly appreciated in view of the results of the past year or two, when good orders were placed and in numerous instances not exhausted. This result makes it hard for the manufacturers. The continued cold weather greatly checks the demand for light goods. There is an improvement in the shipping department which is satisfactory.

BARROW-IN-FURNESS, 22nd April, 1891.

Hematite.—There is no improvement in the demand for hematite pig iron. Hematite warrants are quoted today at 48s. 7d. per ton net cash, while mixed numbers of Bessemer iron are quoted at 50s. net f.o.b. The business is chiefly confined to hematite warrants, which are being reduced to a considerable extent, the decrease this week representing 5,388 tons, leaving the total of stocks in hand at 169,677 tons. Forty furnaces are in blast and thirty-six are standing idle.

Shipbuilding at Barrow.—Trade is at present very good here. Mr. Alexander Adamson, formerly shipyard manager of the Naval Construction and Armaments Company, Limited, has been appointed by the board of directors to the position of general manager of the company in place of the late managing director, Mr. A. D. Bryce-Douglas. Mr. Adamson has had excellent experience in Clyde and Tyne yards, and has been associated throughout with Mr. Bryce-Douglas at the Barrow works. Mr. Blechynden continues manager of the engineering department.

MIDDLESBROUGH, 22nd April, 1891.

Pig Iron.—The iron market is more favourable in tone this week, and prices of pig iron are better, though there is little increase in the amount of business. Consumers do not believe that the advance in prices arises from any genuine improvement in trade, but is brought about by a scarcity of warrants, the holders of which do not feel inclined to sell at present. The market, however, is being influenced by the diminished production of pig iron, the steady decrease in stocks in the public warrant stores, and the improving shipments. A few orders have recently been received from the Continent. The quotations of merchants for prompt f.o.b. deliveries of No. 3 G.M.B. is about 39s. per ton, a figure which some of the makers will take, though they complain that the prices are unremunerative. Makers ask from 39s. to 40s., the most frequent figure being 39s. 6d. Middlesbrough warrants are higher than merchants' iron, buyers offering 39s. 3d. cash, and sellers asking 39s. 6d. The stock in Connal's store on the 20th inst. was 117,736 tons, a decrease of 4,958 tons this month Grey forge has advanced in sympathy with No. 3, and producers ask 38s. per ton, buyers being ready to give 37s. 9d., which is 9d. more than last week's rate. The Scotch consumers are taking more of this quality than might be expected, considering that there are now fifty-two furnaces at work in that district, forty-six having been relighted since the strike ended last month. Local consumption is poor, however, as so many of the finished ironworks are short of orders. Local hematite pig is quoted at 51s. per ton for mixed numbers.

Manufactured Iron and Steel.—In the finished iron and steel trades there are no signs of improvement. Producers complain of the scarcity of orders, and several establishments are only moderately employed. Common iron bars are £5 12s. 6d.; iron ship plates, £5 12s. 6d; iron ship angles, £5 10s.; steel angles, £5 17s. 6d.; iron ship plates, £5 12s. 6d.; steel ship plates, £6 2s. 6d.—all less the usual 2½ per cent. for cash, and f.o.t. at producers' works.

Coke.—Good blast furnace coke can be purchased at from 13s. 3d. to 13s. 6d. per ton delivered here.

Shipments.—Shipments of pig iron are decidedly improving, and amounted to 22,167 tons last week, as against 14,292 tons the previous week. The total shipments for the month up to the 20th inst. were 49,957 tons, as against 42,327 tons up to the same date of the previous month. Of this quantity, 26,045 tons went to Scotland, 4,683 tons to England and Wales, and 19,229 tons to foreign parts.

Work and Wages.—The Seaton Carew Iron Company are blowing out one furnace, which makes the twelfth stopped in the district since November last. A meeting of the Cleveland mine owners and the miners' representatives was held yesterday to consider the proposed reduction of 10 per cent. After a discussion lasting over five hours the following terms were agreed upon:—"The Cleveland miners being unable to admit the justification, in the present state of trade, for the reduction of 10 per cent. claimed by the mine owners, but having offered to accept a reduction of 5 per cent., and the mine owners being unable to accept this amount otherwise than as a part of the larger reduction, which they still maintain to be due, but being desirous of avoiding the strain on the relationship of the parties which might arise by the giving of notices, it was mutually agreed that a 5 per cent. reduction shall take place from the 13th inst., and to extend to the 30th of May, and from that period negotiations shall be renewed, and a meeting shall be held on the 30th or 31st of May for that purpose."

NEWCASTLE, 22nd April, 1891.

The Coal Trade.—In the local coal trade demand is still active, and recent prices for all qualities are maintained. The shipments of coal and coke from Tyne Dock during the week ending the 18th inst. amounted to 112,631 tons, being a decrease as compared with the shipments for the corresponding week last year of 8,495 tons.

Engineering.—Messrs. R. Stephenson & Co. have obtained a good order for locomotive engines, and for some time to come this department of their works will be kept busy. Messrs. H. Charlton & Co., of Gateshead, who are the successors to Messrs. Hawks, Crawshay, & Sons, as manufacturers of the improved Martin's anchors, have just despatched from their works three powerful 6-ton anchors ordered for the Russian warship "Navarino." The firm have orders for a large number of anchors varying from four to six tons in weight.

New Flour Mills.—On the 18th inst., at Dunston-on-Tyne, the new flour mills of the Wholesale Co-operative Society, which have been erected at a cost of nearly £100,000, were formally opened. The mills have a river frontage of 464ft. The two main engines, which have been supplied by Messrs. T. Robinson & Sons, Rochdale, are of the improved tandem type, and can develop 350 i.h.p. The roller milling plant has been supplied by the same firm. There are two mills, and each set of plant will produce twenty sacks (280lb. each) of finished flour per hour, and the united production of the mills is estimated at 5,600 sacks per week. The flour mills have been lighted throughout by Messrs. Ernest Scott & Mountain, electrical and general engineers, Close Works, Newcastle-on-Tyne. This installation is very complete in its details, and consists of about 600 16 c.p. incandescent lamps. The generating plant consists of two vertical 60 h.p. engines, and one of 15 h.p. The two larger engines drive two of Messrs. Ernest Scott & Mountain's "Tyne" 400 lamp dynamos. The jetty and mill yard is lighted with ten 2,000 c.p. "Tyne" arc lamps, the current for these lamps being supplied by a compound dynamo driven by the small vertical engine. Four arc lamps on the jetty are carried on 25ft. poles and fitted with raising and lowering gear.

Electric Lighting.—Some fine electric lighting plant has been sent to the Naval Exhibition at Chelsea by Messrs. Clark, Chapman, & Co., of the Victoria Works. The firm will also exhibit at the same stand some powerful projectors, and one of their high speed turbo-electric generators.

Ship Repairing.—During the past few weeks the ship repairing establishments on the river have been very busy. Among other important contracts is the repairing of the s.s. "Energie," at Messrs. Edwards' dock, North Shields. The vessel, which belongs to German owners, is, we understand, the first ship that was specially constructed, in accordance with Swan's principle, for the carrying of oil in bulk, and she was launched from the Low Walker Yard of Messrs. Armstrong, Mitchell, & Co., about six years ago. The statement that the new steamer "Europe," built by the Palmer's Company, and which is 440ft. in length, had to be taken to the Wear to be docked, there being no graving dock on the Tyne large enough to receive her, is incorrect, as Messrs. Hawthorn, Leslie, & Co.'s dock is capable of accommodating even larger vessels.

DUNDEE, 22nd April, 1891.

Proposed Automatic Railway at the Harbour.—The Dundee Harbour Engineer, Mr. W. Cunningham, has constructed "a short section of a scheme for transporting jute by means of an automatic railway on a full-sized scale." The purpose of the railway is to provide a means for transporting bales of goods from the ship's side to sheds which are at some distance from the landing place. The automatic railway has been so arranged that two vessels may be discharged simultaneously. Mr. Cunningham estimates that from 15,000 to 18,000 bales of jute can thus be landed in ten hours. The trucks are run on an endless rope tramway, and catch the bales of goods as they are delivered from the hatch by means of a shoot formed of a series of rollers. At the point of discharge the bales are automatically tilted out of the trucks. Last week some trials of the automatic tramway were made, and gave very successful results.

Sewage Purification.—The first installation in Scotland of the "International" sewage purification process has been made at the Stirling District Lunatic Asylum, Larbert, under the supervision of Messrs. A. & W. Black, surveyors, Falkirk. The new process supersedes the system of land irrigation formerly in use, and the trials, extending over a period of about one month, have given very satisfactory results.

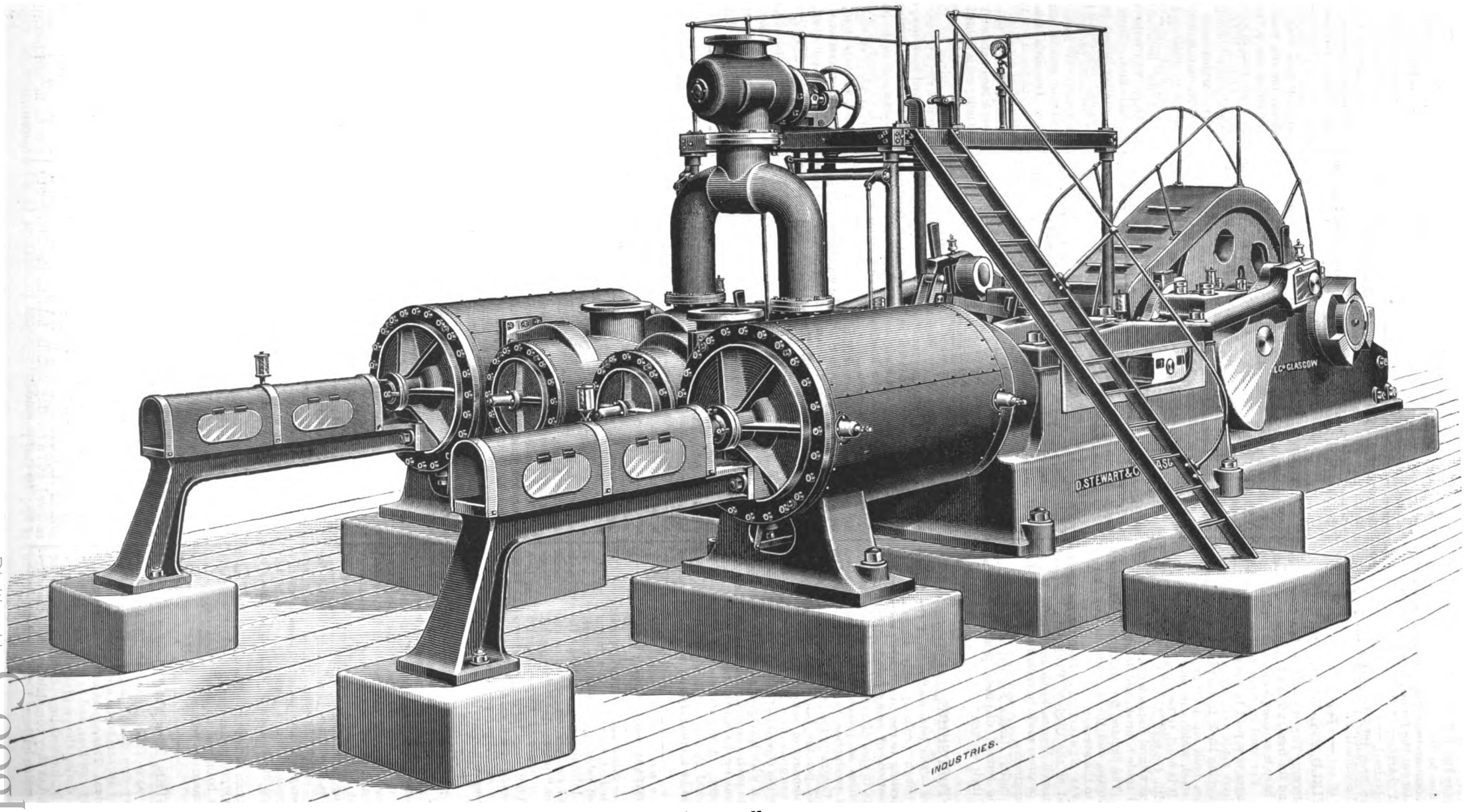
Jute and Flax Trades.—Both branches of the local industry continue active. Cable advices from Calcutta are to the effect that the crop is suffering from want of rain. There is little business done in the new crop, and quotations are unchanged. Jute yarns continue firm in tone, but buyers are not purchasing freely at the prices asked. Light-weight jute goods are in steady demand at recent rates. In the New York market light-weights are quoted at 4 13/16c. per yard, and burlaps 40in. 10½oz. at 5c. per yard. Flax is in limited demand, but consumers' stocks are said to be small, and the market is therefore strong. The market for yarns (especially the fine sorts) is also firm. Manufacturers of linens are fairly busy, and orders are coming in satisfactorily both from home and foreign markets.

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ROLLING MILL ENGINES.

CONSTRUCTED FOR THE PARKHEAD ROLLING MILLS BY MESSRS. DUNCAN STEWART & CO., ENGINEERS, GLASGOW.

(*For description see page* 393.)



GENERAL VIEW.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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93, Hope-street, Glasgow.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 30s. each.

Industries:

FRIDAY, 24TH APRIL, 1891.

THE FUTURE OF INDUSTRY AND LABOUR.

THERE is a prevailing impression that we are on the eve of a period of more or less pronounced dulness of trade, and that the future has little brightness in store for our staple industries. This impression has undoubtedly received a large amount of colour from the very marked decline in the amount of our exports of home produce and manufactures during that part of the present year which has already elapsed. There has been a contraction of demand and of manufacturing operations in many directions, and notably so in our staple industries of iron making, constructive engineering, and shipbuilding. The chemical industries, which Lord Beaconsfield looked to as the most reliable barometer of trade, have also been less buoyant, and they are not likely to be improved by the operation of syndicating all the principal works with a view to the limitation of output and the maintenance of prices. The one cheerful and agreeable oasis in the desert of our industrial outlook is the coal industry, which maintains its activity, in response to an unprecedentedly large demand from many sources. Unfortunately this activity lies at the root of the troubles of some of our staple manufacturing industries, which, but for the continued high price of fuel, would be in a much more satisfactory condition.

It is natural to look at first for causes that lie on the surface, when an attempt is being made either to learn the actual course of the trade of the country or its prospects. But many side influences have combined within the last year to induce the stagnation that has overtaken the commerce of the world—for the altered condition of business affairs is by no means limited to the United Kingdom. The Argentine crisis has been generally assigned as the main cause of the contraction of commercial operations and the lessened confidence in the future. Undoubtedly, that crisis has had much to do with the case. It gave a rude shock to English credit, and proved that much of the business that had been done in recent years was unsound. The recognition of this fact was the chief cause in producing the present financial and commercial situation. It was ascertained that we had nearly 150 millions of British capital locked up in Argentina, and exposed to imminent peril of absolute loss, and this knowledge led the financial world to inquire whether we were not similarly placed in relation to other countries, and, perhaps, even to doubt whether any country, new or old, was solvent and safe. While this spirit of unrest and distrust was rampant, further business based on the operations of credit and speculation was all but impossible. The affairs of Argentina were, however, after all, only an episode in the situation. The money invested there has not by any means been lost, although for a time it may be unproductive; but even if it had been irrecoverably lost, the loss of a hundred millions is hardly an event that would leave permanent traces on a nation that has an annual income of fifteen times that amount, and whose accumulated capital is computed at nearly 10,000 millions sterling. The future is not, therefore, likely to be obscured for any very long time by Argentine troubles; and, if the depression threatens to continue, we must look elsewhere for the cause.

There is no factor that gives more anxiety to the industrial world than the labour problem, which of late years has been forcing itself upon the attention of all classes with a persistence and an aggressiveness that is not to be ignored. It is not, however, a new thing with us; like the poor, it has been always with us. Germany, Belgium, and other Continental countries, where it had formerly been less obtrusive, are now passing through experiences in relation to labour questions that England had undergone many years ago. In Australasia, and in other colonies, labour questions have forced themselves upon public notice with as much energy as they ever did in the mother country. The United States are continually experiencing the same sort of difficulties, which appear likely to become chronic. It is doubtful whether England is not in a better condition with reference to this matter than any other prominent industrial country. It is true that we have not yet succeeded in crushing the head of industrial anarchy, nor have we found any effectual solvent of the problems that so beset the political economist. It may be, indeed, that we are only on the verge of a long, difficult, and costly process of readjustment of the relations of labour and capital, resulting from the necessary accommodation of the earnings of the former to the diminished profits of the latter. But in some of our principal industries, as, for example, the iron and coal trades, we have machinery already at work, which is capable, if continued in operation, of effecting that process by "the easy, artless, unencumbered plan" of a sliding scale, and in others there is usually a recognised relation of wages to prices that makes the process less difficult than it otherwise would be. In Germany, the United States, and other industrial countries, all this has more or less to be commenced *de novo*, and such standards remain to be established. One fact, that stands out with very conspicuous prominence in the midst of this universal restlessness of labour, is the tendency that has been recognised by political economists, both at home and abroad, towards an equalisation of the conditions of labour in different countries. Another fact, now almost equally well established, is the tendency that exists to secure for labour an increasing share of the joint product of industrial work. The facilities for inter-communication between the proletariat of different countries make them not only kin in their aims and objects, but in their ultimate achievements. Wages are necessarily higher or lower according as the cost of living is more or less in different countries, but in spite of the operation of Customs tariffs, State bounties, and other restraints on the natural laws of trade, there is a constant movement in the direction of the equalisation of the cost of living, and, consequently, also of the rate of wages paid for a day's labour. Much has, of course, to be done before this movement will attain its full growth. There is still a great gulf fixed between the coolie labour of the East and the navvy labour of our Australian colonies. But both alike come into the final determination of industrial supremacy, for the Australian colonies hope to establish an indigenous cotton industry, which, in New South Wales, at any rate, as a Free Trade colony, would have to compete in its own markets with the cotton products of India.

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These, however, are the extremes of the case. What is of more immediate concern to us, at the present time, is the fact that Continental labour is undoubtedly becoming more expensive, by reason of the reduction of the hours of labour, and of the agitation which has forced up the rates of wages. Should the time come when the rates of wages are as high, and the hours of labour as short, as in England, the latter country will certainly not be in a worse position in reference to international competition than it occupies at the present time. Many whose opinions are entitled to much respect appear to think that it is to the United States that we must look in the future for successful competition in neutral markets. The United States, however, is a land of surprises. If the present tariff laws were repealed it is probable that wages would fall very rapidly, in response to a fall in prices. But that is not a contingency upon which any wise business man would at present found his calculations. It appears probable that the tariff of last year will soon be greatly modified, but it is a far cry from extensive modification to absolute Free Trade. Meanwhile, England has more to expect from the former event than from the latter. Under a system of comparatively low duties she could probably do a good business with the United States, although it would be uncertain and spasmodic, but under the latter system the American factories and workshops would speedily be reorganising their arrangements in view of a life and death struggle for the supply of their own markets.

The newly appointed Labour Commission will be called upon shortly to deal with some, at least, of the problems of which we have just given an outline. It would be too much to hope that the Commissioners can make any suggestions that would alter the course of events, but if they can accurately indicate their direction they will be likely to do some service. While labour troubles are impending on all hands, and while the manufacturer is almost afraid to accept a contract lest he should be thwarted by the action of his workmen, and involved in losses and lawsuits, it is naturally impossible that the machinery of industry or of commerce can work so smoothly as it would do if labour difficulties were more easily settled. It is not too much to say that at the present time employers, and especially large manufacturers, look with apprehension to their future relations with their workmen. They would give much to have a clear outlook ahead, but this at present appears all but impossible. It is more particularly difficult at a time like the present, when prices are falling on every hand, and when profits over a large area of business operations have become attenuated almost to the vanishing point.

AUSTRALIA AND TRADE.

There have recently appeared three rather important contributions to literature on colonial subjects. These are an essay on "State Socialism in the Antipodes," in the volume of papers called "A Plea for Liberty;" an article on "The Seamy side of Australia," in the April number of the *Nineteenth Century*; and one on "The Eight Hours Day in Victoria," in the newly issued first number of the *Economic Journal*. The first two of these papers are extremely pessimistic in tone; the last, perhaps, errs in the opposite direction. All the papers are likely to promote a feeling of uneasiness, if not even of alarm, among investors in colonial securities, and those who do business in Australia and New Zealand. They represent, from different points of view, the condition of matters, in Australia especially, as tending towards a crisis which might involve a repudiation of debt and separation from the home country. Though such a conclusion is probably overstated, the papers may serve as a wholesome antidote to the inflated accounts of colonial development which are periodically displayed for colonial use and exportation to the home country. The view which these papers give of the Australian colonies is that of a country in which State Socialism has secured complete sway, and in which work organised by the Government is always expected to take the place of private enterprise whenever the latter shows any sign of falling off. According to the two former papers, the result of this policy is that the character of the people has been sapped by the decay of the feeling of individual responsibility and independence.

The working out in the colonies of certain forces now operating in this country and in others whose social institutions are of longer standing than those of the colonies is extremely interesting, since these forces meet with comparatively slight resistance in newly settled countries, and operate there with greater certainty and rapidity than in older countries. Thus the method adopted by the colonial Governments of building railways for public account is proved by the history of Australia to have serious consequences, which are sometimes overlooked in favour of certain immediate advantages. The collection of a great number of men by a contractor to make a railway for a joint-stock company is not generally held to imply responsibility for the maintenance of these men, except during the period and on the terms of the contract between employed and employed. The sudden dispersal of these men when the contract is at an end may, if the numbers be large, produce some economic disturbance in the district concerned, but this, as a rule, soon passes away in the absence of extensive artificial attempts to organise the labour of men for which there has at that particular place ceased to be a demand. In the case of a colonial State railway the collection of men takes place under similar circumstances, but their dispersal is accompanied by a set of conditions different from those with which we are familiar. The men not only claim work from the State, but, under existing laws, make good their claim, and thus the State, having embarked on public works, when these public works are completed, finds itself permanently saddled with the organisation of the labour of the men whom it has been employing. This removal of the unemployed from the labour market has, among other influences, the effect of strengthening the powers of the Colonial trades unions in their efforts to dictate terms to the employers. The Protective tariff, the Factory Acts, and the strength of the trades unions combine to give colonial workmen a position as regards employers, which one of the severest critics of Australian institutions admits is vastly more powerful than the position of American workmen. What, then, according to these critics, is the result of this? The power of the trades unions, exercised in an "unscrupulous, narrow-minded, selfish, and ignorant" manner, deters capitalists from embarking in fresh enterprises, and enhances the difficulty of a would-be employer in obtaining capital wherewith he may embark in business. The argument is that the conditions are extremely favourable for the growth of enormous fortunes on the part of those who have already a footing, and for the protection of these against the competition of newcomers. An incident narrated by one of the critics illustrates this. A partner in a firm in Melbourne asked the advice of a friend in reference to a demand on the part of his workmen for higher wages, or some fresh conditions of employment. His friend advised him to accede promptly to their demands, and, in addition, to present each of them with a gold watch. When asked why he proposed the gift of a gold watch, the friend reminded the employer that the exactions of the trades unions were very useful, in preventing competition in his business, and that he had in consequence only one rival in Melbourne, whereas under normal conditions there was room for half a dozen. The friend added that the men were almost all grey-haired men, who would themselves have been employers if the conditions attaching to the administration of capital were less onerous. This state of matters is said by the critics to be due to artificial conditions which cannot permanently be maintained. The eight hours day is due to the power of the trades unions, and to the consequent absence of competition among workmen. The rapidly increasing growth of a few large fortunes is due partly to the Protective tariff, and partly to the difficulties attaching to the organisation of labour in the colonies; and the conditions generally are attributed to the continuance of extensive borrowing from England. The exaggerated ideas of luxury and of the possibilities of colonial development, engendered at the time of the gold discoveries in 1851, have led, the one to the demand, and the other to the supply, of immense sums of public and private debt, which it is said now amounts to upwards of £300,000,000 sterling. It is not in so many words alleged that the Australians contemplate repudiation, but Mr. Fortescue goes so far as to insinuate that under certain conditions they might think of it. Apart altogether from any prospect of repudiation, however, if it be the case that English money has been maintaining a standard of colonial luxury which for some years the colonists have not been earning, and which there is no immediate prospect of their earning, the outlook is sufficiently serious. There can be little doubt that the publication of these articles will operate injuriously upon Australian credit, and the sooner some apologist arises for the Australian colonies the better. Mr. Fortescue suggests that, under certain circumstances, the appointment of a commission of experts to examine into the finances of Australia may become necessary. No actual corruption is alleged, but the mode in which the accounts are stated is said to be partly unintelligible and partly misleading. Forewarned is forearmed, and although a financial crisis due to the inability of the colonial Governments and colonial banks to meet the claims of their bondholders would be much more serious than the recent Argentine trouble, it might be minimised by taking prompt measures, and by a wise development of the great resources of the Australian colonies.

THE POST OFFICE AND THE BOY MESSENGERS.

The settlement of the Boy Messengers' case is so far satisfactory; but the extent to which the Post Office and other creations of Parliament are interfering to strangle private enterprise is becoming serious enough to justify a drastic re-examination of the whole system. The assumed necessity of conserving for the benefit of the public the possible profits of a few industries, such as letter carrying, electric lighting, telegraphy, telephony, &c., is resulting, not in the acquisition of profit by the public, but in the prevention of profit being earned by anybody. It is absurd to regard the Post Office and the Board of Trade as fetiches which must not be touched. The management of these institutions—the first, certainly, of a positive and useful sort; the second, of a wholly negative and obstructive order—must sooner or later be thoroughly overhauled. While it is comfortable enough for those whose businesses are not likely to be touched by this pottering in pseudo-socialistic legislation, the system is depriving the public of the benefits of invention, and placing an embargo upon the development of industry. It is not too much to say, as regards the Post Office, that no improvement of great moment has been effected since the adoption of the penny post fifty years ago; and that such improvements as have been effected have been forced upon the Department by external pressure. As regards the Board of Trade, it exists almost wholly for the purpose of preventing other people from conducting their business, or at least for placing as many obstacles in the way of their doing so as possible. The old notion of the duty of a Government was that it should foster the industries of a country, and Governments did so by clumsy enough protective and other methods. Yet these methods were always intended to benefit industry. Now Governments exert themselves to devise means to choke industry as effectively as they can. Before they entirely succeed, it is worth while asking whether it is not possible to put a stop to the tendency, and to free some of the suffering industries from the thraldom of Governmental interference. It is to be noted that this interference is directed, not exclusively towards the saving of life and such worthy objects, but is also directed towards strangling present industries with the view of annexing the profit of the future. From the narrowest view it must be seen that an industry must grow to be profitable, and that if it be suppressed at its birth it cannot grow at all.

THE PROPOSED FORTH AND CLYDE SHIP CANAL.

It is quite evident that the scheme for the proposed Forth and Clyde Canal, which we described briefly in our issue of the 13th ult., will not be allowed to occupy the field alone, and it is well that the alternative schemes should be discussed. That put forward by Messrs. Stephenson, of Edinburgh—namely, the Loch Lomond route—has not been kept before the public to such an extent as the other, but it is quite evident that its supporters and promoters are not allowing their project to be forgotten. At the recent Convention of Royal and Parliamentary Burghs held in Edinburgh, a resolution was unanimously carried to the effect, "that in the opinion of this Convention, the construction of a ship canal between the Firths of Clyde and Forth is of national importance, and a scheme for carrying it through should be supported by Government, with a view to the development of trade and commerce, and as an addition to our means of home defence"; and it was remitted to a committee with powers to adopt such means as may be expedient to give effect to the resolution. Curiously enough, a very similar resolution was discussed by the Convention 127 years ago, and it was greatly, if not entirely, owing to its action and advocacy that the Forth and Clyde Canal was formed in its present course and at its present depth, and the mover of the resolution said that if the members of the Convention had

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inherited the wisdom and enterprise and the public spirit of their forefathers, they would agitate for a large ship canal suited to the present day requirements of our Navy and mercantile marine. Of the various schemes which were proposed only two were thought advisable. The Loch Lomond route, started from Grangemouth to near Alloa, and throughout the canal would be 30ft. deep and 72ft. wide at the bottom. From the lock at Alloa the canal would traverse the valley of the Forth, *viâ* Stirling, till it reached high ground and the watershed of the Endrick, and entered Loch Lomond close by the mouth of that river, and a cut would be made to Loch Long. The total length of the canal was 54¼ miles, and its estimated cost £8,000,000. There were no engineering difficulties of any serious kind about the construction, and, although more roundabout than the other scheme, it had the countervailing advantages of a low level throughout, and of an inexhaustible reservoir of water in Loch Lomond to supply its locks. The other route, which we mentioned in our recent issue, is the direct route from Grangemouth to Yoker. It has not only the advantage of being the shorter route, but of striking the great commercial emporium of Glasgow and of passing through a rich district of mineral resources and with many established industries. On the other hand, it had the disadvantages of a high level and of requiring twelve locks, thus causing tedious delays in the passage of ships. The mover of the resolution did not ask the Convention to express any opinion on the relative merits of the two routes, but confined himself to the general question, as he thought that the capitalists who invested their money, or the Government, by means of a Commission, would settle the route to be followed. He was of opinion that if the Government were to guarantee 2½ per cent. on the estimated cost of eight millions, the work would certainly go on. The annual amount of the liability under the guarantee would only be £200,000, and he did not believe that the Government would ever be called upon to pay it. The recent action taken by the Associated Chambers of Commerce, combined with that of the Royal Convention of Burghs, should at least ensure a thorough investigation of the whole subject, and we trust that sufficient interest will soon be exerted regarding it to justify the appointment of a Royal Commission.

Letters to the Editor.

THE USE AND ABUSE OF MATHEMATICS.

To the Editor of "Industries."

Sir,—A friend has asked me to add something to the correspondence in your columns on the subject of "The Use and Abuse of Mathematics" as regards engineering. For over twenty years my work has combined the mathematical and the practical, and, therefore, possibly my ideas on this subject might not be wholly without interest to some of your readers; but I can express them in a letter, of course, only very briefly.

1. Every one who is at all reasonable will agree that a knowledge of pure mathematics combined with ignorance of practical matters is pernicious. It is not only useless and not only harmful in the sense that the time spent in acquiring it has been wasted, and has been withdrawn from the time that ought to have been spent in acquiring a sounder sort of ability—that is, its evil effect is not only negative; it is positively injurious, in perverting the whole habit of thinking and of acting.

I have used the phrase "practical matters," as I often do designedly, for the sake of catching the attention of the so-called "practical man." But let me explain that I mean by knowledge of practical matters, simply knowledge of all kinds of *fact*. This includes all that is definitely and certainly known of physics, chemistry, geology, and other natural science, as well as the mechanical practice of the workshop or of the field, the social and disciplinary organisation of industry, and the economic and financial operations of trade. I do not mean, of course, that a man should make his knowledge of "practical matters" *complete* before he begins to make use of mathematics. If that were to be the rule, he would never use mathematics, as this complete knowledge is quite unattainable in a life-time. What I do mean is that, he should not use mathematics to study or to originate theories on any subject before he has made himself fairly well acquainted with the practical facts of that subject.

2. I think that a merely elementary knowledge of formal mathematics is, perhaps, worse, as far as regards engineering, than no knowledge at all. If arithmetic be considered an elementary branch of mathematics, I make an exception of it; to be an accurate, quick, and rational arithmetician is of incalculable value in every class of engineering work, as also of every other kind of work that is quantitative. Some elementary portions of constructive geometry (not Euclid nor the so-called descriptive geometry!) might be excepted along with arithmetic—such portions as are of real help in genuine practical quantitative work, but which do not lend themselves to encourage a theorising tendency.

Nothing is so common as to find that the real objection of the "practical man" to the mathematical treatment of a subject is wholly based upon his own inability to understand it, and to find that almost at the same moment in which he inveighs with lofty scorn against the complete (and therefore *necessarily* complicated and in a certain degree difficult) mathematical solution of a problem, he will himself offer, with a delightfully cocksure manner, a solution involving only the simplest mathematical forms (which in itself would be a valuable characteristic), but which labours under the disadvantage that it leaves out of account at least half of the most important practical facts of the case.

Is it not absurd that most of our mechanical text-books devote pages and pages to extremely clumsy dodging of the differential and integral calculus? Nearly all our mechanical theories—even the most certainly true, the most commonly known, and the most necessary for practical design—are based upon the methods of the differential and integral calculus. But in order to encourage elementary pupils to undertake the task of understanding these theories, the fact that they are so based is concealed from them, and the students are subjected to long rigmaroles of roundabout, tautological, and occasionally illogical reasoning to arrive at results which can be obtained with infinitely less labour by a more rational process.

For the understanding of all the essential elementary problems of engineering, only the elementary parts of the calculus are needed. Why is it not more commonly known that these elementary parts, if properly taught, for instance, by graphic methods, are much easier to learn than the middle and latter parts of the algebraic and trigonometrical text-books used in our lower-class secondary schools? Why should schoolboys be compelled to learn the difficult and useless parts of geometry, algebra, and trigonometry before they learn the easy and useful parts of the calculus? The only reason is that the school examiners will allow no departure from an antiquated and thoroughly rotten system of education.

3. I would advocate the division of mathematical training into three stages, as follows:—

A. The development of informal but clear and accurate ideas regarding the geometrical relations of space and quantitative relations, and the simultaneous development of the ability to reason about these correctly and logically; but this, without the aid of any sort of conventional symbolism—that is, without diagrams or projection drawings, without letter or other symbols, and without algebraic equations—with no other aid but *models* and *talk*. If a scholar never got beyond this stage, but went through this part of the training alone successfully, he would be infinitely better equipped for his whole practical life-work than the other scholar who has learnt in the usual formal way the books of Euclid, algebra "up to the binomial theorem," and the ordinary school trigonometry.

B. Constructive, plane, and solid geometry on the drawing board, and all sorts of mathematics that can be taught and practised graphically on the drawing board. This includes rectilinear and curvilinear plane constructions, projections of solids, and a great deal of mechanics.

C. The development of mathematical reasoning by help of the conventional systems of algebra, trigonometry, and the calculus.

This system of training would not only give the best possible results when completely carried out, but it would have this incalculable advantage, that, if broken off at any stage, the part already received would yield lasting beneficial results of a perfectly sound kind. It would produce no tendency towards specious mathematical showiness without real knowledge and ability to back it up, and it would produce no inclination to indulge in imaginative theory not based upon fact.

4. I think it ought to be recognised that the even approximately exact solution of the important problems in engineering practice involves mathematical ability of a high order, both in the direction of being familiarly acquainted with mathematical methods and operations, and also in the possession of sound and careful reasoning power regarding the quantitative aspects of physical phenomena. An engineer who devotes himself to practical work, as he must do if he is to get on in his profession, has not time to make himself the possessor of first-class mathematical knowledge such as is necessary for original work in the solution of such difficult problems. It must, therefore, always remain a matter of individual judgment and taste how far each engineer should devote time to perfecting his mathematical ability, because he can only do so at the expense of losing so much opportunity for the gain of practical experience. But this much is clear, that everyone who intends to take a place in the front rank of his profession must cultivate his mathematical ability so far as will enable him to comprehend and to form an intelligent judgment upon the work of others who devote themselves to original investigation in this direction. Moreover, it would be very desirable that these latter should not be discouraged in their very legitimate work by the jeers and derision of the ignorant mob of inferior "practical" men—*i.e.*, men who are ignorant of everything but rule of thumb. Truly practical men will rather seek to assist the genuinely able theorists by maintaining a free, friendly, and respectful communication of ideas between the two classes of workers. I am glad to believe that such has always been the relation between the best practicians and the best theoreticians. I am able to express these last opinions quite unreservedly, because, although I have done a little theoretical work which may possibly be found useful, I myself am very deficient in mathematical knowledge, and have continual cause to regret that, being now in the position I occupy, I did not in my young days advance my mathematical studies several steps further than I actually did.

Yours, &c.,
Robert H. Smith.

Mason College, Birmingham,
21st April, 1891.

THE INFLAMMABLE LIQUIDS BILL.

To the Editor of "Industries."

Sir,—The announcement which appeared in your last issue was received with much pleasure by those of your Scotch readers who are interested in the mineral oil trade, for those who were responsible for "The Inflammable Liquids Bill" seemed to have altogether overlooked the distinction between burning oil of Scotch manufacture and American and Russian petroleum oils. So far as I have been able to learn, Scotch-made oil, which has flashing points varying from 120° to 125° Fahr., has not, during the thirty years it has been in use, been the primary cause of any serious fire or accident while stored in large or small quantities. Accidents have been almost invariably caused by the use of defective lamps, and very often by the upsetting of the same in a drunken brawl, which, of course, legislation is powerless to prevent. In Scotland, petroleum oil, which has a minimum flash-point of 73° Fahr., is almost unknown, and it should therefore be dealt with independently of Scotch oils. In fact, in my opinion, the Bill is to a very large extent unnecessary, as the Petroleum Act of 1879 fully provides for the protection of the public in the conveyance, storage, and handling of petroleum, from which nearly all the fires connected with storage have arisen. The effect of that Act has been to curtail the petroleum spirit trade by one half, and it has practically put a stop to the use of spirit or benzoline or sponge lamps.

If the proposed Bill had become an Act of Parliament the trade in lamp oil would have suffered a like diminution. Moreover, its whole provisions are of an exceptionally harassing and inquisitorial character, and so onerous and intricate as likely to defeat their aim by becoming inoperative—at least, the only other alternative is the ruin of the trade. The provisions of the Bill not only harass producers and distributors, but also add unnecessarily to Imperial and local taxes, by creating a large array of inspectors and other officials, whose chief object seems to be to magnify their offices and render the lives of ordinary people as miserable as possible. Of course, all this means that the price of oil would be increased to the consumer. As a Scotchman, however, I wish to protest chiefly against the effects the Act would have on the Scotch mineral oil trade. It is true that in the Bill a slight concession was made in favour of high test oils, in excluding from its operations oils flashing not under 150° Fahr., but to show how irrational and absurd the concession is the oil must not only flash over 150° Fahr., it must also have a specific gravity not less than ·840, whereas it is well known that lighthouse oils, marine sperm, and mineral colza oils have flash points much over 150° Fahr. and a specific gravity much under ·840. I hope if ever the Bill be reintroduced that its framers will study a little more carefully the conditions and requirements of the Scotch mineral oil trade, and not harass an industry which has been of immense benefit to the working classes.

Yours, &c.,
Paraffine.

Glasgow, 18th April, 1891.

THE LABOUR COMMISSION.

To the Editor of "Industries."

Sir,—The experience of the past certainly justifies the opinion with which you open your leading article on the Labour Commission—namely, that when the Government desires to shelve an inconvenient question, the appointment of a Royal Commission is a favourite expedient. The results of the previous Commissions you mention have not been very great, but still it must be confessed that the indirect results have been considerable, as they have educated public opinion on the points at issue, by the collection and publication of a large mass of information regarding them. I think this fact points to a method whereby special Commissions would be to a large extent rendered unnecessary—that is, by the adoption of the suggestion made by Sir John Gorst in the speech which he delivered shortly before the announcement of the intention of the Government to appoint the Commission, and which at the time was looked upon as a sort of preparatory kite sent up to ascertain the state of public opinion on the subject. Sir John pointed out that almost every foreign country had a Ministry of Industry, and expressed the opinion that one of the reforms which ought to be insisted upon in this country was that there should be some Department specially to look after the interests of the working classes. I would prefer to put the matter on a broader basis, and say that the Department of Industry should look after the interests of all sections of the industrial classes, workers and employers alike, and that it should collect information on all points of interest and receive evidence from all parties who were likely to throw any light on any part of the labour problem.

Possibly the most tangible result of the Labour Commission will be the formation of such a Department of Industry, for the evidence which is certain to be placed before it will show the advisability of collecting that class of information in a more systematic manner than hitherto. Trade statistics of a more definite character in the different departments than we at present possess would have the effect of steadying employment, and possibly of indicating a remedy for those out of work, and thus help to solve the difficult problems connected with periods of trade depression.

The Department might also take charge of the arrangements connected with arbitration and the settlement of trade disputes generally, and all the proposals connected with these questions. The hours of labour in different industries and occupations, the scope and results of the Factory Acts, the employment of women and children, and all questions connected with the health of the different classes of works would come in for attention.

Another matter, which ought at least to be investigated by the Department, is the scope of Government interference in special departments of industry, when these tend to become monopolies. In these days of syndicates, trusts, and "rings," it may soon be necessary at least to have a policeman on the Board of Directors to look after the public interests. If the Commission results in nothing beyond an efficient Intelligence Department of Industry, it will have done good service, and paved the way for further developments.

Yours, &c.,
Economist.

Leeds, 18th April, 1891.

ENGINEERS IN THE ROYAL NAVY.

To the Editor of "Industries."

Sir,—Your correspondent "A. E.," who writes from Portsmouth, is of opinion that the writer of the article which appeared in your issue of the 27th ult. had little experience of the Royal Navy, and that without much experience it is almost impossible for any one thoroughly to appreciate the conditions of the service. He seems to forget, however, that men who know the general requirements of ships of war, but who have not been in the naval service, are likely to form a more unbiassed opinion as to its real requirements than those who have grown up in it and imbibed all its prejudices, and its rather narrow manner of looking at things, and if I may, without discourtesy, venture an opinion on the subject, I think your correspondent is not free from those prejudices.

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As a marine engineer who is acquainted with the requirements both of the Navy and the mercantile marine, I decline to admit the correctness of the picture your correspondent draws of the relative duties of chief engineers in the two services. A modern first-class passenger ship requires almost as much ability on the part of its engineers, if not more in some cases, as at least the average man-of-war, and almost without exception these men have worked their way from the workshop through the various grades till they have reached their present responsible positions. In fact, to begin with, they were "artificers," but with the prospect of bettering their position if they showed that they had the material in them, they set about it in good earnest, and the results in many cases have been most satisfactory. The notice of the late Mr. Bryce-Douglas, which immediately preceded "A. E.'s" letter, was rather a curious commentary upon it. Mr. Bryce-Douglas was a joiner to begin with, and after a comparatively short experience as a mechanic or artificer he had rather a rough time of it for a great many years, but yet he developed into a leader of men and an accomplished engineer. Surely your correspondent will admit that if he had been induced to enter the Navy he would have turned out an ideal engineer officer, and one who could keep his men in their proper places and his engines in good order.

I quite agree, therefore, with the opinion expressed in your article that for the best of the engine-room artificers some avenue ought to be opened up whereby they might be able to obtain the position of engineer officers, and also with the more general opinion that, in every service, unless men get a chance of rising there will be discontent and difficulty.

With regard to the mathematical requirements of the Admiralty, whoever may be nominally responsible for the papers set, it is quite evident that the actual work falls largely into the hands of teachers, who set too high a standard. While I have no wish to depreciate the value of mathematics, I do say most distinctly that it would be possible to get thoroughly efficient engineers whose knowledge did not extend much beyond arithmetic and the most elementary parts of mathematics. Even the elaborate duties pictured by your correspondent require a larger percentage of common sense and experience than of mathematics. The mistake, which is too often made at the present time, is to suppose that education is only to be got from books or in schools or colleges, which, in my opinion, too often produce either pedants or prigs.

Your correspondent remarks that the Navy is a peculiar service. On that point there will be little difference of opinion. A service must be very peculiar when its best men leave it on the earliest opportunity, and when young men cannot be induced to enter it, and I think your article very justly indicated how some of its peculiarities could be got rid of.

Yours, &c.,
M.I.N.A.

Glasgow, 18th April, 1891.

PATENT LAW IN GERMANY.

(From our Berlin Correspondent.)

A carefully drafted proposal for an amendment of the patent law of 1877 has been recently passed by the Reichstag, after having been read three times, and will come into force on the 1st of October next. The chief point to be noticed in the new law is that the examination of patents with regard to novelty is not to be abolished. The new law does not decide what amount of invention is patentable, so that this question must be settled in each case by the Patent Office as heretofore. Publication, if made more than a hundred years ago, is not to act in anticipation of a patent. Patents taken out in foreign countries are to act in anticipation against the inventor, and those claiming rights under him, only after a lapse of three months, and thus an extended period of time is allowed by the Act for an application for a patent in Germany. If an invention is stolen from another person, and an application for a patent has been made, the inventor is able not only to oppose the granting of a patent to the applicant, but to obtain a patent for his own application. The patent fees may be paid for the whole duration of a patent in advance, so that the lapse of a patent through delay in the payment of fees may be rendered impossible. If a patent on which the full fees have been paid should be afterwards annulled, the fees will be returned to the patentee. An application for the annulling of a patent shall not be made when the patent has been in existence more than five years. For the determination of this point, however, a period of three years is provided. The very high fees now payable for a German patent have not been diminished by the new Act, but it is provided that such a lowering of the fees may be made by order of the Federal Council. The important provision that a patent may be revoked after the expiration of three years if the patentee fails to carry out his invention in Germany to a suitable extent, or at least to do everything that he can to carry it out, remains in force, and should be particularly noticed by foreigners. The organisation of the Patent Office is to be so regulated by the new Act that there may be greater security for a proper and efficient examination of patents. Before an application is refused, the applicant is to have an opportunity of answering objections to the granting of a patent. If he should fail to obtain a patent, he may then support his claim by oral evidence. At the preliminary examination expert witnesses may be called, and a statement of the various attempts which the inventor had made may be presented. If the decision of a judge puts a new aspect on the case, the applicant is to have an opportunity of answering any objection raised. A proviso, which is of great importance to chemical industries, is that where proceedings are taken to patent a new material, every material of similar manufacture is regarded as included in the claim until proof to the contrary is shown. The damages payable for the infringement of a patent have been increased. The Patent Office has been established at its new building since the beginning of this month. This new office is in every respect suitable for its purpose, whereas the old one was too small. The public obtain a great advantage from the new arrangement, since the important technical library is now open to all persons from 9 a.m. to 9 p.m. Only a provisional trial of the new arrangement has yet been made, but in view of its great utility and the many expressions of opinion in its favour the authorities will probably continue to grant this privilege.

LIGHTHOUSE ILLUMINANTS.

We have noticed from time to time the contest which has been going on between Mr. Wigham and the authorities who are responsible for the management of our lighthouses, and have admired the vigour and perseverance displayed by the former. He does not seem to be much discouraged by the Report of the Special Committee appointed to investigate the subject, but on the contrary seems to be determined to keep on making improvements on his method of lighthouse illumination. At a meeting a few days ago of the Royal Dublin Society, Mr. Wigham described two important improvements which he has recently devised. One of these is a burner, by means of which gas made from ordinary coking coal can be so enriched by hydrocarbons and by a supply of heated air, as to produce an illuminating power practically double that of the most powerful gaslight now used in lighthouses.

The other improvement consists in a new arrangement of dioptric apparatus, by which lenses of larger surface and greater focal distance than those at present adopted can be used in lighthouses, and thus their power be enormously increased. Mr. Wigham exhibited one of his new burners, and showed by experiment that its power is double that of the cannel gas burner now used, and therefore equal to about 6,000 candles. He also pointed out that if this burner was used in connection with the arrangements of lenticular apparatus, which he described, a power could be evoked for the benefit of the mariner in foggy weather equal to about 8,000,000 candles, which, owing to the composition of the gas light and its great volume, would have an effect upon fog or haze very much greater than that of the most powerful electric light. It would have a much greater intensity, being six times as powerful as that of Tory Island, which is the largest lighthouse flash in the world. From these experiments it is evident that we have not yet heard the last of the contest between Mr. Wigham and the lighthouse authorities.

THE PREVENTION OF SMOKE IN LONDON.

At the last weekly meeting of the Balloon Society, Mr. W. H. Le Fevre, C.E., President, read a paper on "The Public Health (London) Bill, 1891," with special reference to the prevention of factory smoke.

The Chairman, in introducing the lecturer, said that there was no question at present before the public on which opinion was so unanimous as on the smoke question. The members of the medical profession had persistently, for many years, impressed upon the public that pure air was essential to good health and long life, while impure air was detrimental to health and productive of disease. He ventured to say that they had supported this statement with an immense amount of evidence which was incontrovertible. He did not require to say one word in support of the proposition that smoke was a nuisance; they were all at one on that point. What they were not agreed about was the way to get the nuisance abated. He was quite sure they would all hail with satisfaction anything that tended to the abatement of the smoke nuisance.

The author stated that there were no less than nine Bills now before both Houses of Parliament relating to burials, factories and workshops, sanitation, the smoke from furnaces and fire-places, and generally to public health; and he referred at some length to Sections 21 and 22 of the Public Health (London) Bill, 1891, which related to the prevention of smoke.

Much had been done, he said, to solve the problem of complete and smokeless combustion, and many manufacturers had availed themselves of several inventions at considerable cost. The production and use of gas for manufacturing purposes, and the automatic feeding of fires by mechanical stokers, economised manual labour, and effectively and profitably caused coal to be burned as fuel. The Vicars stoker seemed to best comply with practical requirements, and was in operation in the principal works in London.

The author then proceeded to describe the various systems of mechanical stokers, explaining the results obtained—viz., abundance of steam generated by the use of the most inferior fuels, and the absence of the smoke nuisance.

After the reading of the paper, Mr. Atkinson, the mechanical engineer to the London County Council, moved the following resolution:—"That in the opinion of this meeting the Public Health (London) Law Consolidation Bill is entitled to our support, so as to secure the proper sanitary condition of all premises within the district; and further, this meeting trusts that the Act may come into operation the 1st day of January, 1892." He said there were several appliances tending to promote the object they had in view, but from his own practical experience he advocated the adoption of Vicars mechanical stokers. In the North of England factories were the greatest sinners in the production of smoke.

Mr. G. L. Dennis seconded the resolution, and stated he was of opinion that they were suffering more from the result produced by domestic fire-places than from factories.

Major Cresswell and other speakers supported the resolution.

Afterwards Mr. W. R. Merrett moved, and Mr. E. C. Keevil seconded, the following resolution:—"That in the opinion of this meeting the Public Health (London) Law Consolidation Bill, as far as regards Sections 21 and 22, should be extended to all parts of the United Kingdom of Great Britain and Ireland."

Both resolutions were carried unanimously.

Reviews.

The Economic Journal, The Journal of the British Economic Association. Edited by F. Z. Edgeworth. London: Macmillan & Co. 1891.

The British Economic Association has been established for the purpose mainly of providing an organ of the most eclectic order for the promulgation of views on economic subjects. The intention of the Association is to include all shades of economic opinion, and this is undoubtedly a wise resolution, since the whole subject is just now in a state of flux, in which it would be hard to say what is orthodoxy and what is not. The names of the contributors to this and succeeding numbers of the quarterly journal, are evidence enough that the journal will be a really important addition to periodical literature. The first issue fulfils this promise. Many of the articles are of exceptional value, and are varied and interesting enough to attract even the general reader. "The Eight Hours Day in Victoria," "The Difficulties of Socialism," and "The Boycott as an Element in Trade Disputes," by Mr. John Rae, Mr. Leonard Courtney, and Mr. John Burnett repectively, deal with labour questions; "The Fall in Silver," by Mr. Henry Hucks Gibbs, now M.P. for the City of London, with currency; and the remainder of the major articles with theoretical questions mainly. Among the notes and memoranda are excellent notes on Trade and Finance in 1891, and on the recent Baring Crisis, and a note on the Scottish Railway Strike by Professor Mavor.

Elementary Systematic Chemistry. By William Ramsay, F.R.S. London: J. & A. Churchill. 1891.

A new elementary chemistry nowadays is only justified if it marks a new departure in the method of treatment, and in this respect Professor Ramsay's book warrants its existence. There can be no doubt that the scheme which the author has adopted will, as he hopes, help to demonstrate the value of chemical study as a training in classification and as a means of developing the reasoning powers. It is, however, open to debate whether an elementary chemistry for the use of schools and colleges should only have this object in view. We believe that, although such a demonstration may induce some elementary schools to give a greater attention to chemical teaching in the future, this end may be more rapidly attained by urging the value of chemical knowledge for the sake of its general utility and applications to everyday life. We are afraid, however, that the present state of our knowledge is not sufficiently advanced to enable

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us to so systematise chemistry as to prevent it from discouraging the young student, and that converts to its study are more likely to be obtained by the old-fashioned methods of experimentally showing a few facts, unconnected, as they often are, concerning common things, than by plunging into the sweeping generalisations of the periodic law. Notwithstanding the enormous help that the development of this law has given to chemists towards grasping the interactions of the elements with each other, we are still far from a complete explanation of the formation of the greater number of chemical compounds. As the periodic law has had little to do with the historical development of chemistry, and as our knowledge of the constitution of complex organic bodies has been determined almost independently of it, it appears somewhat premature to insist too much upon its value. The author, no doubt, is looking ahead to the time when we shall know what the periodic function is. At present, our want of knowledge on this point makes the classification difficult to appreciate except in the chapters devoted to the consideration of the elements, their halide compounds, and a few other simple groups consisting of compounds of two elements. For compounds containing more than two elements the classification seems to be very laboured, and the author's views on double salts do not diminish the difficulties which continually present themselves. When our knowledge of the elements is such as to enable us to say, for example, that the two compounds $AlF_3 3NaF$ and $AlCl_3 NaCl$ could have been predicted, then a classification based on such knowledge would, no doubt, allow every compound, whatever be its complexity, to drop into its allotted place, and we should be prepared by our theory to find free NH_4 described in the chapter on the principal halides of the elements of Group 1, milk of sulphur under ammonium sulphide, sodium hydride Na_2H as the first-mentioned important alloy, and so on. The author's faith in the unknown function leads him, when speaking of the evolution of oxygen on the addition of cobalt nitrate to bleaching powder, to say that the part played by the cobalt is not yet fully understood, and thus bids us look forward to the time when the theory will enable a student to calculate, from the position of cobalt among the elements, how its nitrate will react when warmed with bleaching powder.

Bibliotheca Polytechnica: A Directory of Technical Literature. First Annual Issue. London: Sampson Low, Marston, & Co. 1891.

This seems a complete and well-classified catalogue of books and journals relating to the various branches of technical literature. The subject headings are given in three languages, German, French, and English, and the usefulness of the catalogue is increased by the numerous cross references, which enable a person seeking information in any special branch to find at once the general subject heading under which it is classified.

Potts' Mining Register and Directory for the Coal and Ironstone Trades of Great Britain and Ireland, 1890.

The present volume is the third annual edition of a reliable statistical and literary work in connection with the coal and ironstone industries of the United Kingdom, which, while compressed into reasonable compass, forms a complete manual of reference to the industries named. Though no new features have been introduced the whole of the information contained in the previous volumes has been carefully revised and brought up to date. In this issue appears the third chapter of a treatise on the theory and practice of mine ventilation, and, dealing with various phases of the incidence of natural and artificial ventilation, forms a valuable addition to the literature relating to the complex questions involved, and deserves to be carefully studied by mining engineers. From the variety and completeness of the information it contains the book should find a place in all colliery offices.

Geometry of Position. By Robert H. Graham. London: Macmillan & Co. 1891.

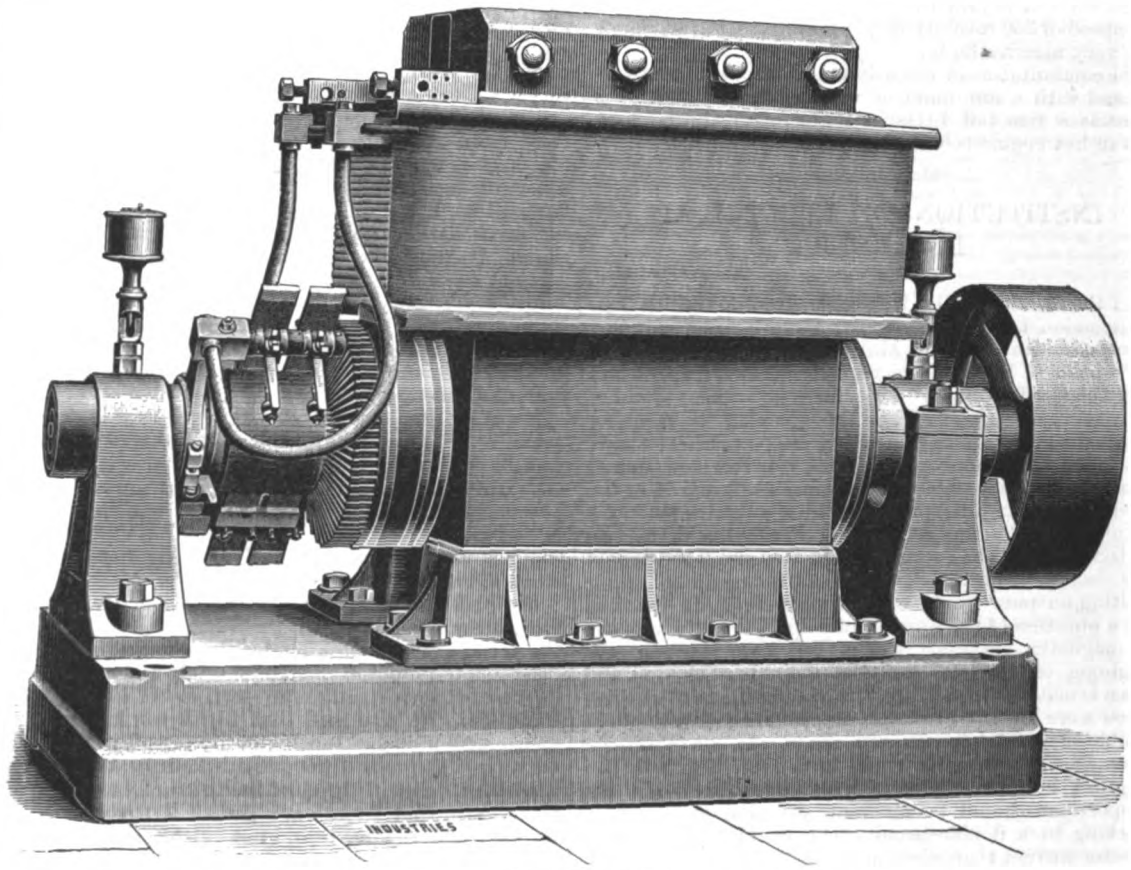
"Geometry of position" as a distinct branch of geometrical science is comparatively modern, and has not, previous to this treatise, received separate treatment in any English work. It may not inaptly be defined as the theory of that branch of geometry of which graphic statics is the practical application, in evidence of which its study has been made a compulsory antecedent to applied graphics in many Continental technical institutions. The author has previously published a work on "Graphic and Analytic Statics," and now issues the present short treatise as an honest attempt to popularise what he believes to be an interesting and useful study. It is essentially a book for the mathematical and theoretical student; and from the style of the text, together with the set of exercises appended to each chapter, we should imagine it is primarily intended to rank as an engineering text-book; when that position is accorded it, and its subject matter is included in the curriculum of studies at our technical colleges, we think it will find its most suitable sphere.

Practical engineers will not find it sufficiently popular, in its precise language, its laborious nomenclature, and dependence upon mathematical demonstration, to make it easy reading, nor does its contents appear to lend themselves readily to practical application. We may, however, direct attention to an example in Chapter II., where the author applies the principles of projective conics to determine the relative angle of advance in an automatic valve gear, without, however, giving sufficient details to show how the results were obtained, or their practical bearing; and to the application of the funicular polygon in Chapter IV. to find the centre of gravity of an irregular area such as a rail section. The examples of roof truss, bridges, and girders selected for consideration are well chosen so as to present important features, and will be familiar to students of graphic statics, the important addition being that the constructions are followed by geometrical and mathematical demonstration. A large number of connected propositions and theories carefully worked out are included in the text, and the work is evidently one on which much labour and pains have been expended.

Mineral Resources of the United States: Calendar Year 1888. Washington: Government Printing Office. 1890.

This statistical report on the condition of the mining and metallurgical industries of the United States is the sixth of the series issued under the supervision of the United States Geological Survey, the period covered being the calendar year 1888. Owing to the delay in the publication of this report, it is unnecessary to allude in detail to the principal statistics, as they have already been published in *Industries*. This work, covering 652 octavo pages, and handsomely bound in cloth, is published at a very low price, and thus compares very favourably with the cumbrous paper-covered blue-book issued at prohibitive prices by our own Inspectors of Mines. The whole work is edited by Dr. D. T. Day, but several important sections have been entrusted to specialists. Thus the section on iron has been written by Mr. J. M. Swank, the general manager of the American Iron and Steel Association, and Mr. F. F. Chisolm. The sections on copper, lead, and zinc have been written by Mr. C. Kirchhoff; those on manganese, petroleum, natural gas, and coke by Mr. J. D. Weeks; that on precious stones by Mr. G. F. Kunz; that on aluminium by Mr. R. L. Packard; that on structural materials by Mr. W. C. Day; and that on coal (230 pages) by Mr. C. A. Ashburner. The total value of the minerals produced in 1888 was £116,910,135. This enormous figure serves to illustrate the immense amount of labour involved in the collection of these statistics. Valuable aid would, of course, be furnished by associations of manufacturers, but the bulk of the returns resulted from direct application to the producers, and it is pleasing to note the spirit of co-operation which renders a report of this kind possible.

SIEMENS' DYNAMO.



General View.

We illustrate above a compound-wound dynamo with drum armature, of Messrs. Siemens' latest type. In this particular machine Messrs. Siemens have used wrought-iron field magnets of a somewhat smaller cross-section than those adopted by many makers, and have wound the series wire on one limb only. This makes the connections simpler, and produces practically the same result as if it were wound partly on each limb. The armature is built up of iron discs, and the conductors consist of strands compressed into rectangular bars, which are arranged round the outside of the armature in the usual way. The end connections are made by the Siemens method, and means have been taken to secure more perfect ventilation. The underneath type of dynamo shown in the illustration has the advantage that massive brackets and framework are not required to secure steadiness of running, and it also relieves the bearings of the great pressure to which they are subjected in dynamos where the armature is on the top, while in a properly constructed machine the proximity of the bed-plate to the magnetic poles does not injuriously affect the efficiency. By varying the supports of the armature and magnets, this design of dynamo can be readily adapted for coupling direct to any type of steam engines, such as Brotherhood's, Chandler's, Willans', or the ordinary double-acting kind.

Dynamos of this construction have been supplied by Messrs. Siemens for the St. James's and Pall Mall Electric Light Station at Mason's Yard, the Whitehall Station of the Metropolitan Electric Supply Company, the Westminster Electric Supply Corporation, the central station of the Bradford Corporation, the Liverpool Electric Supply Company, and many others for public and private installations. At the Royal Naval Exhibition they will shortly have running for illumination of

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the buildings and grounds, in addition to an alternator and some smaller machines, three shunt-wound dynamos of this description coupled direct to Willans I I I engines, each capable of working up to 1,500 amperes at a pressure of 120 volts. The armature is 24in. in diameter, and runs at a speed of 350 revolutions per minute within a magnet with very massive limbs.

The commutators of these dynamos run without sparking and with a minimum of wear, while the machines themselves rise but little in temperature during long runs in hot engine-rooms.

INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of this Institution held on the 9th inst. a discussion took place on Mr. Esson's paper, entitled "Notes on the Design of Multipolar Dynamos."

Professor S. P. Thompson regretted that Mr. Esson had used the word "volume" for something which was not of the nature of *volume*, and he thought that the meaning assigned to it was not the *ampere turns* on the armature, but twice that number. He said a better comparison would have been obtained by considering Fig. 4 in the paper to be a two-pole machine with a double magnetic circuit, both the top poles being N (say), and the two bottom ones S. The surfaces of the two armatures would still be the same, and, so far as he could see, their limiting outputs would remain unaltered. It was thus not a question of the number of poles, but of the number of magnetic circuits. Again, relations between the "volume of current" and the diameters of ring and drum armatures were given, but no mention as to whether these were intended to apply to machines with single or double magnetic circuits was made. In his (Professor Thompson's) opinion it would have been better to distinguish between the two types, for he believed the proportions should be different, and that an armature working in a double-circuit field could safely carry a greater current than when in the field of a single magnet.

Mr. Kapp, speaking of the laminated pole pieces mentioned by Dr. Thompson, said Mr. Joel adopted a similar plan in 1885, with the idea of getting more corners on his magnet, and consequently obtaining a greater magnetic pull. He himself had also designed multipolar machines with a deep slot in the middle of each pole piece, and found that the armature reactions were halved thereby. In comparing bi-polar machines with multipolar ones, he pointed out that it was necessary to make the armatures of the latter machines larger, in order to obtain sufficient space between adjacent pole pieces. This, together with the fact that only shallow armature cores are needed, makes the ventilation of multipolar machines very much better than bi-polar ones. This point, he thought, had been overlooked by the author.

Mr. F. V. Andersen remarked that Mr. Esson's formulæ for the load which could be safely carried by armatures without sparking did not include the number of commutator segments. He thought that increasing the number of such segments tended to diminish sparking, and inquired whether sparking could not be prevented by this means.

In the continuation of this discussion on the 16th inst., Mr. F. V. Andersen, in supplementing his former remarks, said that Mr. Esson's formula for the limiting currents was doubtless true if the brushes be at the polar tips; this, however, meant a considerable lead, and a change of, say, 10 per cent. in the load would necessitate the readjustment of the brushes. For central station work it was desirable that machines should have a very small lead, and this could be obtained by having long powerful fields.

Mr. Housman said that the whole of the author's argument in favour of multipolar machines depended on the length of the air space necessary to prevent sparking being generally greater than that required for the copper. Referring to the limiting non-sparking load, he said that Mr. Swinburne's hypothesis (on which the author bases his arguments, and which assumes that the self-induction of an armature coil is small, and, therefore, only a weak field is required to effect sparkless reversal) was not justified. The coefficient of self-induction of an armature section, as measured by a ballastic galvanometer placed in circuit with a coil wound close to a disconnected section, he found to be very considerable, and by passing various currents through the latter the variation of the coefficient with armature current had been ascertained. The difficulty of variable lead could, as was well known, he got over by using "commutating magnets" or "reversing pole pieces." Those shown in Mr. Swinburne's paper on "Armature Reactions" were quite inadequate as regards size, for in practice they had to be much more substantial.

Mr. Swinburne said Mr. Esson had not dwelt sufficiently on two of the chief advantages of having more than two poles. A four-pole drum armature had very simple end connections, could be perfectly ventilated, and was easily accessible for repair and inspection. The proper ventilation of large machines he considered to be of the first importance. The coupling up of multipolar armatures was, he said, to be condemned most strongly. Considering a large machine with its armature so coupled, and supposing the bearings to wear a little, he pointed out that a very small eccentricity would decrease the lower air gap and increase the upper gap by 1 per cent.; this means that in an armature having a loss of 2 per cent. the bottom half would do double work, thus involving great waste of power and heating. This objection, he believed, had not been urged before, but it was very serious in large machines. The armature conductors should, therefore, be in series, or connected partly in series and partly in parallel, as suggested by Fritsche.

Mr. Housman explained his method of analysing Foucault current and hysteresis losses in dynamo armatures by running them as separately-excited motors without load, and observing the volts and amperes required at different speeds.

Mr. A. T. Snell thought the term "volume of current" would be very useful as a name. His own experience as regards "volume" and diameter agreed with the formulæ given by the author. He did not agree with Mr. Esson that the output of an armature was independent of the number of poles, for he found that the output could be considerably increased by using four poles instead of two.

Mr. Miller remarked that in the case of dynamos for the transmission of power the design was influenced by the voltage of the machine, for there was a limit to the difference of potential that could safely and conveniently be used between commutator sections of ordinary construction. He also said that Mr. Esson had not even mentioned unipolar machines, presumably because he considered they were worthless. This, he thought, was a mistake. One of the chief faults usually attributed to them—viz., that there was a great fall of volts between no load and full load—did not exist if they were properly designed.

Mr. Crompton said the information contained in the paper would be very useful to engineers. Some speakers had implied that there was no gain in making multipolar machines. This, he thought, was not correct, for his firm had constructed large four-pole machines quite as efficient as the two-pole type, with an economy of 40 per cent. in material. In his opinion no machine lends itself so well to the production of high voltages as the multipolar type.

The discussion was adjourned to the 23rd inst.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

(*Continued from page* 380.)

V.

The soap is drawn out of the boiling pan, from above the "nigre," through a pipe provided with a swivel joint, to admit of its being lowered by means of a crab and chain, and carrying at its upper or open end a shovel-like skimmer. The soap is then conveyed, down an inclined wooden shoot, to the "crutching" machine. This consists of two jacketed pans, kept hot by steam, connected together, and having in their centres vertical shafts carrying a number of horizontal arms, consisting of flat iron bars attached at one end, in an inclined position to the vertical shaft, and reaching nearly to the inner circumference of the pan. In the intervals between these arms, fixed bars extend from the pan side to the vertical shaft. The shafts and arms are rotated by toothed gearing, actuated by a small vertical engine, attached to the outside of one of the pans, which are used alternately, the rotating arms being thrown out of gear, and the flow of soap shut off from one crutcher while the other is being used. As soon as the soap begins to pour into the first crutcher, the arms are set in motion, and the desired amount of silicate or other solution, called "runnings," measured in. When French chalk or similar weighting material is used, it may be mixed with the runnings in a small pan fixed immediately above the crutching machine, and run from thence by a pipe leading into the crutcher. If necessary, colouring matter in solution, and perfume, are also added, and the revolving arms passing between the fixed bars thoroughly mix these and the runnings with the soap, so that, by the time the crutcher has received its full quantity of the latter, a uniformly smooth and homogeneous fluid is obtained. The flow of soap from the boiling pan is then directed into the other crutcher by closing one outlet in the shoot and opening the other, and the running and crutching are continued as before.

In this way the process is continuous, and the flow of soap need not be checked until the experienced eye of the attendant watching the stream at the point where it leaves the boiling pan, detects the first signs of the inferior nigre. The crutching pans are emptied after each mixing operation, by drawing a slide covering an outlet in the bottom, and the soap pours out into an inclined shoot, which conveys it into the frame room.

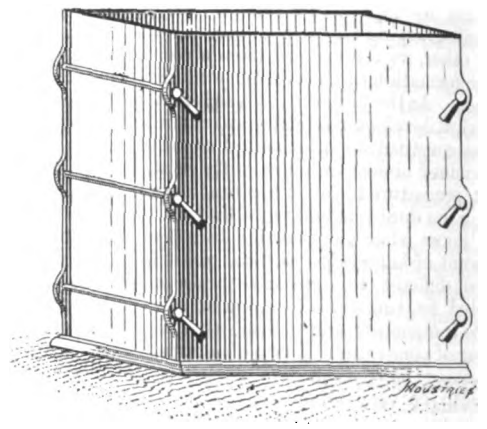


Fig. 4.

This is a large, airy and well-ventilated room, containing the receptacles in which the soap is cooled and solidified. These are sometimes made of wood, but more commonly, and indeed now almost universally, of cast-iron rectangular plates, which are fitted on a base plate and clamped together at each end to form an oblong box, open at the top, as shown in Fig. 4. These frames are placed in rows on the floor of the frame room, carefully aligned on each other to facilitate the subsequent cutting of the soap, and they are usually made tight at the bottom by stuffing twisted strips of paper into the groove in the bottom plate, in which the upright sides and ends of the frame stand. To prevent the soap from sticking to the iron plates, and so tearing when the frame is detached, the whole of the inside is white-washed with lime, and, it need hardly be stated, that the utmost cleanliness, not only in the frames, but in the shoots and all instruments which touch the soap, is absolutely necessary.

Suspended by iron rods above the rows of frames, are the inclined wooden shoots which carry the hot liquid soap from the crutching machine to the frames. These are merely wooden troughs, provided at intervals along the sides, or in the bottom board, with openings, through which the soap is delivered to any one or more frames in the row (see Figs. 5 and 6.) The openings, when cut in the bottom of the shoot, are usually circular, and are closed by wooden plugs provided with handles, and inserted from above; but this form of shoot is not so good as that which has the outlets in the sides, and which are closed by a flat board, sliding in a groove, on account of the resistance offered by the plugs and handles to the flow of soap, and their obstruction to the scraping down of the semi-solid portions which cool en route to the frames.

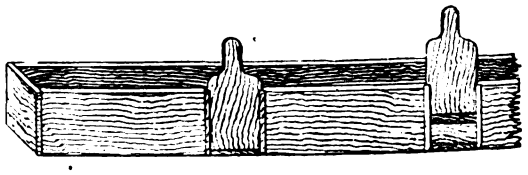


Fig. 5.



Fig. 6.

Commencing with those nearest to the crutching pans, or at the top end of the shoot, the frames are successively filled as full as is convenient, until all the soap is disposed of. Many kinds require also to be crutched again by hand while cooling, and before being left to set; and this is done by plunging a perforated plate of metal, attached at right angles to a long handle, and called a "crutch," into the soap, and working it up and down therein, the workman standing upon a square piece of board resting on the edges of two adjacent frames.

In some factories the scenting of the soap is effected at this stage, the essential oils being added gradually to the soap in the frames, and crutched in or mixed with it by the hand crutch, and, if properly and evenly crutched, this method is preferable to that of adding the perfumes in the hot crutching pan, as the loss by evaporation is,

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in that case, considerable. When hand crutched, however, great care is necessary, or the essential oils will be found in patches or blots in the solidified soap. They should be added and well crutched, a little at a time, from a watering can or sprinkler.

As to the kind of perfume which is used for scenting household soaps, each manufacturer has his own ideas, both as to variety and quantity to be added, but the oils of citronella, spike lavender, lemongrass and sassafras, with nitro-benzene or "oil of mirbane," are perhaps the most commonly used.

On cooling down, the hot liquid soap placed in the frames contracts considerably in volume, and, if left alone, would not only sink and form a deep depression in the centre of the solidified block, but would probably be honeycombed or full of air spaces, and thus cause a great waste in cutting the soap into tablets and bars. To avoid this, the soap is hammered or beaten while in a plastic condition during the process of cooling. This operation, called "knocking down," is performed in the following manner:—A short time—depending entirely on the character of the soap—after the soap has become covered with a solid crust, the general surface is levelled, by running a knife round the inside edge of the frame, and cutting away the congealed soap irregularly crusted on the sides. A piece of hard wood, 4in. or 5in. square, and the same length as the inside width of the frame, is placed on the crust, close to the frame side, and gently hammered with a wooden mallet until the edge of the soap is depressed an inch or two. This is repeated all round the frame, causing the centre to bulge upwards, and care being taken that the surface crust of the soap is not cracked. After three or four hours, the piece of wood is placed crosswise on the arch formed, and the whole surface of the soap flattened to one level, and after an interval of about twelve hours, the mass is again vigorously hammered and knocked down still further.

After cooling for about forty-eight hours, the soap, though still hot to the touch, is sufficiently solid to be cut into slabs and bars, and it may be stated that as a rule, and within certain limits, the hotter the soap can be conveniently and without damage cut, the better will be the appearance and skin of the bars.

To cut the soap, the frame sides and ends are detached from each other and removed, leaving the solid block of soap standing upon the frame bottom. The whole surface is then scraped with an instrument called a scraper, shown in Fig. 8, to remove adhering limewash, and present a smooth surface, when the block is cut horizontally into slabs of about 2½in. thick. This was, at one time, done entirely by hand, and at small works still is so performed, the workman drawing a long loop of piano wire (see Fig. 7) through the soap, first marking the four corners of the block with a gauge consisting of a straight piece of flat wood, in which are fixed at intervals, corresponding with the thickness of the in-

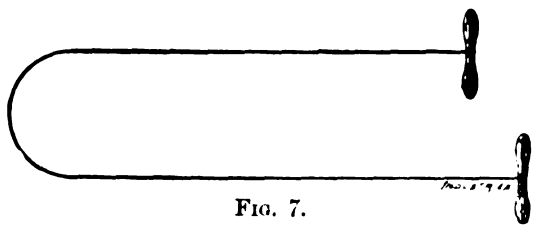


Fig. 7.

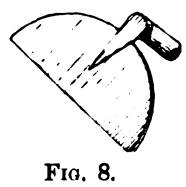


Fig. 8.

tended slab, a number of spikes or teeth. The cutting wire is passed round the block of soap, and is placed in position at the gauge marks on the rear corners by an assistant, while the cutter adjusts the wire to the front corners, and then, seizing the handles, draws them steadily towards him, forcing the wire through the soap, and cutting off a slab. The thin top and bottom slabs, along with the scrapings from the sides of the blocks, the ends of bars, and other scraps, are invariably returned to the soap pan, to be re-boiled.

The process of cutting the slabs by hand is, however, very tedious, and cannot be done where large quantities of soap have to be dealt with. Furthermore, the slabs are more evenly and equally cut, and there is less danger of spoiling them when machine cutting is resorted to.

A "slabbing" machine consists essentially of an upright wooden frame, rather wider than the soap blocks, which carries the tightly stretched horizontal cutting wires, and is mounted between light iron frames, running on wheels. The whole machine is propelled forward by a system of chain gearing and spur wheels, actuated by a winch handle. This machine is placed at the end of the first block of soap in the row, and propelled through the whole series, one after the other; the fixed wires, being forced through the soap blocks, cut them at one passage into twenty or thirty equal slabs. These are then loaded on to light trucks, or carried by hand, to the bar-cutting machines, which divide the slabs into the well-known 3lb. bars.

The bar-cutting machine consists of a wooden framework, on which is fulcrumed a swinging or hinged frame, containing a number of parallel vertical cutting wires. This frame is secured by a catch at the top of the machine, while the slab of soap is placed in position on its edge, and slightly slanted backwards against the wires. The catch is then released, and the hinged frame forced down, the parallel wires cutting through and dividing the slab. The frame is again raised, carrying with it the cut slab, which is delivered on to a board at the back of the machine, to be taken off by an attendant. The bars, removed from the cutting machine, are placed in open pile, crosswise upon each other, to cool and form a "skin" on the surface. Excessively watered cheap soaps are dried, and the skin produced, in stoves heated by steam.

(*To be continued.*)

NOTES ON OILS.

II.

The transformation of oleic acid into solid fatty acids is a problem which is of considerable practical interest, as its value for both soap and candle making is considerably less than either stearic or palmitic acids. The laboratory methods which are in use—viz., by the use of iodine and chlorine, or heating with solid potash—are too costly or too delicate to carry out on the large scale. A process which has been devised by Max Schmidt seems likely to put an end to this difficulty. An article in a French contemporary describes experiments made by another chemist on the process and the extent to which the transformation is carried. The following is an outline of the method employed:—Ten parts of oleic acid are mixed with one part of hydrochloric acid and zinc chloride, and the mixture is kept at a temperature of 180° C. until a portion taken out and heated with some more acid solidifies when cooled. The heating is then stopped, the product cooled, and repeatedly washed with water until every trace of zinc and of acid is removed. The purified fat is then distilled in a current of superheated steam or under diminished pressure. The distilled product is then subjected to hydraulic pressure in order to free it from the unaltered oleic acid. The solid residue should be white and have a crystalline appearance. The chemist who reports upon the process states that the metamorphosed fat, before distillation, has the following composition:—

	Parts per 100.
Liquid anhydride	8
Stearolactone	28
Oxystearic acid	17
Oleic acid	40
Saturated fatty acids	7

The composition of the product, however, varies with the temperature to which the mixture was originally heated. Thus, if the temperature mounts to 200° C., no trace of oxystearic acid is found, but the amount of liquid anhydride increases to 21 per cent., whilst the oleic acid falls to 24 per cent.

The recent meeting of the Scottish Mineral Oil Association, at which prices for paraffin and wax, to come into operation in August next, were fixed, shows that the development of the Russian petroleum trade is making itself felt upon this home industry, and as the American trade now possesses a very extensive fleet for the transmission of the American oil the Scottish trade has further increased competition to face. At Sunderland, the Anglo-American Oil Company have obtained permission of the River Wear Commissioners to carry underground pipes beneath the docks, in order to transmit burning oil from the landing stage to the new oil works to be constructed at Hendon. With regard to the new sources of petroleum mentioned in our last article, a highly promising report has been received of the oil from the Shirani country. The chemist to the Bengal Government certifies it as leaving 92·4 per cent. burning oil after distillation of specific gravity ·8 and flashing point 85° Fahr. This yield of burning oil is far higher than any previously obtained from natural petroleum, the highest yields of the Baku and American varieties being from 50 to 60 per cent. Some attention has been given since the opening of the year to the subject of the use of petroleum waste as a marine fuel, and reports are circulated to the effect that the Admiralty intend trying experiments with it. Mr. Nelson Boyd in a recent address referred to its use, both for this purpose and for locomotives. The advantages claimed for its use at sea by men-of-war are its increased power, 1 ton of oil occupying no more room than 1 ton of coal and giving power equal to 2½ tons to 3 tons of coal, facility of storage, and the fact of it giving no smoke to betray the vessel's whereabouts to the enemy. In connection with this, it is to be noted that the Rangoon Oil Refinery are preparing a new solid petroleum fuel by incorporating 3 per cent. of soap into the heated oil. The product is not easy to ignite, and burns slowly, with very little smoke and great heat.

During the distillation, the liquid anhydride is entirely decomposed, and the oxystearic acid is converted into oleic and iso-oleic acids. The following analysis shows the change in composition:—

Non-saponifiable portion	13·6
Oleic and iso-oleic acids	43·3
Stearolactone	31·0
Saturated fatty acids	12·1
	100·0

The distilled product, after being subjected to pressure, dried, and melted, forms a hard crystalline mass, which does not stain paper and is perfectly free from oleic acid. Its melting point is about 41–42° C., and its general composition is:—

Stearolactone	75·8
Iso-oleic acid	15·7
Saturated fatty acids	8·5
	100·0

This forms an excellent material for making candles. A. Guyot has examined the chemical reactions resulting in the production of the stearolactone, &c., but the results are not of technical interest.*

A memorial, signed by the principal French oil crushers and seed growers of the Département du Nord, has been presented to the French Minister of Agriculture, asking for special protection to their own industries in the new tariff.† They point out the greatly diminished production of oils in France, as shown by the quantities sold during the last forty years, and also that now four-fifths of the oil consumed in France is supplied from abroad. They ask for a duty to be fixed on oil seeds proportional to their richness in oil, and also for the duties on the oils themselves to be increased in like proportion. Moreover, for the protection of the colza industry, a duty should be put upon mineral oil imported.

A new patent has been taken out in France by H. Stein‡ for the use of silicic acid as a decoloriser for crude naphtha, mineral oils, animal and vegetable fats, paraffin, resins, and waxy substances. The silicic acid is packed in sugar refinery filters, and the molten fat or resin is then run on it. The acid is afterwards compressed, and may then be washed with benzine to recover all the oil or fat, and roasted, when it is ready again for use.

MERZ'S UNIVERSAL EXTRACTOR.

We recently illustrated the above apparatus for extracting fats and oils from waste products, and so recovering such bodies in a form in which they can be again utilised (see *Industries*, Vol. IX., page 163). The extractor has since been used for the recovery of grease from the waters of scouring mills, and has not only been found to be economical in its working, but also in this particular case, has furnished a residue which has proved to be an excellent wool manure of high nitrogen content. A further application of the extractor, which we commend to the notice of local authorities and others, is for the recovery of the oleaginous and fatty refuse from large eating-houses and clubs and other waste, which now finds its way to the destructors, as by this treatment a saleable grease and a highly nitrogenous manure can be obtained. The following table shows the results which have been obtained with the above apparatus in preparing seed cakes for cattle food:—

	Proteids in 100 Parts. Pressed Cake.	Extracted.
Rape seed	31·3	33·1
Linseed	29·5	33·2
Earthnut	41·3	44·4
Sesame	31·9	34·2

In which it will be seen that the yield of oil is greater and the nitrogen content of the cake correspondingly increased by its use. Messrs. Nölting & Co., of Dunster House, Mark Lane, London, E.C., are the agents for this extractor in Great Britain.

* A. Guyot, *Moniteur Scientifique Quesneville.*
† *Les Corps Gras Industriels*, February 1st, 1891, p. 207, *et seq.*
‡ *Ibid.*, page 211.

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SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

On the 20th inst. Mr. W. P. Rix read a paper on "Stoneware and Its Application to Chemical Apparatus," in which he gave a historical sketch of the progress made in the manufacture of stoneware vessels adapted to the requirements of chemical industries. The paper was illustrated by specimens of earthenware manufactured by Sir Henry Doulton & Co., of Lambeth, and by diagrams illustrating the different shapes of joints, &c., which had been devised to make air-tight and water-tight connections in pipes. The author discussed the chemical constitution of various glazes, and pointed out that, in vessels required to hold acid and alkaline liquors, special glazes were necessary. For chemical stoneware, glazes of the following composition had been found suitable:—

	I.	II.
Silica	61·81	65·05
Lime.....	13·44	13·68
Alumina	12·71	13·14
Alkalies	11·05	7·24
Iron oxide	·82	·89

After discussing the process of manufacture of joints of various descriptions, the author drew attention to Stanford's and Doulton's joints, in which asphalte was employed for securely cementing the two connections. Stoneware slabs for sectional acid tanks were also shown, and an acid force pump in which the valves were so arranged that, being in a separate piece, if out of order the pump could be repaired without removal.

In the discussion which followed, Mr. Howard and the Chairman (Mr. Tyrer) congratulated the author, and referred to the progress which the manufacturers had made in coping with the difficulties of the chemical engineer.

Dr. S. Rideal next read a paper, prepared jointly by himself and Mr. A. P. Trotter, on "Tanning by the Aid of Electricity," in which was given a description of a series of experiments undertaken with a view of ascertaining what is the precise nature of the hastening effect produced when a current of electricity is passed through an ordinary tanning liquor in which the hides are suspended. After pointing out that many patents exist for the hastening of the tanning process by the employment of mechanical methods, the authors showed that the application of electricity for this purpose could only be explained by either (1) an electrolytic action or (2) by dialysis or osmosis. After reviewing the processes in which electricity had been employed to produce this hastening effect, they described in detail the plant of Worms and Balé and of Groth, a description of which has already been given in our columns (see *Industries*, Vol. VIII., page 498). They pointed out that in the latter process, which they had specially studied, the hides were suspended on frames, and were not subjected to any churning action, as in the former apparatus. Details of experiments conducted to ascertain the variation of the resistance of the liquors, with temperature, percentage of tannin, and loss of voltage due to polarisation of the electrodes, were given in the paper. They showed that under the conditions investigated the electrolytic effect was inappreciable, as considerably less than 10 grms. of hydrogen could be evolved by the total current used in a complete tannage. The hastening effect was observed at night, after the motion and electric current had been switched off, thus showing that the rate of absorption was increased by the hides being put into a condition favourable to rapid absorption by the previous action of the current. Diagrams of the variation of the rate of absorption of tannin from the liquor during the same tannage when no motion was employed, when motion alone was used, and when the tanning was hastened by the passage of the electric current were also shown. The authors conclude from their experiments that, with the apparatus employed, the rate of absorption was approximately sixteen times faster than the ordinary process. Specimens of leather (sole and belting) were exhibited which had been tanned in less than twenty days. The authors also showed that the composition of the hides, as shown by their nitrogen content during the progress of the tannage, corresponded to the loss of tannin from the liquors, and drew attention to the physiological experiments of Ehrmann, Edison, and Lawrence and Harries, as bearing on the absorption of compounds by the skin.

In the discussion which followed, Mr. Hooper referred to the quality of the leather produced by the new process. Mr. Anderson drew attention to the difference between the electrical action upon the skin and upon muscular tissue, Mr. Swinburne pointed out that the electrical energy consumed, as it is so small, could only bring about a condensation of the tannin with the gelatine of the hide if no electrolysis took place, and Mr. Falkenstein, of the British Tanning Company, corroborated the statements of the authors as confirming certain experiments which he himself had been conducting on the rapidity of tanning when a current of electricity passes through the vat. Mr. Tyrer was glad to note so much progress had been made in the new process since the Society visited the experimental works two years ago, and looked upon the future of the process as being full of promise.

Notes.

PUBLIC WORKS AT ROUEN IN 1890.

The petroleum basin at Rouen is now completed. The timber dock is not yet ready for use, but the filling in of the surrounding spaces and levelling of the same was proceeded with during last year. The plan to extend the line of rails of the Western Railway Company to the wood and petroleum basins on the left bank of the river has been approved of, and will be immediately put into execution. Four covered sheds, covering an area of 130,000 square feet, are completed; also five hydraulic cranes on the left bank of the Seine. There are five others now being put up on the right bank, and there is likely to be a further development in the number of these cranes in the future. The Chamber of Commerce is about to obtain permission to acquire land on the right bank of the river as far as Croisset, to enable it to extend the port at any future time, when it may be desirable.

A NEW COTTON MILL IN INDIA.

The latest addition to the increasing number of cotton mills in India is the Peeroo Mahomed Manufacturing Company, Limited, the new mills of which company were opened last month. They are situated within a short distance of Mahaluxmi. The premises in which the mills are located is a double-storied building, which has been recently built. The spinning machinery has been supplied by Messrs. Dobson & Barlow, of Bolton, whilst the engines and boilers have been manufactured by Messrs. Daniel Adamson & Co., of Dukinfield, near Manchester. The engines, according to *Indian Engineering*, have been stated to be 1,500 horse-power, and capable of working 50,000 spindles—that is, nearly 17,000 more than the number the mill is furnished with at present. On the ground floor of the mill are situated the blowing-room and the card-room, whereas the first storey holds mules and reels, and the second one mules only.

THE FRANKFORT ELECTRICAL EXHIBITION.

Great preparations are going forward to make this Exhibition a success. We do not yet know how far English electrical engineers will patronise a German exhibition. It is purely a matter of business. There is a general feeling that Germans will not buy foreign goods if they can help it, so that there is little chance of export into Germany. We hope such ideas are without foundation, and that English firms will find it to their interest to exhibit with as much enterprise as they showed in 1881. We are glad to notice Dr. S. P. Thompson's name among the jury. Messrs. Haasentein & Vogler are going to publish an official journal during the Exhibition, and they have sent out a prospectus in rather curious English. Referring to the scope of the journal they state: "The contents of the paper shall be far from theoretical dryness on one side and amateur shallowness on the other, its get-up not to be rivalled; it will refer in its amusing part also to the *entertaining* sides of the Exhibition."

A REMEDY FOR POTATO DISEASE.

A report of experiments on potato disease by M. Petermann, Directeur de la Station Agronomique de l'Etat à Gembloux (Belgium), has been recently issued. M. Petermann, like M. Girard in France, made tests with sulphate of copper, but he also tried another remedy—viz., sulphate of iron. His experiments showed that the sulphate of copper dressing was effective, and, whilst it did not injuriously affect the weight of the crop, or the richness of the root in fecula, it most certainly reduced the percentage of unsound or diseased potatoes. M. Petermann used a stronger dressing than M. Girard, his formula being (per hectare): Sulphate of copper, 50 kilog.; lime, 25 kilog.; and water, 25 hectolitres. The test showed diseased roots amounting to only 7 per cent. on the total quantity raised, as against 30 per cent. of unsound tubers where the dressing was not used. The treatment with iron is very favourably spoken of, as it resulted in the diseased potatoes being lessened in quantity by 12 per cent. The iron mixture is composed as under:—Sulphate of iron, 50 kilog.; lime, 25 kilog.; and water, 25 hectolitres per hectare. It is simply the substitution of iron for the copper, and the cost of treatment, M. Petermann says, is consequently much less. He regards the experiments as of vast importance, and contemplates further inquiry into the subject.

PUBLIC WORKS IN ECUADOR.

A Consular report states that no advance whatever has been made on the Duran and Chimbo Railroad during the past year, but trains have been running regularly as far as Chimbo, and serve already to bring large supplies of potatoes, vegetables, eggs, and other farm produce to the Guayaquil market. The Congress of 1890 passed a law, embodying a contract proposed by a French syndicate, for the purchase of the present railway company (Compañia de Ferrocarril y Obras Publicas), and for the extension of the line to Riobamba; but the final conditions of this contract have not yet been carried out by the syndicate, although it is reported that negotiations are in progress to complete all the arrangements made. Two similar contracts were also approved by the Congress—viz., for the construction of the Central Railroad from Bahia to Quito, and for that of a cart road from the Pailon to Ibarra. Both of these projects are in the hands of English firms; but up to the present no definite steps have been taken towards carrying them out.

MANUFACTURE OF SALT IN CHINA.

In China, salt, which is a Government monopoly, is obtained by the evaporation of the water of the brine wells which abound in certain districts of Sz-chuen. The wells, states the *Engineering and Mining Journal*, are found about 175 miles from Chung-king, on the bank of an affluent of the Yang-tze River, near the flourishing city of Tzu-lin-tsin. The manufacture of salt, which has been carried on in China for a period of nearly two thousand years, is conducted somewhat as follows, according to a recent authority:—By means of a rude iron drill, holes 6in. diameter, and varying from a few score of feet to 5,000ft. or 6,000ft. in depth, are bored in the rock. The boring is sometimes continued for forty years before brine is reached, and is carried on from generation to generation. When brine is finally found it is drawn up by bullocks in long bamboo tubes by means of a rope working over a huge drum. In the vicinity of the salt wells, natural gas wells are also found, from which gas is supplied to evaporate the brine in large iron cauldrons, leaving the pure salt as a deposit. The product of salt in some districts is enormous. There are twenty-four gas wells and about a thousand brine wells now in operation, producing annually 200,000 tons of salt, valued at $5,000,000.

THE COTTON INDUSTRY.

The cotton industry at the present moment is going through a crisis owing to the recent considerable decline in values of American cotton. Prices of the raw material are lower now than for some time past, the fall from a few months ago being a large percentage. Compared with this time last year, the difference to-day between then and now is close upon 1¼d. per lb. Spinners some months ago bought very freely of cotton in expectation of values rising, but speculators have missed their mark, and are now saddled with a rather serious loss. The crop will be the largest on record. Moderate estimates of the ultimate yield are 8,400,000 bales to 8,500,000 bales. Reports are now gaining currency that the new crop will be a smaller one, but these statements are said to be unreliable, and made for "lifting" present rates. In addition to a great American crop, the Egyptian crop is a larger one than usual, and of fair average quality in the lower grades. Florida cotton is poor, and disappointing to spinners. Yarns for home use made from American cotton have for some weeks past been dragging. The output of the spindles has not been sold. The result is that order lists are lighter than for some time past; in fact, stocks are beginning to show themselves in first hands. If things do not soon take a turn, spinners will begin to agitate for organised short time for a month or so. Cloth for the great Eastern sections has been flat for quite a month past. Calcutta and Bombay shippers have done next to nothing in the way of purchasing. Shanghai merchants, too, have bought very sparingly. The nearer outlets have done, on the whole, fairly well, as has also the home trade. Altogether, however, the cloth section is languid, and the feeling is discouraging in most directions.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

6th April, 1891.

5852. Grass, A. B. ..... Corn or flour mills.
5854. Wrigley, T. ..... Cast metal worms or screws for conveyors and method of moulding the same.
5857. Wood, J. ..... Improvements in the construction of steam engines.
5862. Beck, W. A. ..... Apparatus for slipping ships' boats.
5863. McNaughton & Boswell Valves for hydraulic elevators.
5864. Carruthers & Stevens Fish joints for railways or tramways.
5875. Clark & Hodgson..... Collapsible tubes.
5876. Carter & Fraser ..... Appliance for measuring and delivering granular materials.
5877. Crabtree, T. ..... Combined reducing and stop valve.
5879. Davis, J. M. ..... Coupling link for chains and chain cables.
5888. Morris, Wilson, Strickland, & Lambert..... Construction of tubes.
5891. Lake, W. R. ..... Apparatus for the propulsion of ships or vessels (*Clark*).
5896. Stoddart, T. ..... Cut-off mechanism for steam engines
5897. Murrie, J. ..... Feed apparatus for steam boilers, &c.
5901. Braubach, E. A..... Construction of and appliances for furnaces.
5906. Hallier & Letellier ... Winding apparatus for hauling or raising and lowering objects.

7th April, 1891.

5923. Anderson & Pollock ... Sewing machines.
5924. Row & Brew ..... Apparatus for heating or evaporating liquids.
5931. Hardy & Hardy ..... Valve seats and acid-resisting valves and cocks.
5942. Allen, J. ..... Chain gear adjustment of cycles.
5944. Hudson, Rennie, & Graham ..... Apparatus for the consumption of smoke in the furnaces of boilers.
5946. Avery & Anson..... Fixed poise steel yards.
5950. Von Garn, F. P. ..... Coupling devices for railway carriages or trucks.
5971. Thompson, W. P. ..... Machines for producing type surfaces for letterpress printing (*Dodge*).
5979. Thompson, W. P. ..... Steam boilers and method of utilising the heated products therefrom (*Westphal*).
5992. D'Odiardi, F. E. S. ..... Pneumo-dynamometers.
6000. Redfern, G. F. ..... Quick-firing guns (*Ternström*).
6006. Mahony, F. W. ..... Stop motions for looms.

8th April, 1891.

6016. Nuttall, R. D. ..... Removable toothed gear or cog wheels.
6020. Savage, F. ..... Propulsion of boats.
6028. Walker, G. A. ..... Speed indicators for engines.
6038. Watmough, F. ..... Sight feed lubricators.
6039. Scholefield, R. ..... Apparatus for moulding and pressing bricks.
6046. Dont & Parent..... Stop mechanism for looms.
6053. Munns, W. H..... Steam boiler (*Heming*).
6073. Horn, W. W. ..... Automatic car brake (*Seawell & O'Hara*).

9th April, 1891.

6076. Griffiths & Beddoes ... The propulsion of navigable vessels, aëronautic apparatus, &c.
6080. Wilson, J. D..... ... Cupolas.
6081. Laidlaw, J..... Centrifugal machines.
6090. Bickerton, H. N. ..... Gas engines.
6092. Skelton, R. T. ..... Machine for stitching flat wire ropes.
6094. Lanchester, F. W. ..... Gas engines.
6097. Thompson, W. P. ..... Controlling and regulating the admission of steam in steam engines (*Jalsoriczky*).
6110. Stein, B. ..... Steam boilers.
6111. Barnes, W..... Feeding coal to furnaces.
6112. Langensiepen & Schroeter ..... Lubricator.
6124. Wyss, Ballurt, & Quentin..... Apparatus for cutting screw threads.

10th April, 1891.

6133. Tedesco, L..... Cocks or valves.
6143. Austin, H. K..... Axle guards for railway and other locomotives.
6148. Watt, J. ..... Steam boilers, evaporators, and the like.
6153. Thorn, R. ..... Metal moulding machine.
6154. Cheetham, F. ..... Band or rope attaching device for the carriages of mules.
6161. Crawford, F. H. ..... The driving of gas engines.
6166. Taite, Carlton, & Derlby ..... Speed indicators.
6175. Lake, W. R. ... . Feed-water heaters and purifiers (*McConnell*).
6183. Raworth, J. S. ..... Shaft couplings.
6184. Ibbotson, A. B..... Automatic couplings and coupling buffers for railway vehicles.
6189. Zwerintzeff, N. ..... Power loom.
6190. Harper, R. R. ..... Method of and apparatus connected with block signalling on railways.

11th April, 1891.

6200. Sibley & Honeychurch Fluid pressure motors.
6216. Houlden, H. W. ..... Fluid pressure motor.
6224. Rundquist, F. H. ..... Construction of railway and other wheels cast in iron or steel.
6230. Berthon, E. L. ..... Boat disengaging appliances.
6242. McKay, J. ..... Tube expanders.
6245. Newsome & Harrison ... Method of reversing the rotary motion of spindles employed in mules, spinning frames, and the like.

ELECTRICITY.

6th April, 1891.

5869. Scarlett, G. ..... Indicators for electric bells.
5903. Grimston, Viscount J. W. ..... An electro-pneumatic rock drill.
5912. Sandwell, W. D. ..... The transmission of electricity to portable cranes, &c.
5918. Harris & Power ..... Electric batteries.

7th April, 1891.

5947. Chapman, H. ..... Method of and means for renewing or repairing the filaments of incandescent lamps.
5953. Byron & George ..... Voltaic batteries.
5972. Sillery, W. ..... Electric storage batteries.
5995. D'Odiardi, F. E. S. ..... Liquid electrodes.
5996. D'Odiardi, F. E. S. ..... Magneto-voltaic and static electrodes.
6003. Reilly, J. C. ..... Terminals for cables of electrical conductors.
6007. Lancaster, E. W..... Handles or taps for electrical switches.

8th April, 1891.

6012. Lundberg, A. P. ..... Switches.
6029. Walenn & Timmis ..... Electro-depositing copper, brass, and bronze.
6048. North, G. ..... Electric power apparatus.
6072. Carpenter, C. E. ..... Electro-heating apparatus. (27th September, 1890.)

9th April, 1891.

6104. Timmis & Smith..... Dynamos and motors.
6125. Ritter, J. J. ..... Apparatus for soldering, boiling, and heating.

11th April, 1891.

6194. Kingdon, J. A. ..... Electromotors for alternating currents.
6232. Gwosdepp & Bungé ..... Microphones for telephonic circuits and the induction coils thereof.
6243. Patz & Grebner ..... Galvanic batteries.
6247. Johnson, J. Y. ..... Automatic regulating apparatus in galvanic batteries (*Gendron*).

CHEMISTRY.

7th April, 1891.

5983. Le Sueur, E. A. ..... Apparatus employed in electrolysis.
5984. Willcox, B. ..... Production of azo colouring matters (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5999. Greenwood, J. ..... Manufacture or production of chlorine and sodium amalgam.

11th April, 1891.

6234. Imray, O..... Production of basic gallate of bismuth (*Farbwerke vormals, Meister, Lucius & Brüning*).

MISCELLANEOUS.

6th April, 1891.

5851. Sowerby & Casper ..... Casting metals.
5860. Pilling, M. J..... Water and other taps.
5871. Rothwell, W. G. ..... Apparatus for distributing on the water oil or other liquids by means of explosive rockets or projectiles.
5885. Pickup & Pickup ..... Miners' safety lamps.
5886. Leffler, C. J. L. ..... Material for the manufacture of cutting tools.
5907. Siemens, F..... Regenerative gas stoves.
5908. Dulier, E. E..... Method of and apparatus for destroying smoke.
5915. Fleuss, H. A..... Refrigerating machines.

7th April, 1891.

5933. Waterhouse & Blantern ..... Wire mattresses and their frames.
5935. Davis, E. C. J. ..... The casting of pipes, columns, girders, &c.
5943. Kaye, J. W. ..... Oil cans.
5949. Horne, G. W..... An improved lamp.
5970. Boult, A. J. ..... Railroad chairs (*Wells*).
5977. Robson, J. ..... Preservative coatings for iron or other structures.
5985. Reap, J. ..... Tool for cutting wood to mitre or other angles.
5986. Meixner, F. ..... Barrels for firearms.
6002. Edwards, E. ..... Iron heating pipes (*Marloy & Legat*).

8th April, 1891.

6019. Reading, T. ..... Metallic packing rings and springs.
6026. Reddaway, F..... The manufacture and treatment of woven driving belting.
6044. Brook, E..... Gas furnaces.
6051. Munns, W. H. ..... Stove for heating railway cars (*Harris*).
6067. Mannesmann & Mannesmann..... Railway rails and joints.
6070. Lake, W. R. ..... Signalling apparatus for use on ships or vessels (*Fiske*).

9th April, 1891.

6078. Rhodes, J. C. ..... Signalling on railways.
6084. Westwood & Jones ..... Tubes.
6101. Bradbury, Cryer, & Houghton ..... Automatic shuttle guard.
6128. Johnson, J. Y. ..... The manufacture of gunpowder (*The Dynamite Actiengesellschaft Nobel*).

10th April, 1891.

6134. Laing, J. ..... The distillation of mineral oils and apparatus therefor.
6142. Murray, T. R. ..... Pipe joints.
6152. Jones, G. ..... Fettling for puddling furnaces.

11th April, 1891.

6193. Taylor, J. ..... Belting for driving purposes.
6199. Austin, H. K..... Method of constructing axle boxes and bearings for use upon railway vehicles.
6215. Pitt, G. ..... System of joining by casting, either in stocks or sand, in the joints of elbows.
6219. Young, L. H. ..... Locking nuts used in fastening the fish plates on the rails of railroads.
6223. Ryan & Flynn ..... Automatic signalling of railway trains and appliances therefor.
6235. Lang & Wigham ..... A process for protecting iron and steel wire against corrosion.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

3858. Fowler.
5429. Tattersall.
5553. Denby.
5572. Millington.
6307. Armstrong.
6439. White.
6661. Brophy.
6717. Freeth.
6754. Davies.
6876. Ashworth & Kneen.
6919. Holborow.
6950. Rodger.
7008. Askham & Wilson.
7065. Blamires & Blamires.
7145. Rylands.
7287. Murray.
7360. Evans.
7555. Brookes.
7401. Webb.
7714. Newton.
7736. Clark & Clark.
7832. Allsop.
7861. Monro.
7899. Collis.
8019. Lister & Pedersen.
8053. Booth.
8066. Sumner.
8133. Harding.
8208. Wright.
8274. Shuttleworth.
8330. Houtain.
8519. Prinz.
8557. Chiles.
8587. Phan.
8636. Rylands & Emmet.
8697. Annett.
8739. Boyd.
8761. Howarth.
8776. Edwards.
8796. Hill.
8802. Mosley.
5281. Stevenson & Milburn.
5495. Gittins.
5556. Bradley.
5787. Dunbar.
6349. Brookes (*Higgins & Morgan*).
6710. Woolley & Woolley.
6733. Brewster.
6836. Wiggins & Wiggins.
6897. Hallsworth.
6933. Von Peichl.
6987. Tolladay.
7062. Wild.
7135. Thomson & Haigh.
7205. Horn (*Kreger & Rusbridge*).
7487. Freeman.
7567. Pilkington & Taylor.
7625. Grimshaw.
7728. Mitchell.
7738. Clrathero & Nichols.
7848. Palmer & Ware.
7884. Espinasse.
7935. Huelsse (*Silbermann*).
8026. Johnston.
8059. Hebblewaite.
8107. Wilson.
8137. Oldaker.
8248. Manchester.
8322. Popp.
8401. Gravely.
8523. Paddon.
8576. Linley & Biggs.
8598. Wenger.
8663. Flouest.
8725. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8790. Watson & Robertson.
8799. North.
8811. Kolf.

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8833. Phillips (*Overman*).
8879. McKee & McIntosh.
8887. Abercrombie.
8919. Wilson.
8922. Peters.
8950. Crossling.
8987. Thirion.
8996. Wade & Cherry.
9009. Hurley.
9028. Brooks (*Clarté*).
9066. Turner.
9096. Bosenbecker.
9190. Gibb & Pirjus.
9316. Bourbonnreux.
9365. Ballard.
9503. Tufnell.
9538. Rebikow.
9685. Cox.
9757. Metham.
10116. Pemberton.
10388. Aspinall.
10433. Hall.
11536. Starr.
13465. Cumming.
14021. Morten.
14619. Floyd.
15060. Rogers & Bright.
15442. McCluer.
15489. Fell (*Die Actiengesellschaft für Cartonnagen Industrie*).
16869. Tintoré.
17449. Talbot.
17794. Reed.
18193. Mock.
18398. Falk.
18798. Kasielowsky.
19215. McFarlane.
20064. Parsons.
20524. Pickard. (16th May, 1890.)
21060. Sheppard.

1891.

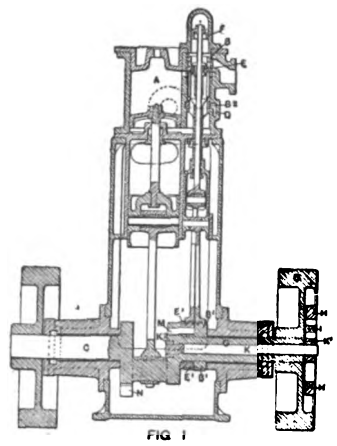
479. Gessner.
1358. Smith.
1952. Stark.
2451. Bond.
2761. Healey.
2812. Zeitler.
2870. Newton (*Messrs. P. Hoe & Co.*).
2993. Johann Martin Seitz & Carl William Weise.
3123. Tate.
3301. Shurtleff.
3342. Schumacher & Rangener.
3740. Koechlin.
3899. Bonne (*Scheller*).
3985. Wood & Blanchard.
3995. Lake (*Hull*).
4073. Wild.
4104. Hurlin & Rowsell.
4199. Zirrgiebel & Faulwetter.
4216. Bush & Powers.
4227. Bayly (*Franklin*).
4261. Higbee.
4271. Newton (*The American Electric Railway Signal Company*).
4304. Boult (*The Milwaukee Carving Company*).
4333. Campion.
4376. Sinclair.
4403. Boult (*Reinmann, Dittmar, & Falkenhausen*).
8840. Horn (*De Long*).
8884. Macfarlane.
8888. Tweddel & Seath.
8921. Allday.
8937. Poole.
8986. Morecroft.
8995. Aria.
9003. Gell.
9013. Sankey.
9057. Adams.
9098. Baxter.
9120. Cox.
9261. Headech.
9323. Sibley.
9383. Horn (*Harkins*).
9506. Kerr.
9557. Warburton & Stuttard.
9960. Slaughter.
10195. Abel (*Sachsische Webstuhl Fabrik*).
10461. Sellars.
11688. Mary Ann Duffy (Widow and Administratrix of the late Thomas William Duffy) & James Smith Barnfather.
15841. Bywater & Beanland.
16042. Litchfield.
16568. Hill.
17214. Kirkham.
17608. Dahl.
18066. Davies Bros. & Co., Ld., & Bayliss.
18750. Lobban.
19125. Nix.
19785. Lockwood.
20078. Hull.
20649. Giraud.
20812. Sowden.
21131. Young & Young.

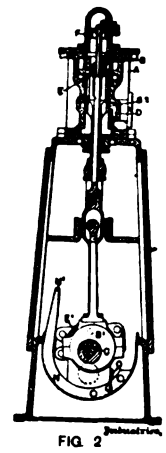
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

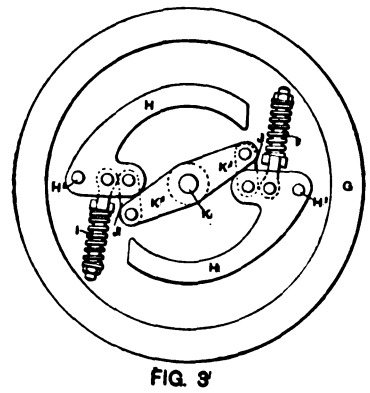
Jacquard Looms.—*Thomis, Priestley, & Priestley, Bradford.*—This specification relates to improvements in the arrangement and construction of the uprights used in Jacquard double-lift open shed machines for operating the harness and healds. With uprights of the ordinary construction, when any require to be changed, the card cylinder is kept in contact with the respective cross wires until the ascending lifting grate has passed the descending hooks of the other legs of the respective uprights, when the card cylinder is allowed to recede and the uprights return to their normal vertical position and rest at the bottom upon the ordinary perforated guide board; but in this invention each pair of uprights is made separately, with a collar on each, and they are mounted independently of each other, and with their lower parts passing through a perforated plate. Between each pair of uprights is placed an additional upright with a hook at the top, and to the bottom of this centre upright is attached the harness or healds. The central upright carries a cross-bar, through holes in the ends of which the other uprights pass, and when either side upright is raised the centre upright is raised also, and retained by a stationary supporting bar until liberated by the card mechanism; the time of contact of the card cylinder is greatly reduced, and more time is obtained in which to allow it to change the pattern surface, thus the Jacquard loom may be run at a greater speed than would be possible with uprights constructed in the ordinary manner. Claims: In a Jacquard machine, the combination of the side and centre uprights as and for the purpose described.—No. 4787. March 27th, 1890. 8*d*.

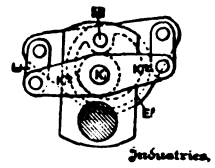
Single-acting Steam Engines.—*N. Chandler, Hednesford, Staffordshire.*—An engine constructed on the principle of this invention is shown in the annexed illustrations, of which Fig. 1 is a sectional elevation and Fig. 2 a sectional elevation at right angles to Fig. 1 and taken through the valve chamber, Figs. 3 and 4 being enlarged details of same. Sliding in a suitable chamber on one side of the main cylinder A is the distributing valve B which regulates the supply and exhaust to the upper end of A and is actuated through suitable connecting rod from the eccentric B^1 on the main crank shaft C of the engine. Connected to the lower part of B is a sleeve valve B^2, which is so adjusted that as the piston of the engine nears the lower end of its stroke


FIG. 1


FIG. 2

it closes the exhaust port D sufficiently to ensure a compression of the exhaust steam in the cylinder. Sliding inside B is a piston valve E, balanced by means of a second piston F, which is actuated by means of a connecting rod. The latter passes through the hollow connecting rod of B, wherein suitable stuffing boxes are placed, from the eccentric E^1 also on C. This piston valve is for the purpose of closing the supply ports in B, so cutting off the supply of steam at any desired point in the piston's stroke, and is governed directly by means of a centrifugal governor carried by the fly-wheel G, and consisting of two weighted levers H (Fig. 3) pivoted at H^1, and which are held in the position shown, when the engine is running at its normal speed, by springs I. The movement of this governor is transmitted to the eccentric E^1 and so to E by means of links J, connecting the ends of H to a radial arm K^1 on the rod K, which rod passes through an axial hole in C. Other radial arms K^2 (Fig. 4) are formed on the other end of K which are connected by links L with projections on an eccentric E. This eccentric at a point within the bearing of its strap is journaled on a pin M fixed to an extension on one of the crank arms of C. In order to cause oil to be thrown to the top of the crank chamber a trough N is arranged within the crank chamber and is


FIG. 3

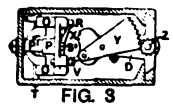

FIG. 4

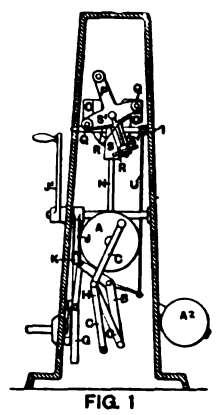
partly immersed in the oil and water therein. Fixed to one of the crank webs is a metal blade O, which, as the crank rotates, passes through the trough and forces the lubricant before it up the trough and out of a nozzle N^1 at the upper end thereof. Five claims are made.—No. 5076. April 1st, 1890. 8*d*.

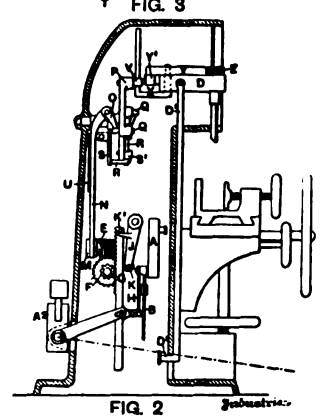
Hydraulic Motors.—*E. Davies, London.*—A flexible bellows arrangement of waterproof material is used in lieu of a cylinder and piston, and is said to be particularly suitable for small power engines driven from ordinary water mains. The piston rod is secured at one end to the top of the cylindrical bellows, and at the other end embraces a crank pin. A special arrangement of plug valve is placed in the foundation at the base of each bellows, and is operated by a semi-circular tappet on the crank shaft. This arrangement of tappet enables the valve to be held open during the out-stroke of the engine, but shuts the same sharply at the desired point, and leaves the exhaust open during the back stroke. The plug of this valve contains two parallel passages, one for admission and the other for the exhaust. Claims: The motive power engine as described; the plug valve and means of operating same; the bellows arrangement in combination with the rest of the mechanism.—No. 4653. March 25th, 1890. 6*d*.

Pressure-reducing Valve.—*J. Scott & J. Thornton, both of Bristol.*—In a valve constructed according to this invention the valve box is provided with two valve seats. Steam at high pressure flows into a space between two valves of differential areas, lifting the upper and larger valve against the resistance of a spring adjustable from the exterior. The lower and smaller valve is loose and independent of the upper valve, and is held on its seat by the high-pressure steam, but a reversal may take place when there is no steam in the main boilers, to allow steam to pass from the winch boiler, back along the main steam pipe, through the small lower valve (which it lifts by acting upon the underside thereof), and thus into the passage which ordinarily constitutes the inlet for high-pressure steam, whence it is led by a special pipe to any desired point. Claims: A spring-loaded reducing valve with a return valve enclosed in the lower part of the same valve casing whereby steam may pass reversely through valve casing from low-pressure side in the absence of high-pressure steam from the opposite side; valves with oblique wings, causing slight rotation of valves when lifted.—No. 4328. March 20th, 1890. 6*d*.

Mortising Machines.—*J. Anderson, Newcastle-on-Tyne.*—This specification, which has been prepared in such a manner as to render its interpretation a matter of some difficulty, relates to an automatic arrangement for rotating the chisel of a mortising machine upon its axis, whilst at the same time it is in motion vertically. Almost the whole of the mechanism of a mortising machine is described, including a toggle and radius-bar arrangement for varying the stroke of the chisel, and an arrangement apparently intended to increase the depth of successive cuts from zero to a maximum, and on the completion of such a series to raise the chisel automatically in readiness to commence anew, but only the portion of the invention referred to in the first paragraph hereof appears in the provisional specification. Figs. 1, 2, and 3 illustrate a mortising machine in sectional front


FIG. 3


FIG. 1


FIG. 2

elevation, sectional side elevation, and sectional plan respectively, and in the views the chisel is carried by the vertically reciprocating slide D, and has at its upper end the spur pinion Z, which, with the segmental rack Y, which operates it, is also carried by D. The segmental rack is provided with a rearwardly extending tail or crank arm X, which extends upward also, so that at any point in the travel of the carriage it may be operated by the upper end of the arm P of a rocking lever, which is caused to oscillate by means of a plate S, and a somewhat complex arrangement of mechanism brought into operation thereby. It appears to be intended that the oscillation of the lever P causing a reversal of the chisel shall take place only on the completion of a series of cuts of increasing depth as aforesaid. There are three claims.—No. 3994. March 14th, 1890. 6*d*.

Chain Links.—*J. Scott, Liverpool.*—The inventor's object is to fix the studs of a stud link chain in position in the links after the links proper are constructed, and for this purpose the stud is divided in the middle of its length, each half being provided with a notched end adapted to fit the interior shape of the link, a wedge being driven in between the abutting ends of the half studs to keep them in position to form a strut across the link, the opposite ends of the wedge being riveted over into recesses formed at the junction of the halves of the stud. The operation may be performed with ease and rapidity by unskilled workmen. Claims: A stud link and the individual components thereof substantially as described.—No. 8040. May 23rd, 1890. 8*d*.

Cross Weaving Mechanism.—*J. Fairburn, Jun., Burnley.*—This is an arrangement for actuating the upper and lower needles used in cross-weaving, in which some or all of the warp threads do not lie parallel with eath other, but are crossed over as in "lenos," and are locked together by the weft shots. It is particularly applicable for securing the severed edges of fabrics woven in two or more breadths in the same loom and subsequently separated from each other by the severance of the weft. In this application of the apparatus four needles are preferably employed, two of which are fixed in a frame with their points projecting downwards, the other two being fixed to an oscillating piece with their points projecting upwards and being made to oscillate laterally to the right and left alternately with the motion of the needles above them immediately before the formation of the shed, and whilst the points of the upper needles are above those of the lower ones. The vertical movement of the upper needles to form the shed is effected by a band operated by the vibrating sley. The lower needles carrying the crossing threads are moved laterally by a cam operated by a ratchet wheel, which is actuated by a catch attached to the frame carrying the upper needles. The projections on the ratchet wheel may be varied in accordance with the design of the fabric to be woven. The slide frame carrying the upper needles when in motion brings a projection thereon against a tooth of the ratchet wheel to cause the latter to receive motion and to operate the lower oscillating needles as required. Claims: For securing parallel breadths a slide-piece

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operated by projections to produce lateral movement at the points of the needles of the crossing threads.—No. 7550. May 15th, 1890. 8*d.*

MACHINE FOR DRILLING FALLERS.—*H. Haigh, R. Walker, & J. Mitchell, all of Keighley, Yorkshire.*—In the accompanying illustrations is shown a drilling machine for the above purpose, of which Fig. 1 is a plan, Fig. 2 a side elevation, and Fig. 3 a sectional front elevation. The bed A carries the upright and cross slides B and C, to hold the fallers, adjustable from handle D and hand-wheel D^1 respectively. A also carries the head E with drill spindle E^1, and a box F, in which is a disc F^1 with pin F^2 actuated by elliptical wheels G and H and gear wheels F^3, F^4, F^5, and F^6. As F^1 revolves it actuates a lever J^1, which,

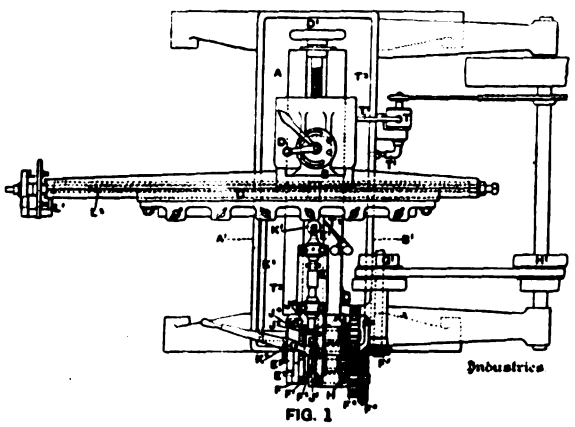


FIG. 1

through a slide J^5 attached to E^1, feeds and withdraws the drill at intervals. After the drill has finished one operation, a stud J^2 upon the slide comes in contact with a spring catch J^3, pushing back the spring J^4 and releasing the slide bar E^2, which is kept in tension by the spring K. The slide bar E^2, on being released, operates a pivoted lever K^6, which in turn, by means of levers and rod K^3 and K^4, operates a horizontal rod K^5, giving motion, through levers L^1, to a ratchet and ratchet wheel L attached to one end of the cross slide, which operate a screwed rod L^2, moving the slide C and faller into position for the next hole to be drilled. The bar E^2 and the drill are brought into position for the next feed, by means of a weight K^1 connected to J by chain K^2 and an eccentric swivel E^3. Attached and adjustable upon C are dogs M fixed so that, when sufficient holes have been drilled in the faller, one of the dogs comes in contact with a spring catch N, depressing same and releasing a clutch P operated by lever R and spring S, thus throwing the horizontal rod K^5 out of gear, so preventing further movement of the slide; the

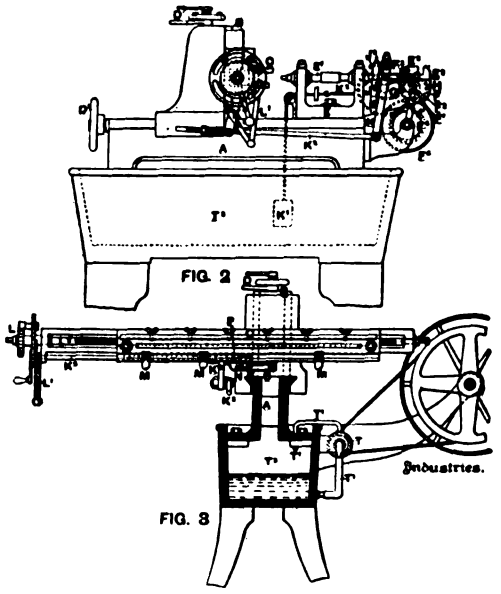


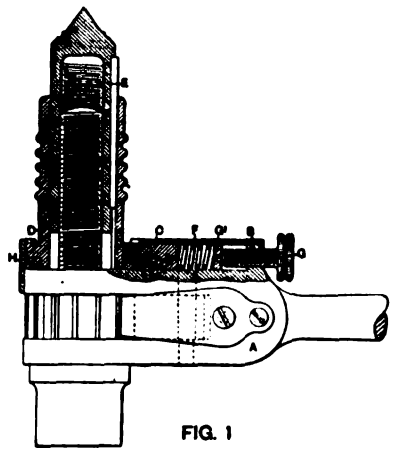
FIG. 3

lever K^4, when not engaged with clutch P, is loose upon the rod K^5. A small pump T, operated from the driving shaft, is used for lubricating the drill, and which, by means of pipes T^1 and small nozzle T^2, propels a small jet of lubricant upon the faller; the liquid is placed within trough T^3. Six claims are made.—No. 5045. April 1st, 1890. 11*d.*

PNEUMATIC RAILWAYS.—*E. Locher, Zurich.*—In railways constructed according to this invention, hollow cylindrical carriages for goods and passengers travel in a cylindrical tube through which they are propelled by air pressure therein. The brake mechanism is adapted to act upon carrying and guide wheels, which are supported on bearings secured to the ends of the carriages and which travel upon longitudinal rails. Pressure is exerted between brake blocks and the peripheries of the wheels by a toggle and screw arrangement, and owing to the brake blocks being arranged on those portions of the peripheries of the wheels which are away from the rails, the operation of the brakes not only retards the rotation of the wheels, but presses the wheels against the rails and so produces a further braking action. The carriages make a tight joint with the interior of the tube by means of peripheral rings of metal, for example, arranged at short distances apart and almost touching the wall of the tube, by which arrangement of the rings annular air spaces are forced around the carriage—these spaces rendering equalisation of air pressure between the two ends of the carriage very difficult, if not impossible. Doors and the platforms for attendants are provided at the ends of the carriages. Compressed air may be employed to force the carriages through the tubes, or a partial vacuum may be created ahead of the train, which will then be propelled by atmospheric pressure acting at its rear. Claims: For pneumatic railways the hollow cylindrical carriages with carrying wheels, guiding wheels, and brake arrangements at its ends, as described; the combination with the foregoing of toggle lever brake mechanism; the arrangement of peripheral rings, as and for the purposes described.—No. 7826. May 20th, 1890. 11*d.*

SAW BENCH GUIDE AND FEED.—*F. R. Boultbee, London.*—This is an automatic feed and guide designed to obviate the dangerous manipulation on the bench of short and very narrow pieces of wood by hand. A reciprocating feed-block works in guides on the saw bench, and is reciprocated by a crank and connecting rod placed at the rear of the saw bench. A wooden fence and tilting cradle are attached to the feed-block, and are capable of being changed in accordance with the work required. The throw of the crank, and consequently the travel of the feed-block, may be varied at will, and the point of attachment of the connecting rod to the feed-block may be altered to adjust the range of the travel, and cause it to take place at distances from the saw which are in accordance with the size of the pieces being cut. The speed of the crank is regulated by the usual arrangement of cone pulleys. Claims: An automatic reciprocating device and guide as described; the combination of a changeable fence with the foregoing.—No. 7782. May 19th, 1890. 6*d.*

RATCHET BRACE.—*W. Kimber, Steventon, Berkshire.*—The inventor's aim is to obtain a self-acting feed. In the accompanying illustrations Fig. 1 is a part sectional elevation and Fig. 2 a part sectional plan of a ratchet brace with a female feed screw, and embracing the principle of this invention. On the shank A of the handle carrying the drill socket, rotating mechanism, and


FIG. 1

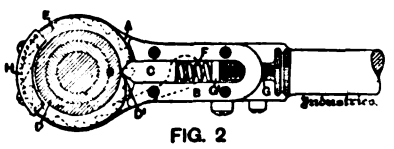
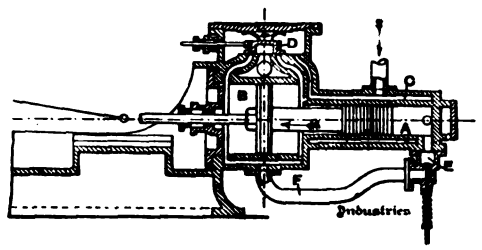


FIG. 2

feed screw, is formed a box B, in which is fitted a sliding pawl C adapted to engage with one or more notches D^1 formed in the flange of a collar D mounted on the feed screw E. The sliding pawl C is pressed forward by a spiral spring F, the elasticity of which is capable of being adjusted by means of the milled-headed set screw G, threaded into the end of the box B, and acting on the spring F through the washer G^1. The collar D is connected to the feed screw E by means of a feather and feather-way, as illustrated in the accompanying illustration, and it is confined by means of a flanged plate H screwed, or otherwise fixed, to the top part of the shank A of the hand lever. The inventor also describes a brace with a male feed screw. Four claims are made, embracing the construction of self-feed ratchet braces as described, with modifications.—No. 12488. August 9th, 1890. 6*d.*

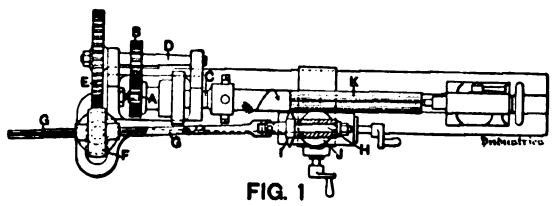
GAS ENGINE VALVE GEAR.—*O. V. Plauen & M. Hille, both of Dresden, Germany.*—This invention relates to the valve gear of engines driven by explosive mixtures, and the improvement consists in the combination with the admission valve for gas or vapour of a suitably balanced lever oscillated in one direction by the engine, and in the other direction by gravity, and through the medium whereof the operation of the admission valve is so controlled that the latter will be opened at every stroke of the slide valve or not, according as the engine runs at the ordinary or at an excessive speed. Opposite to the stem of the admission valve is arranged a reciprocating finger moving synchronously with the slide valve, and adjacent to this is placed the oscillating lever, which carries a movable pin controlled by a spring, the lever and the pin being so disposed that when the lever is in a certain position (the operative position) the pin will be lengthwise between the stem of the admission valve and the reciprocating finger. The pin has such a length that, under the said conditions, the finger on advancing will press the pin against the valve stem, and thus open the valve, the pin being pushed backwards again by this spring when the finger recedes. Sideward of the said lever there is an oscillating or reciprocating tappet, which, at every stroke of the slide valve, acts on the lever to oscillate the same so as to throw the pins out of line with the admission valve stem and the reciprocating finger; the lever is, however, balanced in such a manner that when the engine runs at the proper speed the lever, after having been swung out of its operative position, will return thereinto just in time to be again acted upon by the reciprocating finger at its next forward stroke. The admission valve is in this case opened at every stroke of the slide valve. But if the speed of the engine be too great the lever on oscillating backward will be too late for the pin to be engaged by the reciprocating finger; the admission valve will consequently then remain closed, and the cylinder will not receive any charge of explosive mixture. This skipping of charges continues until the engine has re-assumed its normal speed, whereupon the admission valve is opened again regularly. Claims: In combination with the admission valve of a gas or petroleum engine a valve gear of the type described. The details of this particular example are fully claimed.—No. 10642. July 9th, 1890. 8*d.*

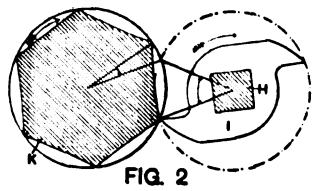
COMBINED GAS AND COMPRESSED AIR ENGINES.—*J. C. Mewburn, London, Dr. R. Proell, Dresden, & E. Fischinger, Niedersedlitz, near Dresden, Germany.*—The present invention consists in combining a compressed air motor and a gas or explosive motor in such a manner that an exchange of heat takes place between the two motors—viz., that the excess of heat generated by the explosive motor serves to heat the compressed air while the excess cold created by the compressed air motor serves to cool the explosive motor. The accompanying illustration shows a sectional side elevation of one way in which the invention can be



carried out. A is the gas or explosive cylinder, and B the compressed air cylinder. The compressed air enters the jacket C of the gas cylinder at atmospheric temperature and takes up heat from the said jacket, whereby the compressed air becomes heated and the gas cylinder is cooled. From the jacket C the compressed air passes into the valve box and is distributed by a slide or other valve D to the two sides of the piston in the usual manner. When the two pistons have nearly finished their stroke in the direction of the arrow, the valve opens the front port to the compressed air, while the exhaust valve E of the gas cylinder opens simultaneously, and the exhaust gases from this cylinder, which are still of a high temperature, pass through the pipe F into the jacket of the compressed air cylinder, as well as into the compressed air cylinder, and simultaneously heat the cylinder itself and also the compressed air with which the gases mix, and the mixture is able to expand without undue reduction in temperature. When the compressed air is working on the return stroke in the back end of the cylinder heat is conveyed to it by the hot walls of the gas cylinder as well as by the hot piston and piston trunk. In two claims the inventors embrace the methods of combining a gas and compressed air motor substantially as and for the purpose set forth.—No. 7177. May 8th, 1890. 8*d.*

LATHE FOR TURNING ANGULAR SECTIONS.—*C. G. Dahlgren & G. H. Svensson, both of Göteborg, Sweden.*—A lathe for the above purpose is shown in plan in Fig. 1 in the annexed illustrations, Fig. 2 being an enlarged end view of the cutters. Geared by means of gear wheels A B with the live spindle C of the lathe is a counter shaft D, which shaft also carries a second gear wheel E, gearing with a spherical wheel F mounted by means of a feather on a shaft G. This shaft G is connected by means of a universal joint with the spindle H of the cutters I (Fig. 2) journaled on an ordinary slide rest J. The speed of the cutter relatively to that of the blank K to be operated upon may be altered by replacing the wheels A B or E F by similar wheels of different relative sizes, so that any number of facets may be cut on the blank K. Claims: (1) The combination of a lathe adapted to receive and revolve a blank, with a rotary cutting tool adapted to be revolved with a velocity the proportion of which to that of the blank is equal to the number of facets to be cut by said tool divided by the number of blades thereon for the purpose described; (2) the combination of a lathe adapted to receive


FIG. 1


FIG. 2

and revolve a blank with a rotary cutting tool having two equidistant cutting blades and adapted to be revolved with a velocity the proportion of which to that of the blank is equal to half the number of facets to be cut by said tool; (3) the combination of the live spindle C adapted to receive and revolve a blank, gear A B, shaft D, spur wheel E thereon, spherical wheel F gearing with said wheel E, shaft G keyed to said wheel F and movable back and forth therein, universal joint and shaft H with rotary cutting tool, said tool having equidistant blades and adjustable rest block J carrying said shaft, the whole substantially as set forth.—No. 824. January 7th, 1891. 6*d.*

FLEXIBLE SHAFTING.—*F. Y. Wolseley & P. H. Craven, both of London.*—Shafting constructed according to this invention is particularly applicable to comparatively small machines, but is also applicable to larger shafting revolving in fixed bearings when the parts of such shafting are required to be at an angle to each other. In one example a flexible guide sleeve is shown, within which rotates the flexible shaft, composed of a number of pieces more or less barrel-shaped, the radius of the barrel being approximately that of the smallest curvature in which it is intended that the shaft shall be worked. The ends of the barrel-shaped pieces are preferably convex, and have formed in them cylindrical holes parallel to their axis, the holes being so disposed that when the pieces are end to end the holes in one piece correspond with

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those in the next piece. Cylindrical pins, somewhat smaller in diameter than the holes, are inserted therein, so that the opposite ends of each pin take into the holes in the ends of adjacent barrel-shaped pieces. Thus any required number of these pieces are caused to rotate together, and the pins being loose in the whole of the pieces, the latter may be placed at any angle to one another without interfering with their rotary motion. A piece of cord or the like may pass through central holes in the entire number of the pieces and may be secured to washers at each end of the shaft to prevent their separation. Lengths of rigid shafting placed at an angle to one another, and revolving in bearings, may be connected by loosely fitting pins in the manner above described. Claims: The flexible shafts as described, with loosely fitting driving pins and separate pieces connected by a flexible end or the like; connecting lengths of ordinary shafting as described.—No. 7632. May 16th, 1890. 8*d*.

ELECTRICITY.

ELECTRICITY METERS.—*A. Gay, Brighton, and R. Hammond, London.*—The invention relates to an apparatus for measuring and recording electric currents. In the annexed illustration Fig. 1 is an elevation of the recording mechanism, and Fig. 2 the measuring mechanism embraced by the invention. The drum

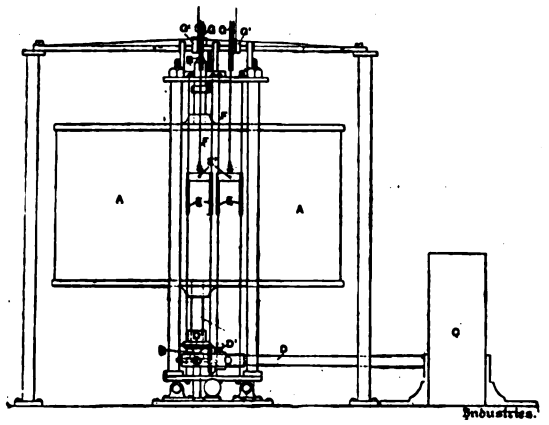


FIG. 1.

A, around which is placed the paper on which the record is to be made, is carried in cup jewels B in a suitable framework, and is driven continuously by means of a suitable clock-work in C, rod D, and bevel gearing D^1. Sliding in slides E are carriages E^1 carrying the marking pens, the points of which project against the periphery of A. The carriages E are supported and moved by cords F on pulleys C. On the shafts of these pulleys are smaller pulleys G^1, around which are wound cords connected to the measuring mechanism. Referring to Fig. 2, the measuring mechanism consists of two plates H H^1 connected together by means of a fine wire I passed around pegs J, and the ends of which are connected to the electric mains if the current is continuous. If, however, the current is alternating, the said ends

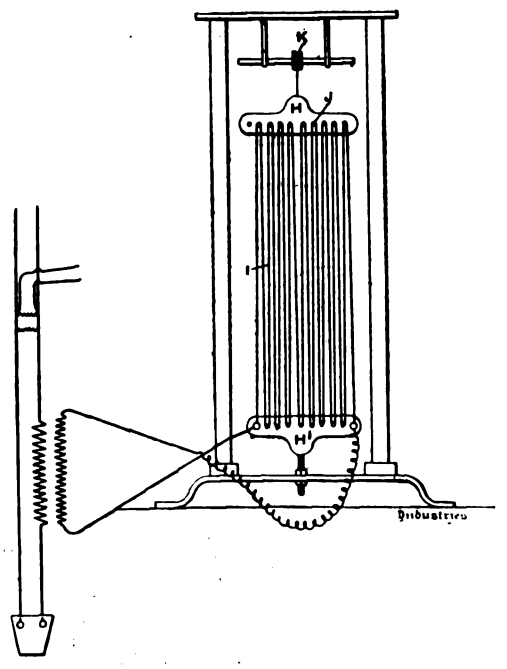


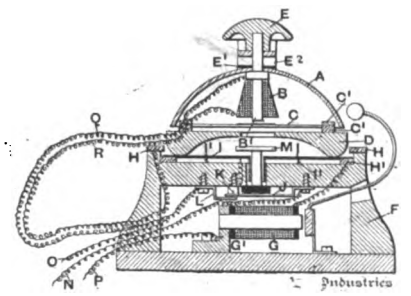
FIG. 2.

are connected in series with the secondary coil of a transformer. The plate H is connected to the cord wound on pulleys G^1 (Fig. 1) passing over roller K. It will thus be seen that any variation in the current will alter the distance between H and H^1, so raising or lowering E^1. In six claims the inventor embraces the apparatus as described.—No. 4992. March 31st, 1890. 11*d*.

ELECTRIC LAMP ILLUMINANTS.—*J. Clegg, London.*—The invention embraces a method of coating the illuminants with a metallic compound. For this purpose one of the following metallic solutions is used:—(1) Oxides of metals, or metals themselves dissolved in volatile solvents; (2) oxides of metals, or the metals themselves dissolved in a suitable solvent, and the resulting solution mixed with a volatile liquid. One of these solutions is placed in a suitable vessel in which the illuminant is suspended, which latter, after a vacuum has been created in the vessel, is electrically heated, which causes a deposition thereon of the oxide or oxides or metals. Claims: In the manufacture of light emitters or illuminants for electric lamps, the above-described treatment causing a deposit on them of metallic matter by electrically heating them to incandescence while they are suspended in a vessel from which air is excluded, above a volatile liquid such as alcohol, having dissolved or suspended in it a haloid or acid salt or an oxide of some one or more metals.—No. 694. January 14th, 1890. 6*d*.

DYNAMO ARMATURES.—*J. Nebel, Charlton.*—In place of winding drum armatures in two parallel circuits from brush to brush, in which arrangement a large sectional area of conductors is required, which, as radial depth is limited, must be obtained by increased width, reducing thus the number of conductors and of commutator segments, the inventor winds two, three, or more sets of convolutions side by side, each set having its series of commutator segments, thus reducing the sectional area required for each conductor, and proportionally increasing the number of commutator segments. The brushes touch simultaneously as many of the commutator segments as there are parallel windings. Claims: A drum armature having two or more separate conductors, or, as an alternative, two or more lengths of a continuous conductor wound a number of times round the armature, each convolution connected to a separate commutator segment, and each of the brushes covering simultaneously as many segments as there are conductors.—No. 4824. March 27th, 1890. 8*d*.

ELECTRO-TELEPHONIC APPARATUS.—*E. F. Furtado, London.*—The inventor's object is to simplify the construction and to reduce the first cost of apparatus of the above description. In the annexed illustration is shown a sectional elevation of a telephone constructed according to this invention for standing on a table. A is the gong of the call bell, fixed to the back of which is the telephone coil B, the pole B^1 of which is made adjustable towards or from the diaphragm C, held between two rings C^1 on the mouth-piece D, by means of nut E, flat spring E^1, and bar E^2. The stand F carrying the bell coil G and hammer G^1 has two metal rings H H^1 attached to the upper part thereof, between which rings is a movable plate I normally forced upwards by springs I^1. J is a metal contact piece normally in contact with a binding screw K, L is a second contact piece, and M a push button. The wiring of the instrument is as follows:—N is line wire, O wire from battery, P wire to earth and battery, Q and R



receiver wires. When the receiver is placed on the stand in the position shown in the illustration, a circuit is established from line through contact piece J, screw K, plate I, ring H^1, and bell coil to earth by means of wire P, so that on a person at the transmitting station pressing the button M the gong is sounded. When the person at the receiving station takes up the receiver the plate I rises and presses against the ring H, thereby switching off the bell circuit and establishing a circuit from line through J, K, I, H, wires Q R, to battery wire O. When the button M is pressed a current is sent from battery through J and L to line round bell coil at the station with which communication is desired to earth and battery sounding gong at that station. Claims: (1) In electro-telephonic apparatus the combination of a gong forming a case or cover for the telephone mechanism with a means of sounding the said gong, as described; (2) in electro-telephonic apparatus arranging the gong of the call bell in the manner shown for the purpose specified.—No. 5008. March 31st, 1890. 6*d*.

ELECTRICAL WELDING.—*H. Lemp, Lynn, Massachusetts, U.S.A.*—According to this invention, the work during the operation of welding, upsetting, or the like, and while heated, is moved by hand or mechanically past electrodes conveying currents thereto. In the present invention, instead of securing the stock to copper blocks sliding upon two other blocks, the stock itself is slid past suitable current-carrying contacts bearing on the stock, and which remain stationary. Independent mechanical jaws are provided for the purpose of holding the stock, so that it may be traversed and have end pressure applied thereto during the operation. Thus, the current-carrying arrangements are not used for the purpose of applying pressure to the work, and therefore need only be proportioned for current-carrying purposes, the advantage of this arrangement being that the wear and tear is upon parts which are easily and cheaply replaced, and not upon surfaces which, for electrical purposes, must be maintained in perfect condition. The conducting wires or electrodes bear upon the work and move laterally towards the same, being carried in a fixed support and pressed against the work by a spring. A cam plate is provided for the purpose of disengaging the contacts from the work. An arrangement of current-conveying contact, provided with a water jacket for cooling it, is described in conjunction with a hydraulic piston for forcing it against the work. Where it is desired to rotate the work in the operations of upsetting and subsequent forging, an arrangement of lathe is shown in which the head-stock and tail-stock are both insulated from the base. The current-applying arrangements are insulated, and are similar to those already described. Claims: Current-bearing electrodes mounted on a fixed support in combination with mechanical chucking and damping devices, which are longitudinally movable; the spring and cam plate for engaging and disengaging the electrodes; means for rotating the work in contact with the electrodes; the cooling arrangement for the contact, and hydraulic piston in combination therewith.—No. 20986. December 23rd, 1890. 8*d*.

CHEMISTRY.

TAR PRODUCTS AND FUEL.—*J. Bowing, Tilbury.*—Small coal, coke, lignite, or the like is introduced with a suitable amount of water into a vessel capable of withstanding sufficient steam pressure. On top of the small coal or other material is placed as much tar, shale oil, or other similar material as is necessary, together with the coal for the purpose of forming briquettes, and for the extraction of coal tar products. Good results are obtained by using about 250lb. of tar or shale oil to each ton of coal. The vessel when charged is closed, and steam from a boiler is passed into the top of the vessel and allowed to force its way gradually downwards towards an opening in the bottom controlled by a valve; thus the tar is heated and, together with the steam and a variety of tar products, is driven into the body of the mixture, coating the whole of the fuel particles. A large proportion of the water in the mixture together with steam and free earthy matter passes out at the bottom orifice, and shortly afterwards the water and steam flowing out at the bottom will be found to be carrying with them a considerable quantity of various tar products, which may be collected and used. A hot and substantially dry mixture may now be withdrawn from the vessel and compressed into briquettes or used as fuel in its uncompressed state. Claims: Effecting the mixture of coal, coke, or lignite or the like with tar shale oils, or similar substances, by treating the coal when wet and in the presence of tar, to the action of steam; the recovery of the products from tar and shale oils in the manner substantially as described.—No. 9199. June 13th, 1890. 6*d*.

MISCELLANEOUS.

ANTI-CORROSIVE AND ANTI-FOULING COMPOUNDS.—*M. E. Dejonge, Stapleton, Staten Island, U.S.A.*—The compounds for the above purpose are made of the following materials:—Colophony, paraffin, fusel oil, zinc dust, and talc or asbestos. Example: To 1lb. melted paraffin are added 4lb. to 6lb. finely screened zinc dust and about 1oz. to 2oz. of agatite (talc or asbestos), according to the stiffness of the pulp desired to be obtained. The well-stirred mixture is forced through a fine sieve while in a heated state, and is then ready for use. Three claims are made.—No. 19160. November 28th, 1890. 4*d*.

METHOD OF WELDING METALS.—*H. E. Fowler, Newhaven, Connecticut, U.S.A.*—The method embraced by this invention refers principally to lap welds for joining the ends of band saws, plates, and bars, and the manufacture of water pipes, boiler shells, and the like. The process consists of first forming holes in one of the parts to be united, so that when the parts are heated and welded by any convenient means a portion of the metal of the other part will be forced into said holes, so strengthening the joint. In modifications holes are formed in both the parts to be welded, and in some cases these holes are made to coincide and pins or rivets inserted. Seven claims are made, embracing the methods of making lap welds substantially as described.—No. 3854. March 11th, 1890. 8*d*.

NUT LOCK.—*J. P. Bayly, London.* (*R. Conway, Argentville, Missouri, U.S.A.*)—The invention consists in forming the screwed portion of the bolt with ordinary grooves, leaving a section of threaded portion between each groove. This bolt is passed through the fish-plate and rail in the usual manner and is screwed into a square nut sufficiently large for its corners to come in contact with the flanges of the rail, so preventing it turning. The face of this nut is cut away in such a manner that a projecting angular piece is left in one corner thereof. This projection is formed with a dovetailed groove projecting from the corner of the nut towards the centre thereof, so that when the nut is in place upon the bolt a suitable locking-piece engages in the dovetailed groove and a band projection upon this locking key enters one of the grooves upon the projecting end of the bolt and prevents it unscrewing. Three claims are made.—No. 7108. May 7th, 1890. 8*d*.

EARTHENWARE PIPES.—*T. Street, Kilburn.*—To ensure a tight joint between lengths of earthenware pipe the inventor forms a pair of raised rings at the spigot end of each length, the outermost ring of the pair being slightly bevelled, and the space between the two rings forms a recess extending almost completely round the circumference of the pipe, its continuity being interrupted by a raised connection joining the rings together and lying parallel with the axis of the pipe, this connection being termed a "key." Within the flange at the opposite end of the pipe a pair of internal rings are formed, which have a recess between them, and which are also connected by a "key," the arrangement being such that when the lengths of piping are in position the internal and external rings and keys and the interrupted annular spaces exactly overlie one another. Holes are provided in a part of the flange which must be uppermost when the pipes are laid, and through these holes cement is poured to fill the spaces above alluded to. A groove in the face of the pipe is provided for the reception of clay if considered necessary, the clay being put into the groove before the pipes are jointed. Claims: Particularly the keys, and the filling holes arranged in relation thereto, so as to ensure a flow of cement round the joint.—No. 4490. March 22nd, 1890. 6*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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PELLATT'S GUMMING MACHINE.

CONSTRUCTED BY MESSRS. JOSEPH RICHMOND & CO., LIMITED, KIRBY STREET, LONDON, E.C.

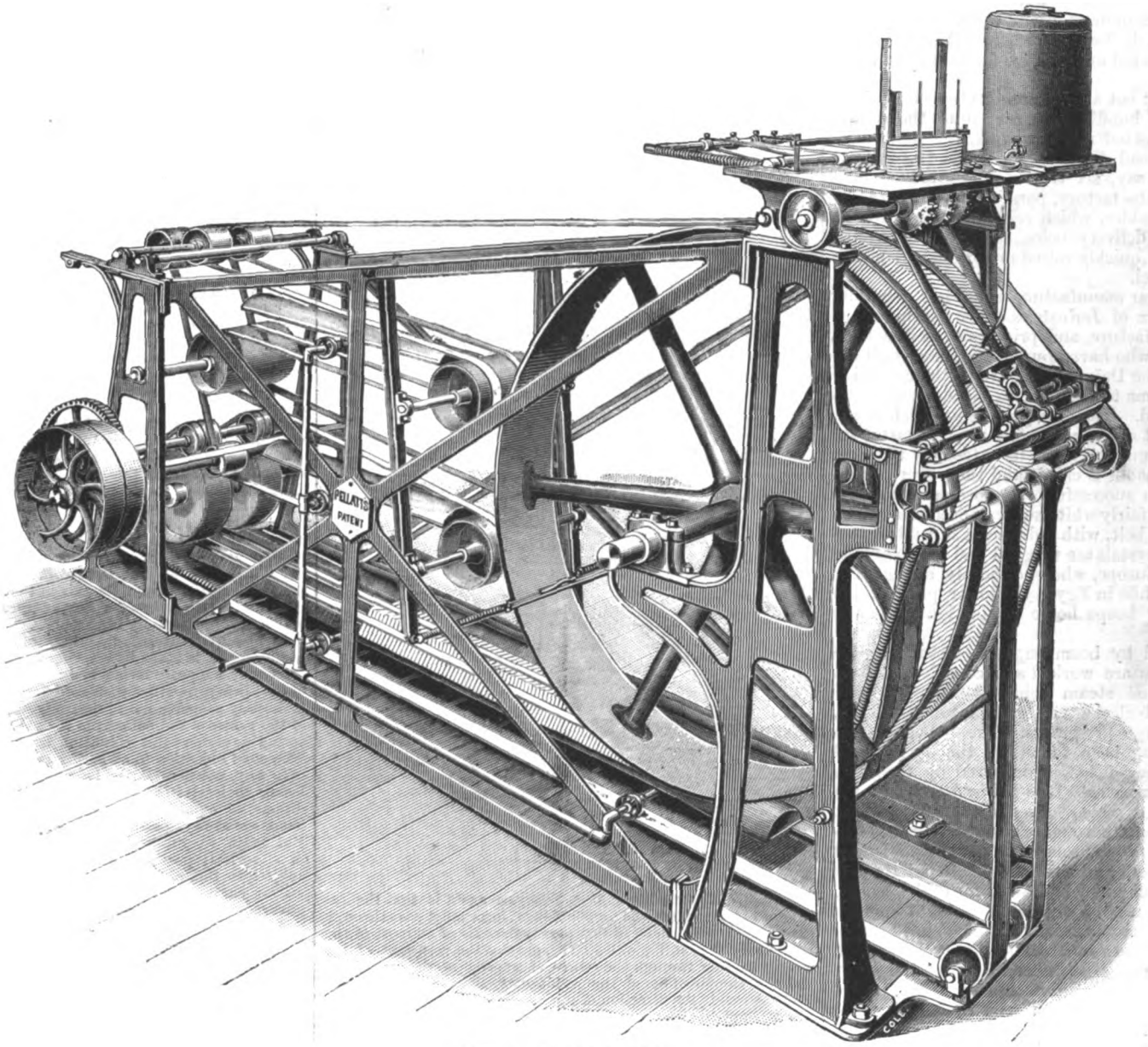


FIG. 1.—GENERAL VIEW.

IMPROVED PRINTERS' MACHINERY.

IN our issue of the 27th March we briefly noticed some of the principal exhibits of Messrs. Joseph Richmond & Co., Limited, of 30, Kirby Street, Hatton Garden, London, E.C., at the recent Printing, Stationery, and Kindred Trades Exhibition. We are now enabled to give illustrations of Pellatt's gumming machine and Gough's patent relief colour stamping press, which are shown in Fig. 1, above, and Fig. 2, on page 416, respectively. The former is for gumming envelopes, &c., and we are informed will fan out, gum, dry, and deliver envelope blanks at the rate of 20,000 per hour at an inclusive cost of one farthing per thousand. The machine occupies a space of 10ft. by 2ft. 6in., is self-contained, and requires very little power to drive it. It is simple, and, without requiring skilled labour, will operate on paper of varying thicknesses. The press shown in Fig. 2 is intended for stamping in relief bill and note paper heads, crests, &c., and also—by the half revolution of the ball lever—to wipe and colour the die. It is claimed that the results obtained by this machine are superior to copper plate or litho printing, and compare favourably for cost with these processes.

THE SUGAR INDUSTRY IN EGYPT.

By Mr. KILLINGWORTH HEDGES, M.INST.C.E.

IT will be quite another year before the new railway bridge, which is in course of construction over the Nile, at Boulak, will be finished, enabling passengers for the south to start from the Cairo Station, instead of having a long drive to the present terminus of the Upper Egypt Railway, which is at Boolak Dakroor. A seven hours' journey through a most fertile country, teeming with stock, and green with the first crop of "burseem," or clover, brings one to the head-quarters of the vast agricultural country which is known as the lands of the Daïra Sanieh. At first the reckless expenditure of capital by the ex-Khedive Ismail prevented any return being obtained either as interest or profit, but since the administration of the estates has been placed in the hands of a mixed commission of English and French, instead of being a burden, the cultivation of the land, and consequent employment of labour in the factories where the raw products are prepared for the European markets, has enabled not only the interest on the Daïra loan to be punctually paid, but has also rendered a reserve fund probable, which will no doubt be used for extending the factories.

The growth of the sugar cane and cotton plant are the principal industries on the lands of the Daïra Sanieh. These have an area of 327,000 acres, and are all under an irrigation system which of late years has been greatly developed, a special department having been formed on the Indian model, with English engineers for each district, who have been selected by Sir Colin Moncrieffe, the engineer-in-chief. Main canals run through the provinces, and from these branches are taken until the whole of the supply has been usefully distributed on the land. There is still a need for more reservoirs to pen up the water of the Nile when in flood, and a surveying party is now in Upper Egypt examining the proposed sites. Whether the Lake Moeris scheme of Mr. Cope Whitehouse, which has been so often advocated by this gentleman, will be included as suitable for one of the proposed reservoirs in Lower Egypt is uncertain. Although the flooding of the ancient lake would bring prosperity to the adjoining country, it would do nothing to help the irrigation of the country above; hence the delay in accepting Mr. Whitehouse's plan. On our way up country we had plenty of evidence showing that the late Egyptian Government did not neglect to try numerous methods of mechanical irrigation. There are screw pumps and centrifugal pumps by almost every known maker, lying idle by the score, and in most cases destined to remain so, while the pole and bucket of the "shadóof," worked by the Egyptian peasant or "fellah"—these contrivances raising water perhaps 30ft., by a series of lifts—are seen at work in every direction, until the borders of Nubia are approached, when the shadóof gives place to a clumsy water-wheel pump, called a "sakieh." A certain portion of land is irrigated by each pump, which is turned by oxen. The late Government found these wheel pumps a convenient means of taxation.

The Daïra lands are for the most part prepared for cultivation by the administration, who own over forty sets of steam ploughing tackle. The planting of the cane is done by the tenants, who are fellaheen, and who pay a rent of from £9 to £15 per acre. The whole of the crop is purchased by the Daïra by weight at a fixed price, so that all the tenant has to do is to cut the canes and bring them to the trucks. The price varies according to the quality and abundance of the crop; for this year, which is a very fair one, the pay is 7½d. per 100lb. of canes cut and delivered. The canes are planted in February and cut in January of the following year. For the next succeeding two years other light crops are sown —for instance, "burseem," or clover, may be grown the first, and the land allowed to lie fallow the second year, the canes being again planted the third year.

The sugar factories are thirteen in number, and may be classed as ten complete factories and three half-factories. They are named after the "teftisches," or

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estates, which surround them, and stretch from Bibeh in the Lower to Motannah in Upper Egypt. The oldest have been established sixteen years, and nearly all those in Upper Egypt are connected by an agricultural railway about 500 kilometres in length, of standard gauge, which not only enables the canes to be brought to the factories, but also completes the connections with the railway which extends as far south as Assiout, but which is under construction to Girgeh, and will before long reach Assouan, where a short length of line already constructed enables the first cataract to be passed.

The canes are first cut and trimmed, then stacked on camels. The large bundles are secured to the camels by a single rope knotted round a stick, the removal of which allows the load to drop alongside the railway trucks. A train of, say, six trucks is shunted on to a raised platform at the factory, parallel with which is an endless revolving ladder, which raises the canes to the mill, the speed of delivery being regulated by a feed roller, which can be quickly raised or lowered by means of a large hand wheel.

The details of sugar manufacture would not generally interest the readers of *Industries*. The machinery is all of French manufacture, and principally comes from Messrs. Cail, Paris, who have now supplied nearly all the mills belonging to the Daïra Sanieh. With the exception of the addition of lime to the juice in the defecators, no chemical is employed. The only process in which power is not utilised is that of the scum presses; the latter are of simple screw design, and must be extremely tiresome to work; however, labour is cheap, and the power presses tried have not been successful. The process ends with the centrifugals. A fairly white sugar is produced, which is lifted by a canvas belt, with side pieces of rubber, to a floor above. The crystals are weighed and bagged ready to be exported to Europe, where, curiously enough, the demand is great, while in Egypt the lower price of the imported beet sugar keeps home production out of the market.

Power is supplied by beam engines erected in suitable positions; these are worked at a considerable back pressure, the exhaust steam being utilised for heating purposes. The boilers are after the locomotive type, only with extra large fire-grates. The "megass," or crushed cane, having been taken by the agricultural railway to the drying fields, is delivered by trucks in heaps close to the furnaces. It is fed by hand through a hinged furnace door, which leaves a space over a flat plate. The ashes, when thoroughly burnt, are pushed forward by a rake, and drop through the bars into a tunnel below, which runs under all the boilers. In all the factories a high brick chimney is erected for coal burning, but when megass is used a much less draught suffices, and an ordinary short sheet-iron chimney fixed above each boiler gives the best result. The facility with which this waste product megass is utilised has been the result of long practice, the evaporative efficiency of 2¼lb. of megass being equal to 1lb. of ordinary coal used under the same conditions.

The factories work night and day during the winter months, in shifts of six hours each, a European manager or deputy having to be on duty all the time. With this exception natives attend to everything, and work carefully and willingly, although the wages are on a scale which would be considered ridiculously low in Europe.

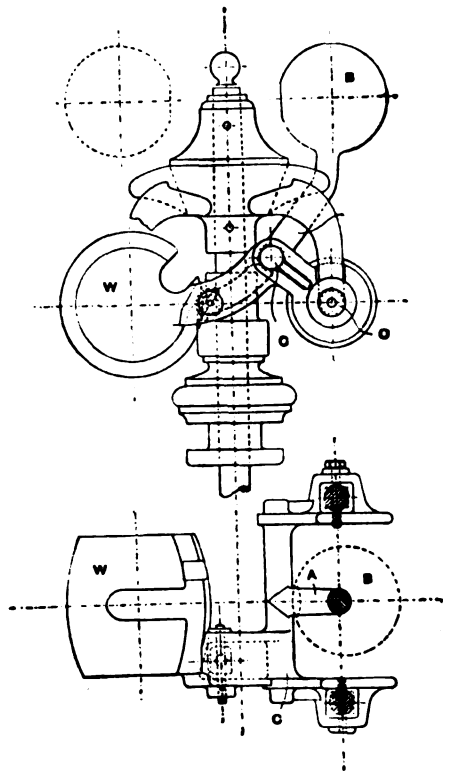
The larger factories manufacture their own gas for lighting purposes, but the results are not satisfactory. The electric lighting question is now receiving attention, and the writer has lately visited the factories, at the request of the authorities, for the purpose of reporting as to the cost of establishing and maintaining an installation of electric light, which shall not only illuminate the interiors of the buildings, but also the receiving yards and megass drying fields, the latter being the most important, as over 300 men are nightly employed outside each factory in drying and preparing the megass, and in transporting the canes to the mill.

STEAM ENGINE GOVERNORS.*

(*Continued from page* 392.)

Dr. Proell's governor, represented in Fig. 6, is another extremely interesting modification of the loaded Watt type of governor. In this case the arm D carrying the ball W is inverted and attached to the muff C, and it is guided by a second link attached to the spindle at A and connected to the arm D at B. The weight is thus constrained to move in a curve, the centre of which is at a point Z, and the effect is, therefore, somewhat similar to a Porter governor running at this considerably greater altitude. The graphic investigation of this governor may be followed out on the same lines as that adopted in connection with the Porter governor. The construction is indicated in the illustration, in which the lettering corresponds precisely with Fig. 1, but in this case the values given to the weights are purely arbitrary, and are not taken from an actual example. As designed by the inventor, the No. 3 governor running at a speed of only 160 revolutions has a velocity difference of 2 per cent. between the extreme positions, corresponding to a lift of the muff of about 2in., but the governor can be made still more sensitive if desired.

In the Buss governor, which is shown in Figs. 3, 4, and 5, a somewhat peculiar compound pendulum is employed, consisting of a bell-crank A, one end of which carries a ball B, and the other a cylindrical weight W. There is one pendulum of this description supported on each side of the rotating axis in such manner that the arm carrying the cylindrical weight W extends across the axis. Each pendulum is fitted with a stud C, which engages with and imparts movement to the muff. By a suitable choice of the weights of this pendulum, the system can be made absolutely isochronous within an angle of oscillation of about 20 degrees. Beyond this angle the pendulum is in unstable equilibrium in both



Figs. 3 and 4.

directions. The condition of equilibrium again is that the resultant of the weights and the centrifugal force must pass through the virtual centre which in this case is the axis of support of the pendulum; thus in Fig. 5 let F G represent the resultant of the weight passing through the centre of gravity of the pendulum, and F K the direction of the resultant centrifugal force: then F O represents the direction of the resultant of these forces and again completing the parallelogram F G H K, F K represents the centrifugal force. In the middle position this acts upon the weight B alone, and the speed may therefore be computed as before. In the other positions, the effect of the centrifugal force must be proportionately distributed over the weights B and W to determine the speed. In the number 00 size—which is here taken

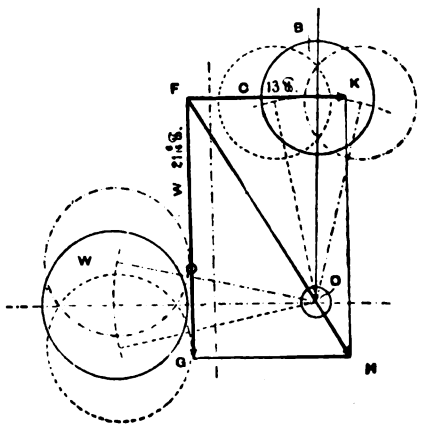


Fig. 5.

as an example—the total weight of each pendulum, together with one half of the muff, is 21·6/10lb., and the centrifugal force in the middle position is found to be 13lb., which corresponds to a speed of 188 revolutions per minute. Between the two extreme positions, the governor shows a variation of 2 per cent. only, and it could easily be made more sensitive if desired. The design of this governor is extremely compact, and the greatest degree of sensitiveness can be obtained with a very moderate speed. The latter is an important consideration, because not only does a high-speed governor require more driving power, but it is also subject to considerably more wear than another running at a slower speed.

If a governor is made extremely sensitive throughout its lift, there is considerable liability of over-running or "hunting," and this might be checked—whilst at the same time retaining the highest degree of sensitiveness—by making the governor extremely sensitive about its middle position, but less sensitive, and therefore more stable, on approaching the highest and lowest positions. This is one of the objects aimed at in the construction of the Four-Pendulum governor shown in Figs. 7, 8, and 9. In this governor there are four pendulums A, which are suspended in such manner that under the influence of their own weight alone they would fly apart until they had nearly reached their extreme outer position A, corresponding to the highest position of the governor. They are, however, held in the inner position by the weight of the muff W which is applied through the pivots of the pendulums. The latter are supported by short links C from the spindle at D, and the sliding weight, which is made in one piece with the muff, encloses the whole governor. A light spring E is inserted to add to the stability of the governor, and for adjusting the speed of the governor to a nicety. The small illustration shown on the left-hand side of Fig. 7 represents an arrangement for varying the speed of the governor whilst in operation. For this purpose the spindle is elongated and the muff is loaded by means of a spring S held down by a nut F, which is screwed on the spindle. By arresting the milled wheel G or F, the nut is caused to move on the spindle, the spring being consequently compressed or expanded, and the weight upon the muff varied accordingly. By the use of this extremely neat arrangement, the speed of the governor may be easily varied by about 50 revolutions per minute. This governor is so proportioned that it is almost isochronous about its middle positions, but a velocity difference of 8 per cent. is required to move it from the lowest to the highest position.

A governor constructed in such a manner that the height of the cone of revolution is constant in all positions of the balls could only be in equilibrium at the one particular speed which corresponds to this altitude, and the governor would therefore be absolutely isochronous. This result is obtained if the balls are guided so as to describe a parabola and supported in a direction normal to the parabola at every point. One possible method of obtaining this consists in hanging the balls from a flexible leaf spring wound upon a base curved to the evolute of a parabola. There are practical difficulties in the way of carrying out this idea, but a feasible approximation to these conditions is found in the Watt governor with crossed arms, if proportioned so that within the range of movement required the arc of a circle described by the balls coincides approximately with an arc of a parabola having its axis in the axis of revolution of the governor. In this way a governor can be easily constructed which is approximately isochronous.

In many centrifugal governors of the loaded class, the place of the weight is taken by a spring. The condition under which such governors can be made isochronous is that the resistance of the spring, together with the effect of the weight of the balls, is directly proportional to the centrifugal force or to the distance of the centre of the balls from the axis of rotation, and in some spring governors this condition is more or less nearly fulfilled. The chief objection to all spring governors is their liability to give way, not necessarily by breaking, but more frequently by losing their elasticity, thereby upsetting the whole of the conditions of equilibrium. Dead-weight governors, on the other hand, are always positive and not subject to any such changes. But again, weight governors can only be fixed with their axis in a vertical position, whilst many spring governors are not subject to this restriction, and are, therefore, also applicable on marine engines and in many other situations where a weighted governor could not be used.

A governor cannot, of course, prevent all variation of speed, because it is only brought into action after a change of speed has actually occurred, and the most it can do is to restrain the variations of speed within certain limits. For this purpose the governor must be as sensitive as possible, but the greatest degree of sensitiveness admissible in a governor is limited by other considerations. If, for example, a governor is made absolutely isochronous, it could only act by alternately closing and fully opening the valve, and manifestly this would be useless, because we require a governor to *adjust* the valve according to the power required. A governor which is too sensitive might in this way easily produce still greater variations of speed than a far less sensitive apparatus, and, indeed, there are instances in which engines labour under this defect. For most purposes the variation of speed of a governor between the highest and lowest positions should not be less than 2 per cent. of the mean speed, and, generally speaking, the sensitiveness of governors should approach as nearly as possible to this limit. This ideal cannot be conveniently attained with the Watt governor, nor yet easily with the simple "Porter" governor, but it is realised in the Proell, Buss, and other governors.

Another cause of unsteadiness in a very sensitive governor consists in the effect of the inertia of the moving parts, which will cause the governor to over-run or "hunt," and this difficulty is greatly enhanced with every increase of weight. The remedy for this defect consists in the application of what is known as a "cataract" or "dash-pot," consisting of a small cylinder containing a piston, the two ends of the cylinder being in communication by means of a passage, the size of which may be regulated by a small set-screw. The small piston rod is attached to the muff or other moving part of the governor, while the cylinder is connected to any fixed part. Such a dash-pot will offer a resistance to *sudden* variations of the position of the governor, whereas it will permit of *gradual* movements. It will therefore prevent over-running due to the inertia of the governor, without, however, affecting the sensitiveness of the governor, because it does not interfere with the condition of equilibrium, but merely retards any change of position. In cases where the highest degree of sensitiveness is required, such a check can scarcely be dispensed with. Dash-pots worked with oil or water have been introduced, but a simple air cataract, such as has been described, is preferable to these.

So far we have considered these governors merely in regard to their sensitiveness as speed indicators, without reference to the resistances which they are called upon to overcome. These resistances may be divided into two kinds—namely, the internal frictional resistance of the governor proper, and the resistances of the regulating mechanism. The effect of the former is almost insignificant in a well-designed governor. If the governor is combined with a good equilibrium throttle valve the total resistance to be overcome is also extremely small, and if the governor be only chosen sufficiently large, the resulting varia-

* Paper read before the Manchester Association of Engineers on the 11th ult., by Mr. C. F. Budenberg, M.Sc.

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tion of speed will not greatly exceed those of the governor proper. On the other hand, the force required to move heavy valve gear is considerable, and in many cases amounts to several hundredweights. Such a resistance will, of course, very considerably affect the sensitiveness of the governor. It is, therefore, important to consider the action of governors with reference

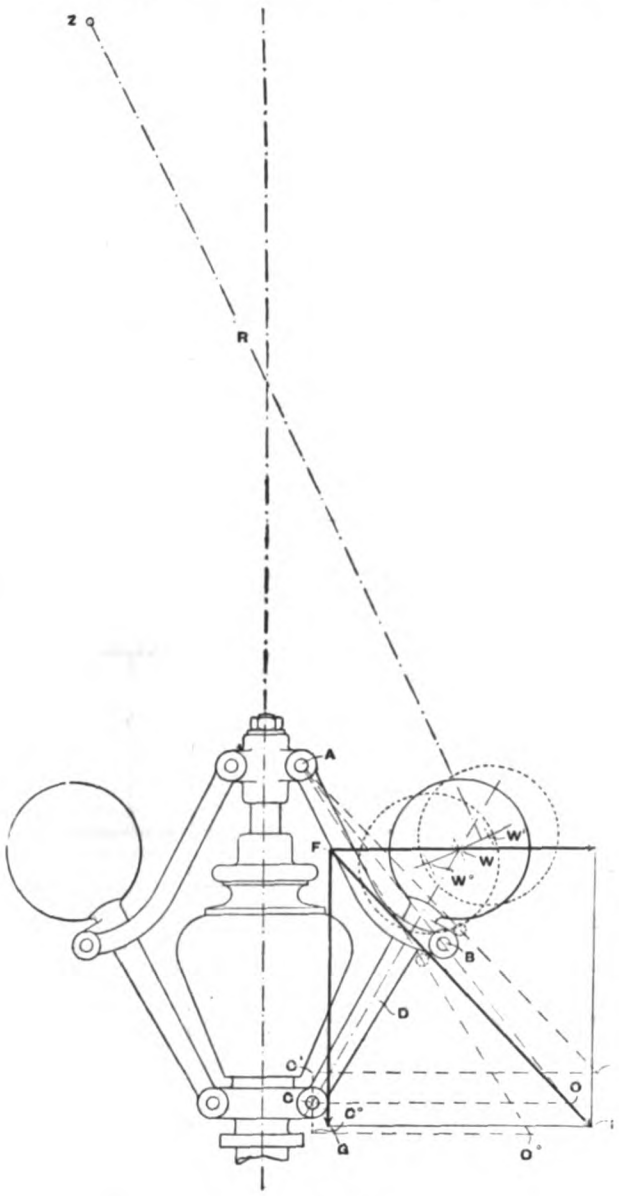


FIG. 6.

to the force which they are capable of developing with a certain variation of speed, and, given a certain maximum variation of speed, it becomes an important problem to determine the size of governor which will develop the required force within the given variation of speed. It is usual to denote as the "energy" of a governor the force in pounds which the governor is capable of developing with a variation in speed of 1 per cent. I prefer to call this the "force" or "powerfulness" of a governor, and would reserve the term "energy" to express the work which the governor would be capable of performing with a speed variation of 1 per cent., or one-half the powerfulness multiplied by the distance which the muff would move if set free with a variation in speed of 1 per cent. To determine the powerfulness it is only necessary to find out what additional weight would be needed on the muff to maintain equilibrium with an increase in speed of 1 per cent. The centrifugal force varies as the square of the speed, and therefore an increase in the speed of 1 per cent. signifies an increase in the centrifugal force of 2·01 per cent.

If in Fig. 1 we therefore produce F K to L, so that K L = 2·01 per cent. of F K, and draw a new parallelogram F L M, then continuing G H until it meets L M in N, M N will represent the powerfulness in pounds. In the present instance this would amount to nearly one pound. By determining the position of the balls if set free under the centrifugal force G N, we could arrive at the displacement, and this, multiplied by the powerfulness, would represent the energy of the governor. To give some idea of the powerfulness of governors as actually made, a list is appended showing the value of these in pounds for the different sizes of the Buss governor.

Powerfulness of Buss governor :—

No.....	000.	00.	0.	I.	II.	III.	IV.	V.
Lbs.....	1·2	1.4	1·6	2	3	4	6·4	12

Generally speaking, the powerfulness of a governor is proportional to the weight of its moving parts, and a loaded governor therefore has a decided advantage in this respect over another which is not weighted. In the Buss governor the weights are arranged in the most compact manner in proportion to its general dimensions, and this governor therefore has the advantage of a very great powerfulness, whilst occupying small space. In other words, in this governor the powerfulness attains its maximum in proportion to the space occupied, whilst in the Four-Pendulum governor the powerfulness is at its maximum in proportion to the weight, because the points of support of the

STEAM ENGINE GOVERNORS.

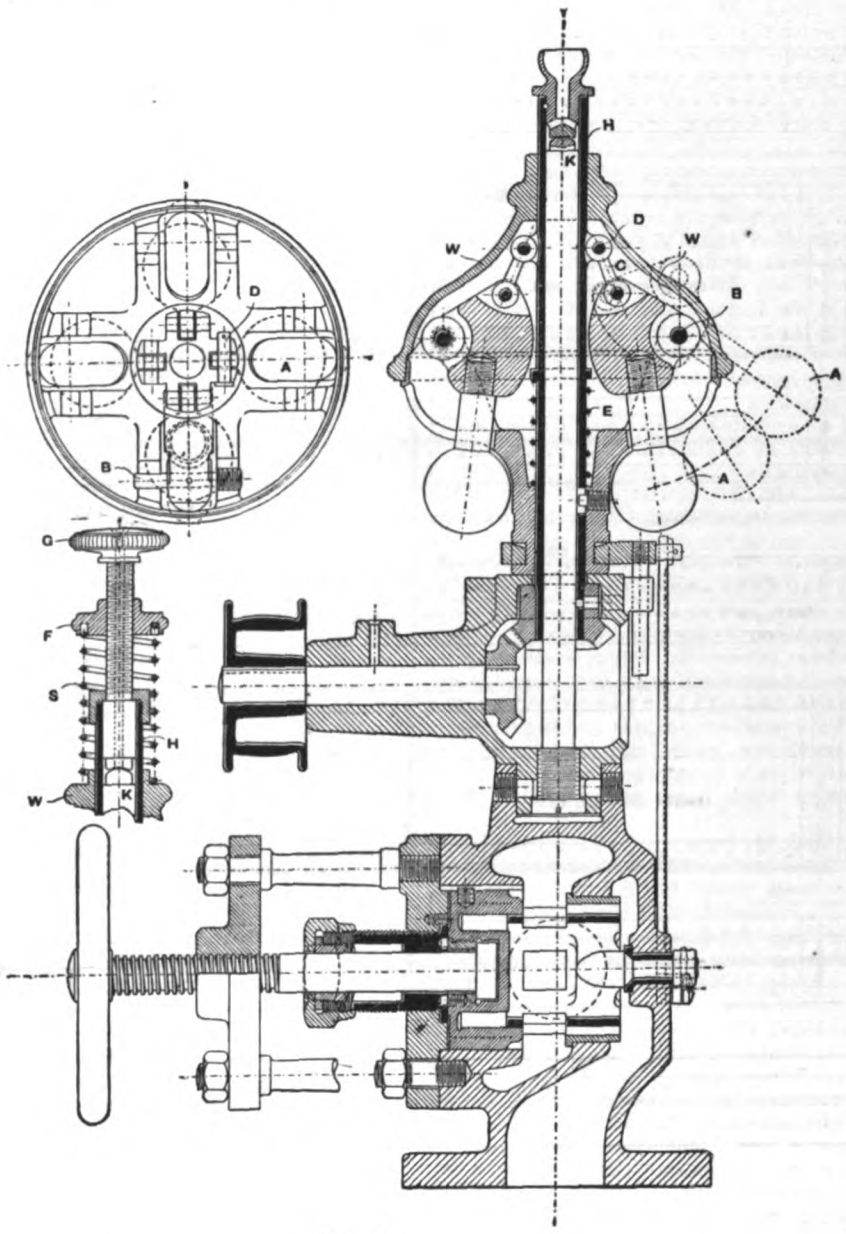


FIG. 7.

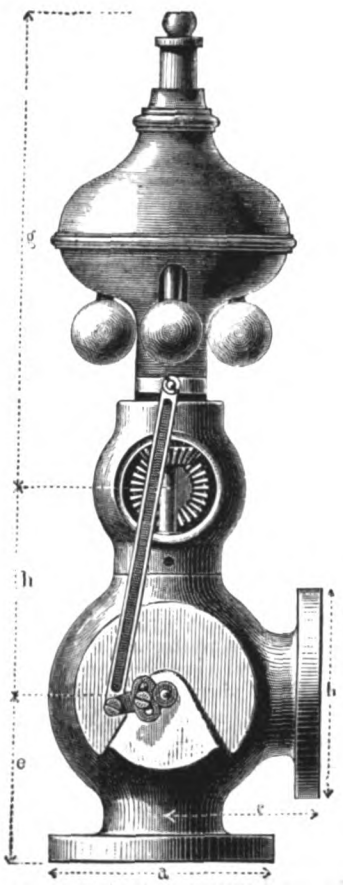


FIG. 8.

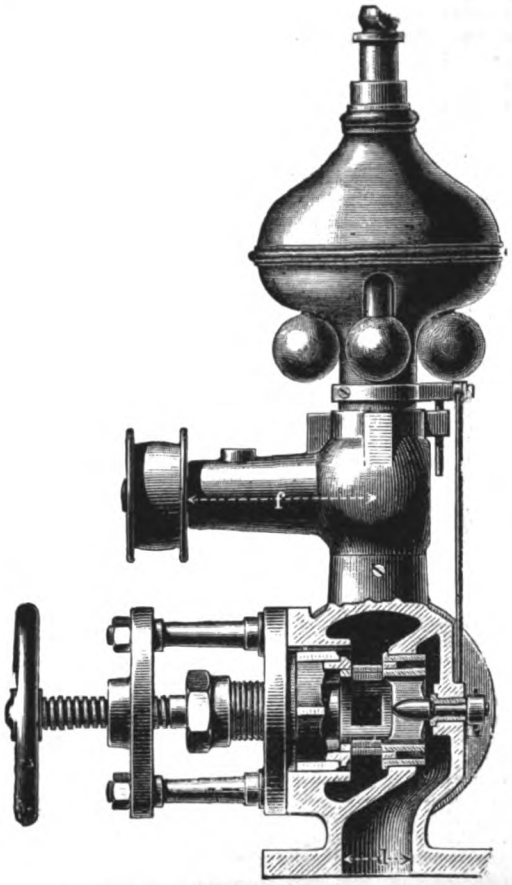


FIG. 9.

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THE NEW DALMARNOCK BRIDGE AT GLASGOW.

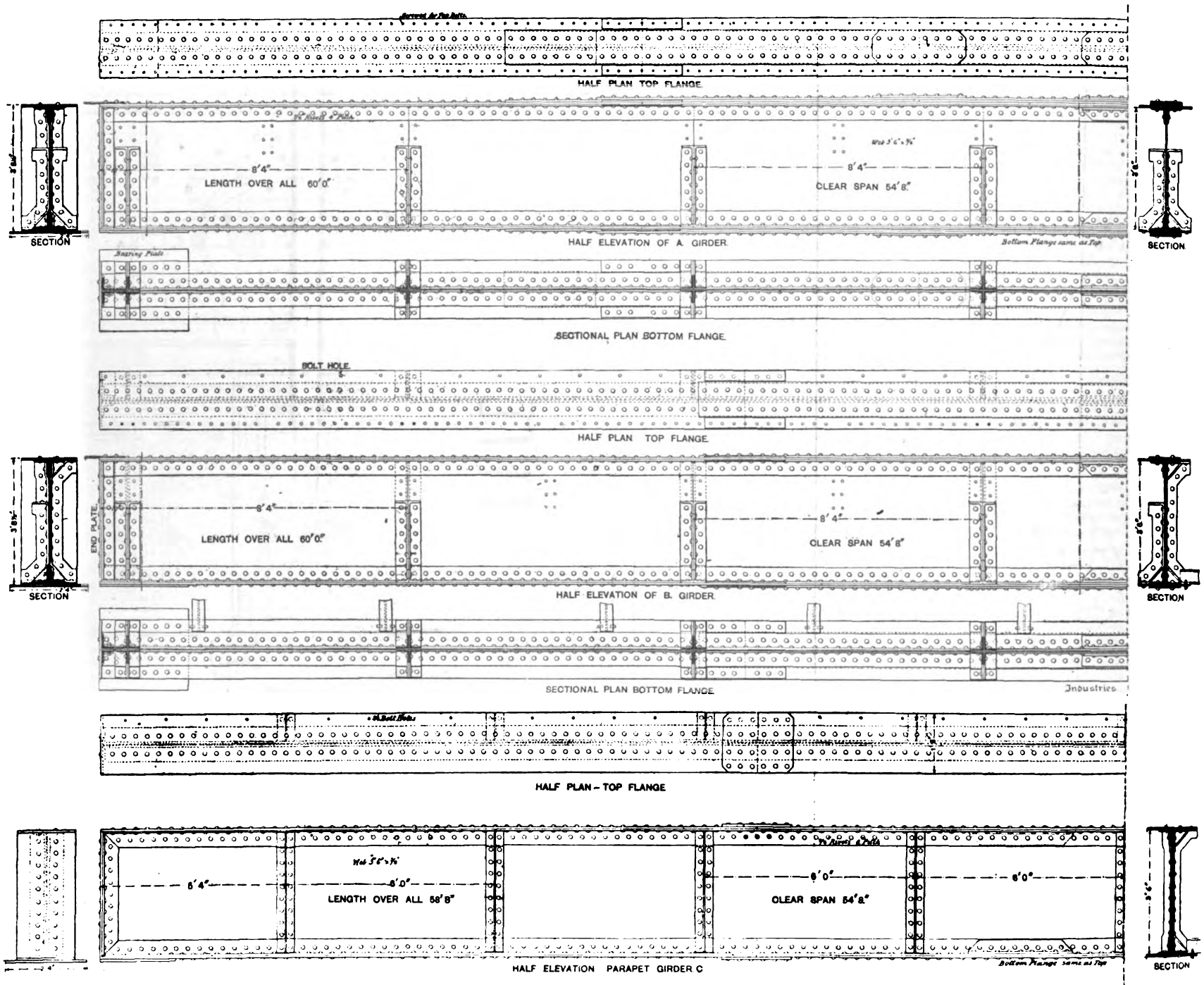


FIG. 1.—VIEWS OF GIRDERS.

pendulums being in the weight attached to the muff, the whole of the weights help to give energy to the governor. In nearly all governors the powerfulness varies more or less in different positions of the muff, and to obtain the best results it is of importance that any such variation should correspond with the resistance required to be overcome. In the Buss and Four-Pendulum governors the powerfulness is not very variable, but the Watt and Porter governors produce a very variable degree of force in different positions, even at the angles ordinarily employed. In these governors the powerfulness is greatest in the lowest position, and is reduced as the muff rises, the difference in the force between the highest and lowest positions amounting in many cases to as much as from 12 per cent. to 16 per cent. In an ordinary throttle valve, however, the resistance offered increases as the valve closes, and this variation frequently amounts to 25 per cent. In these governors, therefore, the force developed is reduced as the resistance increases, and a proportionately greater increase of speed must therefore take place before the governor can close the valve. In the cross-arm governor the powerfulness is still more variable than in the Watt and Porter governors. In choosing a governor for any particular work, the resistance should first be determined, and, if the maximum allowable variation of speed is known, the required size of governor can be graphically determined by the methods indicated. Owing to the action of the resistance alternately in both directions, there always must be two limits of speed for each position within which the governor will not be affected. If the variation of speed of the engine in the course of one revolution exceeds these limits, the governor will move at each stroke of the engine. This is unnecessary, and an amount of friction sufficient to overcome this is therefore desirable.

(To be continued.)

THE NEW DALMARNOCK BRIDGE AT GLASGOW.

THE main road connecting the village of Rutherglen with the southern or Bridgeton division of Glasgow has hitherto been carried across the Clyde on timber structures. The first bridge spanning the river at this point was constructed in 1820–21, and was replaced in 1848 by a similar structure, also of timber. This, in its turn, having been found to require numerous repairs of late years, and being generally in an unsound condition from age, was condemned, and instructions were given to Messrs. Crouch & Hogg, of Glasgow, to submit designs to the Joint Bridge Committee for a structure, at once handsome in appearance and capable of accommodating the heavy traffic of this route. We give on our two-page supplement a general elevation of this bridge, shown in Fig. 3, and in Fig. 4 views of the pier and caisson, while Fig. 5 shows a half transverse section and part plan of the superstructure. Above and on page 413 we give views of the main girders (Fig. 1) and a part elevation of the parapet (Fig. 2). Numerous extensive manufacturing works are situated on both sides of the river, and the new bridge serves an important and rapidly growing district, in which the traffic is frequently of a very heavy nature, and the concentrated loads of considerable weight. A temporary structure having been completed, and the old timber bridge removed, in the spring of 1888, a commencement was made on the new one in July of the following year, the foundation stone being laid on October 11th, 1889. Owing to the presence of abandoned and inaccessible coal workings beneath the bed of the river, it was ultimately decided to adopt the girder type of bridge, although any further subsidence is considered highly improbable. The structure, the estimate for which is about £30,000, is, as now completed, one of the handsomest of those spanning the Clyde, and consists of five spans each 54ft. 8in. wide, the width between the parapets being 50ft., leaving a 32ft. roadway and two footpaths each 9ft. wide.

The bed of the Clyde at this point is composed of muddy clay and fine running sand overlying sandstone rock. In each case the foundation is formed on the rock, duly levelled and benched, the greatest depth attained being 56ft. below river bed. The piers were founded by means of caissons and compressed air. The caissons are rectangular in plan, with rounded ends, being 63ft. over all by 9ft. at the bottom, and 62ft. 3in. by 8ft. 3in. at the top. The working chamber is 8ft. high, an inner skin spaced 2ft. from the outer shell running around it. The skins are of ⅜in. plate, and are strongly braced together by double bracing of 3in. by ½in. bars, and frames of 6in. by 3in. by ½in. tees. The cutting edge is formed of steel plate 7in. by ½in. outside the iron skin, and by an internal 6in. by 4in. by ½in. steel tee bar running

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around the caisson. The roof of the air chamber is strengthened by thirteen cross girders, 1ft. 6in. in depth, and running across the width of the caisson. Above the air chamber the skin is single and composed of ⅜in plate, being stiffened by three tiers of angle bracing spaced 11ft. 3in. apart.

Each caisson was furnished with two shafts of 3ft. internal diameter—one for the men, the other for spoil. The shafts were composed of ¼in. plate strengthened by 6in. by 3in. by ½in. tees running around them externally and spaced 4ft. 6in. apart. The joints of the inner and outer skins of the working chamber, as also those of the shafts, were kept tight by caulking. The permanent caissons extend to low-water level, above which temporary caissons were carried up above high-water. With the exception of the steel tee bar and plate forming the cutting edge, the caissons were constructed throughout of iron.

An interesting feature in connection with the work of excavation inside the caissons was the method adopted for dealing with the difficulty of getting the buckets expeditiously filled in a long narrow chamber 63ft. in length by only 5ft. effective width. A rail being fixed to each side of the inner skin, some 3ft. up from the cutting edge, a light trolly was constructed to run on this improvised line, which commanded the whole length of the caisson. The bucket, being lowered on to the trolly, could at once be pushed to any part of the caisson and returned with equal ease to the shaft when loaded. Whatever the state of the floor of the caisson might be, no interruption to the passage of the bucket could occur, as the caisson, of course, carried down with it this serviceable and ingenious device. It may here be noted that caissons and compressed air were employed in preference to open cylinders, owing to the existence of the old coal workings in the neighbourhood of the site already mentioned. Had such been met with open cylinders, flooding would have resulted, whereas by the employment of compressed air no inrush of water into the workings could occur. The air-locks were similar in construction, differing only in the details of winding arrangements in that for spoil and of air chamber in that for the passage of the workmen.

The air chamber was composed of $\frac{7}{16}$in. plates, strengthened externally by 6in. by 3in. by ½in. tee bars. The air chambers were lighted throughout by the electric light, and no difficulty was experienced in obtaining efficient native labour for the work under compressed air. With the exception of a mishap owing to both doors of an air-lock opening simultaneously, with accompanying escape of air and inrush of water into the air chamber, no accident occurred in founding the bridge, nor were any lives lost in connection with the caissons or piers.

The spaces between the two skins of the air chamber, and also the caisson itself, were filled at the commencement with enough Portland cement concrete to sink the caisson, additional quantities being added as required. Finally, on the rock being reached, and duly levelled and benched out, the air chambers were filled up with concrete well rammed, and subsequently grouted through the shafts, the remainder of the caissons being afterwards filled with concrete up to low water, and the masonry then commenced.

The piers, which are 62ft. 3in. over all, by 7ft. 6in. at cut-water level, and 53ft. by 6ft. above, are solid ashlar, and terminate in handsome moulded caps with fine red granite columns.

The abutments call for no special remark, nor has their construction entailed any work of exceptional difficulty. The wing walls are curved, and handsome granite columns and moulded capping stones are in keeping with the rest of the structure, and present a particularly pleasing appearance.

Passing on to the steel work of the superstructure, the spans, five in number, are made up of five parallel web girders, 3ft. 6in. in depth, with ⅜in. webs and 5½in. by 5½in. by $\frac{5}{16}$in. double angles at both top and bottom booms. The girders are spaced 10ft. 5in. apart from centre to centre, with the exception of the two outside girders, for which this dimension is reduced to 9ft. 2in. The four internal main girders are connected throughout their length by cross-girders, spaced 8ft. 4in. from centre to centre, having a depth of 1ft. 3in., and made up of a ⅜in. web plate and top and bottom flanges, each composed of two 4½in. by 4½in. by ⅝in. angles. Midway between these cross-girders are placed 6in. by 6in. by ½in. tees for carrying the buckle-plates of which the floor is made up, whilst plate bearers run parallel to the main girder, and are spaced equi-distantly between them. The plate bearers are made up of four 4in. by 4in. by ½in. angles, two forming the upper and two the lower flange, and a ⅜in. web, 1ft. 2⅜in. in depth, the upper angles being joggled to fit into the cross-girders. The flooring is made of ⅜in. buckled plate, 4ft. 7½in. by 4ft. 1½in., secured by ⅝in. rivets, 4in. pitch. The flooring under the pathway of each side of the bridge is, however, Lindsay's patent steel flooring, flushed with Portland cement concrete, and secured on either side to the main girder, on which it rests, by ⅞in. bolts. Rolled joists, 5in. by 4½in., by 23lb. per foot, and spaced 6ft. apart, connect the bottom flanges of the two outside main girders on both sides of the bridge, and form a support for the gas, water, and sewage pipes carried across the river by the bridge, beneath the roadway.

Handsome cast-iron facings are attached to the exteriors of the outside girders, divided into panels 3ft. square and of ½in. metal. The parapet, standing to a height of 3ft. 6¾in. above the level of the roadway, is also of cast iron, and consists of a series of columns 2¾in. in diameter, and spaced 9in. from centre to centre, terminating in square pedestals and connected by segmental arches, the whole forming a handsome design, and imparting a graceful and pleasing appearance to the structure. The roadway, 32ft. in width, has a rise in the centre of 4in., the buckle plates being covered with Portland cement concrete 9in. in thickness at the centre of the roadway, and 5in. in thickness at the sides. Above this a layer of sand from 1in. to ¼in. in depth is spread, on which 4in. granite cubes are built. The footpaths, 9ft. in width, have an inclination towards the roadway of 1in. in 4ft., and consist of 3in. machine-planed Arbroath pavement, backed by a layer of engine ashes bedded on clean lime mortar, grouted with cement, and protected from the roadway by a stout granite curb 12in. by 6in.

The main girders have a camber of 1in. at the centre. The iron employed in the construction of the caissons has a minimum ultimate tensile strength of 22 tons per square inch, with 8 per cent. elongation in a length of 8in. with the grain, whilst across the grain it is required to stand 18 tons per square inch, with 3 per cent. elongation in a length of 8in., and was manufactured by Messrs. Dorman, Long, & Co., Limited, of Middlesbrough.

The superstructure is of steel, having an ultimate tensile strength of 30 to 33 tons per square inch, with an elongation of at least 20 per cent. in a length of 8in. The usual bending tests were required—viz., that strips 1¼in. in width shall, when cold or after tempering, bend without fracture to a curve whose inner radius is equal to one and a half times the thickness of the specimen. The steel was rolled by Messrs. A. & J. Stewart & Clydesdale, Limited, at their Clydesdale Works at Mossend, and by Messrs. Goodwins, Jardine, & Co., Limited, at their works at Coatbridge.

THE NEW DALMARNOCK BRIDGE AT GLASGOW.

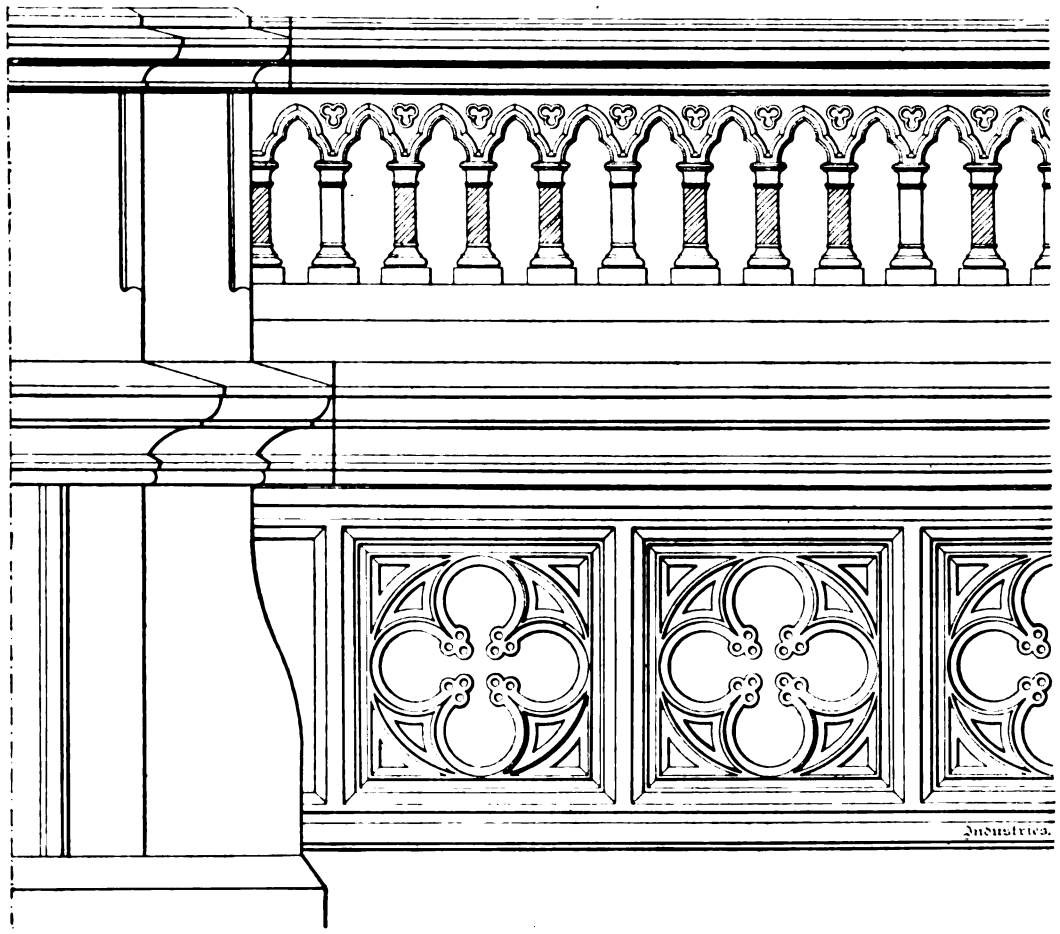


Fig. 2.—Part Elevation of Parapet.

The bolts and rivets throughout the structure are of Yorkshire iron, having an ultimate tensile strength of at least 24 tons per square inch.

The engineers are Messrs. Crouch & Hogg, of Hope Street, Glasgow, MM.Inst.C.E., and the contractor is Mr. A. H. Boyle, of Banknock, Bonnybridge, N.B.

The iron and steel work has been executed and erected by Messrs. Goodwins, Jardine, & Co., Limited, of Motherwell, and the ornamental castings supplied by Messrs. W. Macfarlane & Co., Saracen Foundry, Glasgow.

The structure was to be opened for traffic on Monday last, but the opening ceremony has been deferred until next week.

The courtesy of the engineers has enabled us to place the foregoing particulars before our readers, for which we are greatly indebted.

IRON AND STEEL WORKS IN CHINA.

From recent papers received from China we learn that some progress is being made in the erection of iron and steel works in that country. After much delay and discussion a site has been chosen on the northern slope of the Hanyang Hills, between the ridge and the Han River, opposite the city of Hankow, and thus close to the Yangtze, with which afterwards the works will be connected. It is understood that the works will comprise for the present two large blast furnaces of the Cleveland type, with all their appliances and machinery, and capable of producing about 100 tons of pig iron daily. There will also be a complete Bessemer plant, including two 5-ton converters, with cupolas, casting cranes, blowing engines, &c. The rolling mills are specially adapted for the production of rails; in fact, the chief object of the Chinese in designing these iron and steel works has been the supplying of material for their future railway system. They have, however, added a small Siemens-Martin steel plant, chiefly for the object of casting soft steel for ship plates and special metal for the Viceroy's small arms and gun factory. The malleable iron department will be tolerably complete, including some twenty puddling furnaces and a plate and bar mill, with all indispensable machinery. It is roughly estimated that the works will cover about forty acres. The most of the blast furnace plant has already been delivered, and the contract requires that the whole of the plant must be delivered in the first month of next year.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 28th April, 1891.

Iron.—The prices established by the Paris syndicate now rule the business of this market. These prices were for the past week 136s. 6d. per ton for bars and 144s. 6d. per ton for joists. This tariff has not been abated, except in one or two instances where the contract was of great importance, as in one case where an order for about 500 tons of joists was received at under 129s. per ton. The Government have signed a contract with the Mediterranean Iron and Shipbuilding Company La Seyne, for the building of the ironclad "Jaureguiberry," for which Messrs. Schneider, of Creusot, will furnish the armour plates. The state of the provincial markets is not so firm as that of Paris. In the Meurthe-et-Moselle district forge pig is quoted at from 42s. 6d. to 43s. 6d. per ton, and foundry pig at 54s. 6d., delivered at the works. The foundries of Pont-à-Mousson, which have large orders of pipes on hand for exportation, will be obliged to buy about 10,000 tons. This metal will most likely be brought into France temporarily from abroad. At Rosselange, in the Orne valley, much disaffection exists among the miners on account principally of the fines which they are obliged to pay if the percentage of stone exceeds a certain proportion of the iron ore got. In the Ardennes there have been no orders of any importance, and the market is very weak. Messrs. Warin & Son, of Sainte-Wast, Nord, are about to establish a sugar manufactory at Fins, the cost of which is estimated at about £18,000. The directors of the committee of the association of "The Iron Works of France," whose term of office had expired, have been re-elected, with Baron R. Reille as president.

Copper, Tin, Lead, and Zinc.—The increase of the stock of copper on the European market has caused this metal to depreciate in value here as elsewhere. The following are the latest prices quoted at Paris:—Best Chilian bars, £56 5s.; ordinary Chilian bars, £54 5s.; and best selected, £58 10s. the ton. The tin, lead, and zinc markets are dull, with a decided tendency to a falling off in prices.

The Manufacture of Submarine Cables in France.—The manufacture of submarine cables was not carried on in France until after 1889, when, the telephone lines having been handed over to the State, the General Telephone Company established workshops at Bezons-sur-Seine. In 1890, a cable was despatched from these shops and successfully laid between Martinique and Guadeloupe. Bezons having been found to be an inconvenient locality, the works have been transferred to Calais, and were inaugurated on the 18th inst. on the occasion of the shipment of a cable of 1,062 miles in length, weighing 2,367 tons, the first turned out of the new shops.

Launch.—The "Armand-Béhic," built at La Ciotat for the Compagnie des Messageries Maritimes, was launched on the 26th inst. She is fitted for the accommodation of 164 first, 179 second, and 112 third-class passengers. The length over all is 501ft. 7in., and width 49ft. 7in. The engines are triple-expansion of 700 h.p.

The French Navy.—The French Naval Estimates for 1892 are framed in view of the Mediterranean Squadron comprising three ironclad divisions, but the three small ironclads, the "Vauban," the "Bayard," and the "Duguesclin," are to be replaced by three larger vessels, while there is also to be a reserve squadron in two divisions, consisting of three small ironclads, three ironclad coasting vessels, three third-class cruisers, and three torpedo boats. In the Channel the ironclad squadron of the North will be composed of three men-of-war, an ironclad coasting vessel, a third-class cruiser, and four torpedo-boats, so that the French fleet in European waters will comprise, in 1892, eighteen ironclads, twenty-five cruisers, and torpedo boats.

Telephones in France.—It is probable that telephonic communication will shortly be established between Bordeaux and Paris, a distance of about 358 miles, as it is expected that the Chamber of Commerce and Municipality of Bordeaux will be willing to contribute towards advancing the requisite funds (about £2,600) to the French Government, which, under this condition, has consented to carry out the work and to undertake the management. Telephonic communication has also recently been established between Bordeaux and Pauillac, the port of Bordeaux, at a distance of about 25 miles.

BERLIN, 27th April, 1891.

German Coal and Iron Syndicates.—The yearly report of the Frankfort-on-Main Chamber of Commerce contains some important information as to the working of these syndicates. Various syndicates and conventions were formed in order to limit the production of pig iron. Working agreements were entered into between the coal owners, and a coke syndicate was formed, which absorbed the total production of the Lower Rhenish and Westphalian mines. Such unions have an important effect by making the production proportional to the consumption, and thereby regulating the prices. Notwithstanding the long and severe winter, the closing of river traffic, and the difficulties of transport on the railways, only a gradual and moderate recovery of prices has taken place. Though the unions make it their chief aim to maintain prices, these must be ultimately regulated by the general state of business and the demand of the public. Considerably higher prices have been arranged by the coke manufacturers for the summer contracts of the present year. This increase seems to be due to the efforts of the united coke selling conventions to maintain prices rather than to a real increase in the demand. The abnormally high prices of raw materials has a most prejudicial effect on German trade, and the improved state of German industries is counteracted by the increased cost of production, which prevents their competing with the other markets of the world.

VIENNA, 27th April, 1891.

The Iron Market.—The condition of the iron market has remained unaltered during the past week, and trade is still sluggish. The syndicates have maintained prices, but have not been able to impart any activity to the market. The large orders which have been expected have not yet been placed, but will no doubt arrive before long. The stagnation in the iron market will then be at an end. The negotiations with Germany are drawing to a close, and the Austrian tariff on iron would thus be reduced from 1s. 7d. to 1s. 2d. Mr. Wittgenstein is at present in Berlin for the purpose of making an agreement with the German works.

Austrian Exhibits at the Frankfort Electrical Exhibition.—The Electrical Exhibition at Frankfort will be the most important exhibition of electrical industry since the Vienna Exhibition of the year 1883. The progress of electrical discovery made since that year will be brought into notice, and the arrangement of the Exhibition is sure to be well considered and carried out under the able superintendence of the former director of the Berlin General Electricity Company. The progress made in the various works is very great, and the firms will no doubt do their best to be well represented in the competition. The installation for the distribution of power, which is being erected by the Oërlikon Company, is remarkable for the high tension of the current and for the distance to which the power is to be transmitted. Austrian firms generally are engaged in producing new machinery for the Exhibition. Messrs. Ganz & Co. are constructing an electrical railway on which the speed of the trains will be 28 miles an hour. Models and drawings are to be shown at the Exhibition. Messrs. Siemens & Halske, and Messrs. Kremenetzky, and other well-known firms will be represented. Mr. Kareis, Mr. Kohn, and Professor Schlenk have been chosen to represent Austria on the Exhibition Committee.

Explosion at an Ironworks.—A serious fatal explosion occurred to-day at Baron Rothschild's ironworks near Witnervitz, Moravia. The manager and six workmen were killed and many others injured. The disaster was caused by the bursting of a steam pipe.

BRUSSELS, 28th April, 1891.

Electric Lighting at Brussels.—Many private houses have been lighted electrically by means of Buffet batteries. The Belgian and Parisian Bank is trying to form a company for the purpose of working this system of lighting. Some opposition has, however, already been made to the scheme.—The contract for the poles required for the electric lighting of the Grande Place in Brussels, which had been opened to competition, has not yet been awarded, as the permanent commission has not approved the decision of the committee, who had decided on their use. The lighting of the Grande Place has been under consideration for two years past, and would be an interesting application of electric lighting. It is scarcely likely to be carried out under present conditions.—Some large installations have recently been erected by M. Dulait, of Charleroi, who is the head of the largest firm of electrical engineers in Belgium. In addition to various schemes carried out in Belgium, M. Dulait has numerous orders from France, and intends to establish an important agency in that country. The electrical and hydraulic works of M. Dulait have been largely extended, and the firm is engaged in the manufacture of carbons and insulators. Some of the staff are employed at the Charleroi central station, which is in itself a large business. The dynamos made by the firm have a good reputation in the industrial world. The electric lighting of the house of the Count of Flanders on the Julien system has been very successful. The rigidity of the plates is an important factor in keeping these accumulators in good order, and maintaining their reputation.—The Tudor system is also highly spoken of, and the company which supplies these batteries guarantees their successful working. There is an excellent installation at the brewery belonging to M. Willemans-Ceupens, and the Metropolitan Café is lighted by 400 incandescent lamps, which have a very pretty effect.

DÜSSELDORF, 28th April, 1891.

The Iron and Steel Market.—The condition of the iron and steel market, already a difficult one, has been made much more difficult by the renewal of the strike among the coal miners. It is reported that certain larger works, among which are the Rhenish Steel Works, the Phœnix Works, the Duisberg Works, and the Bothumer Works, have already stopped a part of their work in consequence of a want of coal. If the strike of the coal miners increases, a total stoppage of the Rhenish-Westphalian iron trade will result, since this industry, owing to competition, will not admit of higher prices being paid for coal. The price of puddled pig iron has already advanced, but for other sorts prices remain unchanged. Orders for 8,250 tons of steel rails and about 7,000 tons of iron sleepers, as well as the necessary bolts, have been placed by the State railway management at Cologne. The number of blast furnaces was as follow:—

	January, 1890.	December, 1890.	January, 1891.
Pig iron and spiegel iron...	65	66	66
Bessemer pig iron	9	9	10
Thomas pig iron	24	27	27
Foundry iron	28	30	31
	126	132	134

The Westphalian mine owners are forming an exclusive union. This union, whose place of meeting is at Essen, has notified by means of a circular that all workmen who should not have resumed their work before yesterday will be dismissed. This attitude has produced a very good effect on the workmen at the mines of Messrs. Krupp. The submission of the mine owners is very improbable, since they regard the strikers as not being thoroughly in earnest.

The Coal Market.—The chief feature of the past week was the spread of the strike among the Westphalian miners, which first broke out in the previous week. The first stoppage of work occurred on the 16th inst. On the 21st inst. the strike had affected six mines, and on the 24th inst. sixteen mines. During the past few days 9,189 workmen have been out on strike. The total number of the Westphalian miners is about 127,000. Even in the pits which are still in operation work is very slack, and stores of coal have been reduced to a minimum in consequence of the long winter. A deficiency in the supply of coal is therefore apparent, and high prices are quoted. The present Minister, in contrast with his attitude during former strikes, has advised the managers of the mines to flatly refuse all attempts at a compromise. Public opinion is decidedly against the miners, since it is generally recognised that their condition has been much improved during the last two years.

AMSTERDAM, 27th April, 1891.

Steamboat Companies.—It appears from the report of the directors of the Royal West-Indian Mail Packets Company in Amsterdam, that, after writing off a sum of £7,500, there remains for the year 1890 a net surplus available for dividend of £2,477, out of which a dividend of but 2 per cent. can be declared. This unfavourable result is owing to various circumstances. The gross earnings on passenger and goods traffic increased last year by 18 per cent., principally as a consequence of a larger number of boats running, the monthly service having been altered into one every three weeks. The working expenses, however, show a larger increase, whilst the competition of an English undertaking, opening a new service from London to Surinam direct, had to be met. The loss of the steamer "Prins Willem I.," and the rise in wages and the price of coal, also affected the net receipts. The report of the Steamship Company "Nederland" (Amsterdam-Java) is of a much more favourable character. The net receipts in 1890 resulted in an available balance of £56,694, the shareholders receiving a dividend of more than 9½ per cent. But for the loss of the "Prins Frederik," in June, 1890, the result would have been even better. The fortnightly mail service last year was kept up by twenty-five journeys out, and twenty-six journeys homeward, whilst the company employed besides two steamers of the "Phœnix" and five vessels of the Royal Mail Packets Company. Two new steamships—the "Prinses Sophie" and the "Prins Hendrik"—both built by Messrs. Caird, at Greenock—commenced running last autumn. Fifteen steamers, of an estimated value of £500,000, are now on the company's books. The directors state that the Government has renewed the old mail contract with the company pending the framing of a new one rendered necessary by the rejection, in 1890, of the Bill for the approval of a joint subsidised mail service by the "Nederland" and Rotterdam "Lloyd" Steamboat Companies.

STOCKHOLM, 25th April, 1891.

Manufactured Wood Industry.—The manufactured wood works in Sweden are, on the whole, doing well. The production is increasing, and the market is extending. The Bodafors Chair Manufactory turns out about 60,000 chairs per annum, which are distributed throughout Sweden, and are also exported to England, France, and Spain. Another prosperous establishment is the Ericsson Carpentry Manufactory at Orebro, which has recently secured some important contracts, mostly for the home market.

The New Warship "Thula."—The tenders for the building of this new warship have now been received, and show how near two competitors may be to each other in price. The tenders were:—The Motala Engineering Company, £79,333; the Kockum Engineering Company, £79,277; the Bergsund Engineering Company, £73,611.

The Miners' Strike.—The large miners' strike in the Norberg mining district has been compromised. The masters offered to leave the matter to the decision of a committee consisting of three men chosen by the masters, three men chosen by the men, with the chief of the official Mining Department as chairman. The committee was to fix the rate of wages at the Kallmora and other Norberg

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mines. This offer was made on condition that the men returned to work before the 29th inst., and the men have since decided to do so. It may be worth mentioning that the Salvation Army did their utmost to bring about a reconciliation, and to dissuade the men from persisting in the strike.

THE STATE TELEPHONES.—The long distance telephones in Sweden, between Stockholm-Gothenburg and Stockholm-Malmö, continue to give great satisfaction. On the former there were 7,482 conversations during March, and on the latter 5,659 conversations.

SHIPMENTS OF WOOD PULP.—The export of wood pulp from Sweden during the month of March was as follows:—Chemical wood pulp (dry) 1,667,496 kgr., (wet) 1,106,592 kgr.; mechanical wood pulp (dry) 2,126,882 kgr., (wet) 641,000 kgr. The aggregate exports during the first three months of the present year amount to 17,249,998 kgr., against 14,123,000 kgr. during the corresponding period of 1890, and 9,924,000 kgr. during the corresponding period of 1889.

CHRISTIANIA, 25TH APRIL, 1891.

THE CHRISTIANIA CEMENT COMPANY.—This company is now in bankruptcy, which is a rare occurrence in Norway with such a large industrial undertaking. The share capital is £55,555, and the buildings, which were on a large scale, were completed last autumn, since which date the works have had plenty of orders. The installation was, however, much more expensive than was estimated, and the company has incurred liabilities amounting to about £47,000. With the present machinery the capacity is about 70,000 barrels of cement annually, but with an outlay of £5,500 it could be increased to 100,000 barrels. The bulk of the shares is in German and Swedish hands.

NEW TINWARE WORKS.—A new manufacture has been started at Skien, where the Stjernen Works have begun the manufacture of trays, boxes, and other descriptions of tinware. This is, we believe, the first industrial establishment of its kind in Norway.

THE HOLMENKOL ELECTRIC RAILWAY.—The projected electric railway to Holmenkollen will cost about £33,300, and the working expenses will be about £2,777 annually. The company intends to make a double line, and to run trains every two minutes.

COPENHAGEN, 25TH APRIL, 1891.

THE STEAMER "GEFION."—The steamer "Gefion," belonging to the United Steamship Company, Copenhagen, has just been lengthened 30ft. at the shipyard of Messrs. Burmeister & Wain, Copenhagen. The accommodation on board has been much improved, and the speed has been increased.

THE CRUISER "HEKLA."—The new cruiser "Hekla" has just had its engine trials in the Sound. It was launched in November last year, and will be ready this summer. The vessel has an armoured deck, is provided with powerful guns, and is fitted with torpedo-firing appliances and electric-light projectors. The engines are calculated at 3,000 i.h.p., and have been made at the Messrs. Burmeister & Wain's shipbuilding and engineering works, Copenhagen. The "Hekla" is 225ft. long and 33ft. broad.

NEW STEEL VESSELS.—A syndicate at Nordley, on the island of Fonö, has recently ordered four steel vessels from a Sunderland firm. The dimensions are:—Length, 175ft.; breadth, 30ft.; depth of hold, 16ft.; size, about 620 registered tons; and a dead-weight carrying capacity of about 980 tons. The price is £27,000 complete. A syndicate at Kolding has ordered a similar vessel from the same Sunderland firm.

MADRID, 27TH APRIL, 1891.

RAILWAYS IN THE SOUTH OF SPAIN.—The line which runs from Lorca to Huercal through a lead district has been opened for traffic. A new line of railway from Xerez to Arcos is projected. Arcos is the most important town in the province of Cadiz, and has at present no railway. It is stated that the southern system of railways, which is officially known as the Madrid, Alicante, and Saragossa line, intends to purchase the Andalusian system, which consists of a large group of lines with a safe and increasing traffic. The traffic on these lines will be still further increased when agricultural improvements are made in this district.

ELECTRIC LIGHTING AT MADRID.—Some progress is being made in electric lighting at Madrid, but the price is still very high. About 28,000 lights are served from the two central stations. The German company is at present using only one of their four large engines for driving the dynamos.

CONTRACT FOR ARMOUR PLATES.—It is reported that the Spanish Government are about to make a contract with the Creusot Works for 2,500 tons of armour plates to be used in the building of ships in the Government yards. A strong feeling has been expressed against this purchase, as it is thought that the Government will soon be able to obtain armour plates in sufficient quantity from the works of Mr. Martinez Rivas.

SHIPMENT OF ORES AT BILBAO.—There is a large and unexpected decrease in the shipment of ores at Bilbao. This decrease gives rise to some uneasiness, as arrangements had been based on a normal shipment of at least 3,500,000 tons of ores per annum. Bilbao has for the present lost the Italian market for hematite pig iron, and manufacturers must look forward to produce puddled iron or steel for sale in Spain.

NEW BANK AT BILBAO.—Although there is a branch of the Official Bank of Spain at Bilbao, and also a special local bank called the Bilbao Bank, which has very good credit, it is felt by merchants and by the industrial classes that there is room for a new bank, which should offer increased facilities. The granting of increased facilities implies greater risks on the part of the bank, but it seems probable that the capitalists who are starting the new bank will make it a success.

COAL IN THE PROVINCE OF ALMERIA.—It is reported that coal is to be worked in the province of Almeria. Though the coal is not of good quality, it will serve for many purposes.

ROME, 27TH APRIL, 1891.

THE OUTPUT OF MINES IN ITALY.—A report giving the total production of Italian mines in 1889 shows an increase of 38,240 tons over the production in 1888, valued at about £47,040, or an increase of 3·13 per cent. in the quantity and 2·19 per cent. in the value. The 726 mines in active work in the kingdom have given an aggregate output of 1,222,187 tons of various ores, valued at about £2,142,160. The production of 1888, compared with that of 1887, had shown an increase of 1 per cent. for the quantity and of 4·6 per cent. for the value. The larger quantity produced in 1889 is due to the larger number of mines or to the more active working of those in existence. The increase in the value of the production is not proportionate to that of the quantity, owing to the fact that the rise in the market prices has been limited to a few metals, such as zinc and antimony, whilst there has been a decline in the price of several ores. The increase, both as regards quantity and value, is mainly due, in order of importance, to the larger production of zinc ores, mercury, coals, lead ores, iron pyrites, asphalt and bitumen, antimony, and auriferous ores, &c. The larger decrease has been found in sulphur, copper ores (only in the value), silver ores, iron ores, spring salt, and boric acid. 48,981 workmen were employed in the mines, that is to say, 130 less than in 1888. The average annual production per man in 1888 was valued at £42 12s., whilst in 1889 it reached £43 14s. This fact seems to indicate an improvement in the management of the mines. The following table shows the production of the mines in Italy in the year 1889:—

Production of Ores.

Products.	Number of Mines Worked.	Production. Quantity Tons.	Value in Units. Lire.	Total Value. Lire.	Number of Men Employed.
Iron ores	43	173,489	10·88	1,887,231	1,418
Manganese ,,	5	2,203	23·51	51,801	46
Copper ,,	16	48,214	27·82	1,341,528	1,300
Zinc ,,	102	97,059	85·08	8,257,775	10,587
Lead ,,		36,894	191·42	7,062,348	
Silver ,,		1,997	875·64	1,748,663	
Gold ,,	20	10,932	46·50	508,427	451
Antimony ,,	5	563	177·75	100,072	328
Mercury (metal)	9	385	5090 00	2,274,450	533
Iron pyrites	4	17,022	14·48	246,494	343
Coals	37	390,320	7·32	2,858,154	2,714
Sulphur	419	371,494	66·36	24,652,876	29,028
Salt	19	28,490	—	556,633	635
Asphalt, bitumen, & petroleum, also mineral waters	28	33,521	—	620,532	996
Aluminite	1	5,600	25·00	140,000	76
Boric acid	11	2,473	500·00	1,236,550	99
Graphite	7	1,531	7·00	10,271	27
Total	726	1,222,187		53,554,255	48,931

In my next letter a table will be given showing the production of the metallurgical and chemical works.

NEW YORK, 18TH APRIL, 1891.

A NEW PULLEY COVERING.—A very reliable and inexpensive pulley covering has recently been brought out by the Burt Pulley Covering Company, 385, Washington Street, Buffalo, N.Y. It is known as Brazilian gum pulley covering, and is applied by means of a brush to the pulley, four coats being put on. After the last coat is on, the gum is allowed to harden for twelve hours, and then the face of the pulley is oiled with castor oil or any good belt dressing and the belt put on. This covering is guaranteed to prevent slipping of the belt, and is as simple as it is efficacious.

NO DUTY ON RECOVERED SULPHUR.—The classification of recovered sulphur as refined brimstone, subject to duty at the rate of $8 per ton, has been overruled by the Board of Appraisers, U.S.A., which decides that the article is entitled to free entry as crude sulphur.

"WHALEBACK" STEAMER.—The "whaleback" steamer "Colgate Hoyt,' which was described and illustrated in *Industries* some months ago, has developed another good quality in addition to those already claimed for her by her builders. Her captain reports that on a winter trip she proved herself a first-class icebreaker, the peculiar form of her bow working away and breaking up easily the ice which was forming rapidly on the lake as she came through. The whaleback ships are to be tried on the ocean as well as on the lakes, one being under construction which is to be sent through the canals to the Atlantic. This boat will be employed in carrying iron ore from Cuba to the United States.

THE WORLD'S FAIR AT CHICAGO.—Progress in the arrangements of this Exhibition is being rapidly made. The following table, giving a comparison between previous Exhibitions and the present one, will serve to show on what a large scale the Exhibition at Chicago in 1893 is to be held:—

Where Held and Year.	Total Acreage.	Square Feet Under Roof.	No. of Days Open.	Receipts.	Guarantee.
London, 1851...	21½	700,000	144	£356,000	English Govt.
Paris, 1855...	24½	1,866,000	200	128,000	French Govt.
London, 1862...	23½	1,291,800	121	328,852	English Govt.
Paris, 1867...	87	3,371,904	217	420,735	French Govt.
Vienna, 1873...	280	—	186	—	£900,000
Phila., 1876...	236	1,688,858	159	762,745	£500,000
Paris, 1878...	100	1,858,778	194	506,330	—
Paris, 1889...	173	1,000,000	183	1,660,000	£720,000
Chicago, 1893...	1,037	3,579,000	179	—	£3,088,870 to Mar. 31st

The Société des Chemins de Fer Glissant, of Paris, has made application for permission to erect a two-mile track on the Exhibition grounds at Chicago for the purpose of showing the hydraulic sliding railway, which was in operation during the Paris Exhibition of 1889. The cars slide on a film of water, and are propelled by jets of water thrown out from turbine pillars erected along the track.

PHILADELPHIA, 17TH APRIL, 1891.

THE COKERS' STRIKE.—During the last few days there has been a steady increase in the number of applications for work by the cokers in the Connelsville region, and the shipments of coke, although still small, are increasing rapidly. The evictions of men from the houses belonging to the Frick and McClure companies continue, and it is stated that a number of Hungarians will be sent from the East to take the places of the strikers. It is evident that the men were not prepared for such a long strike, since the men who are daily going back to work are driven to do so by actual necessity. The 10th Regiment will be withdrawn at the end of the week, and the companies fear there will be further disturbances. There are still 14,000 men out on strike.

THE PENCOYD IRON WORKS.—Work has been resumed during the day in the big mill of the Pencoyd Iron Works. The men are willing to return to work until July, and then sign a scale for the ensuing year. The steel department of the works has been running steadily since the beginning of the strike.

THE REMOVAL OF THE DELAWARE ISLANDS.—Tenders have been received for the removal of 18,000,000 cubic yards of material, 18,000ft. of temporary wharfing, depositing 2,500,000 cubic yards of the former on League Island, which constitute the proposed improvement to the Philadelphia Harbour. The tender of Messrs. James A. Mundy & Co. amounted to £445,840, that of the Penn Dredging Company to £733,600, and that of the American Dredging Company to £683,600. The specifications include the formation of a channel about 2,000ft. in width, and about 55,000 square feet in cross section at mean tide. The work is to be commenced on or before May 15th, 1891.

PROBABLE STRIKE OF MINERS.—The Convention of Miners and Mineowners at Pittsburg has terminated suddenly because the Conference Committee has failed to come to an agreement upon the eight hours question. This abrupt termination means that the friendly relations which have hitherto existed between the two classes have come to an end. It means also that 75,000 miners will stop work on May 1st, and that, directly or indirectly, 500,000 men will be affected.

NAVAL.—The Navy Department has authorised the payment to Messrs. W. Cramp & Sons of the second instalment of the price to be paid for cruiser "No. 12," the 21-knot vessel known at the Department as "The Pirate." This payment was made upon evidence that one-fifth of the work of construction had been completed. It has also authorised the tenth payment of £17,910 to be made on the armoured cruiser "No. 2," known as the "New York," also building at the yards of Messrs. Cramp. This is an indication that one-third of the work upon the vessel for which the contract was signed last July has been completed. The United States coast defence vessel "Monterey," now in course of construction at the Union Iron Works, San Francisco, will be launched on the 28th inst.

RAILROADS.—A new railroad has been incorporated to connect Chicago and Indianapolis by a direct line. The name is the Indianapolis, Longspirt, and Chicago Railroad, and the capital is £800,000.—The annual report of the Chicago, Burlington, and Quincey Railroad shows gross earnings of £5,555,180; expenses, taxes, rentals interest on bonds, and sinking fund, £5,038,600; net earnings £506,500; dividends, at the rate of 5 per cent., £763,900.

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RELIEF COLOUR STAMPING PRESS.

CONSTRUCTED BY MESSRS. JOSEPH RICHMOND & CO., LIMITED,
KIRBY STREET, LONDON, E.C.

(*For description see page* 409.)

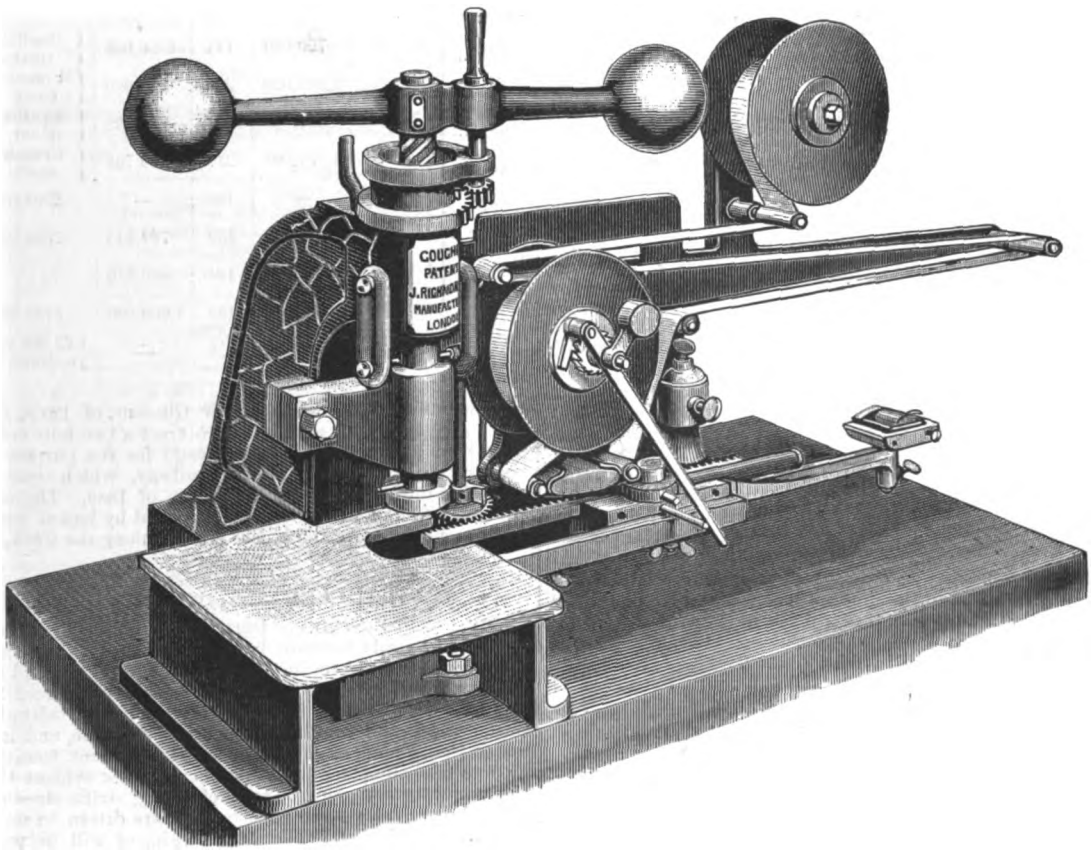


FIG. 2.—GENERAL VIEW OF PRESS.

NOTES ON PATENT LAW.

III.

(*Continued from page* 352.)

WE have in the present article to consider what exactly is meant by an invention in patent law. The importance of doing so arises in two ways—first, because only an invention can be patented, that is to say, can be the subject of a patent grant; and, in the second place, because it is in respect of his patented invention only that a patentee has any rights. But though it has to be considered in these two distinct lights, it will be found that the word itself is in no degree ambiguous. A perfectly definite meaning has been assigned to it, and although it may sometimes be a matter of difficulty to express that meaning in exact words the difficulty arises as a difficulty of expression and not of thought.

The easiest way of approaching the technical definition of the word is to call to mind its common meaning. We speak of that as an invention which any person has devised or contrived for a distinct purpose. Thus a story told, not because it is true, but because it will, though untrue, serve a purpose, is said to be an invented story. An instrument contrived to accomplish a given object is said to be invented with that object, and similarly anything else such as a formula, or a shape, or an expression, or an argument, which is capable of originating in the mind and subserving a purpose, is commonly called an invention. Of inventions of this class the mental original is the essential feature. There is another sense of the word "invention" which is now almost obsolete, but is preserved in a few technical expressions—the old Latin sense of discovery. Thus, the Empress Helena is spoken of as the "*inventress* of the true cross," the meaning not being that she originated the legend which identified a particular piece of wood with the true cross, but that she discovered the genuine thing.

Now, both these senses are included in the word "invent" as used in patent law. It is equally invention to originate and to discover a novelty. Hence it is not necessary for a patentee to satisfy the Crown that he has come into possession of the idea which is embodied in his invention in one or other of these ways. In either case he may be the inventor, if only the idea is a secret known to him. Indeed, for this purpose the word discover must be understood in the most extended sense. It conveys, perhaps, according to its common use, the sense of learning from the study of nature or by the process of reflection; but for present purposes it is not to be confined within any such limits. If a man were to go abroad, say, to Japan, and there learn by observation the art of lacquering, he would, upon introducing that art into this country, be as truly and as fully its inventor as if he had acquired it by the process of experiment in his own laboratory. So that it is correct to say in the most comprehensive terms that, by whatever means a man becomes possessed of a secret, provided it becomes *his* secret, he is for the purposes of patent law its inventor. To this extent the technical meaning of the word is larger than its ordinary sense.

But the vast body of things that can thus be called inventions is much cut down when we come to inquire what inventions are patentable. Here, again, we may advance a long way towards our conclusion upon a very well-known path, for it is commonly enough understood that a patentable invention must have something to do with merchandise. Everybody appreciates, to a greater or less extent, the ingenuity and originality of Darwin's theory of the origin of species, but nobody would for a moment suppose that Darwin could have taken a patent for it. It could not be embodied in any material thing, which should be either a presentation or a result of the theory. But, on the other hand, when working upon Darwin's theory of variation, M. Pasteur succeeds in producing a new and protective variety of some dangerous bacillus, the secret root of anthrax or of hydrophobia, for example, there is no doubt that if he chose he might obtain a valid patent either for the ameliorating process or for the medicinal lymph in which it results. The mere abstract idea cannot be monopolised, but when it has taken shape in some concrete substance it becomes fit subject for a patent grant. So much will be readily understood, but it is necessary to be somewhat more precise, for this is a topic which has been much discussed, and upon which the law has been laid down with great accuracy. The word has received statutory definition by the Patent Act of 1883, which says that it means "any manner of new manufacture the subject of letters patent and grant of privilege within section six of the Statute of Monopolies." The passage here referred to was quoted in our first article. The material words may, however, be usefully quoted again. They are to the effect that letters patent and grants of privilege may be made "of the sole making or working of any manner of new manufactures within this realm to the first and true inventor and inventors of such manufactures which others at the time of making such letters patents and grants shall not use, so as also they be not contrary to law, nor mischievous to the State by raising prices of commodities at home or hurt of trade or generally inconvenient."

The word "manufacture" in this clause has supplied the test by which all new abstract ideas have been tried and found wanting when proposed as subject matter of a patent. A new theory, for example, is plainly not a "manufacture," which, as was said by Lord Kenyon in a celebrated case, means "something made by the hands of man." But although the meaning of the term has been thus strictly observed, it has not been by any means narrowly defined. Whatever can be worked or made has been held to fall within it, and accordingly a manufacturing process or a manufactured product has been equally included. This comprehensive definition is, however, subject to one curious restriction, of doubtful authority, perhaps, at the present day, but still of sufficient importance to merit notice here.

It has been said that to support a patent there must be some *useful* and *vendible* article, the subject of the patent, if it be a patent for a manufactured article, or the object of the process, if it be a patent for a method of manufacture. This is, perhaps, a fair inference from the ordinary sense of the word manufacture, but it is a distinctly unfortunate one, because it establishes a most arbitrary distinction between useful inventions, and has the effect, if now sound law, of shutting out from the protection of the Patent Act the whole class of most meritorious inventions which are directed, not to the production of useful articles, but to the rendering innocuous of such as are naturally noisome. At the present time, when questions of sewage disposal have attained to vast and still growing importance, the question is one of no slight significance, and certainly the authorities, as they stand at the present moment, appear to show that deodorising processes and other similar methods of treatment intended to make sewage matter, not vendible, but only harmless, are not capable of being patented.

There is another class of inventions, often said to be incapable of being protected by a patent grant—namely, medicines—but in this case there would seem to be some misapprehension of the law. The fact is that what are commonly called *patent* medicines are not *patented* medicines. On the contrary, they are, many of them, secret compounds, and more accurately termed proprietary medicines. By an infelicitous convention they have come to be called patent medicines, although neither historically, nor at the present time, has their liability to stamp duty borne any ascertainable relation to patent grants. But although this is the case of so-called patent medicines, the proprietors of which choose, as a rule, to trade upon a reputation for secret knowledge rather than to accept the conditions of a patent grant, there seems no reason to doubt that any such medicine might be protected in this latter way if its inventor chose to make the necessary application. Indeed, at the time when the meaning of the word "manufacture" was a subject of discussion in the Courts the case of a medicine was more than once put forward by the judges, who defined the law as the very type of a patentable article.

But, although an abstract principle cannot be the subject matter of a patent, it may in a proper case be very effectively protected by a patent. This result, which, thus stated, appears, perhaps, paradoxical, is brought about in the following way. The Courts have always held that a substantial infringement of a patent is not rendered the less an infringement by the circumstance that the infringer has taken pains to introduce differences for the purpose of obscuring the essential identity of what he has made with what the patentee has protected. If such colourable imitations were allowed to pass, it is clear that the protection afforded by the grant would become illusory. It is therefore, in most cases, a matter of prime importance to ascertain what are the essential constituents of the invention. If its essence has been taken by the infringer, he will be held liable notwithstanding any ingenuity that he may have displayed in devising distinctions in respect of non-essential parts. If, therefore, the essence of an invention consists in the application of a new principle, the patentee is entitled to claim protection in respect of any possible application of the same principle, even although the mode of applying it which is complained of be totally distinct from anything that he had thought of, on the ground that other methods of working out the same principle are only colourable imitations of his invention. In one case a plaintiff successfully established a claim to

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the broad principle of applying detonating powder to the discharge of firearms. In that case the infringer adopted a form of gun-lock unlike any that the patentee has described, but, inasmuch as his lock was constructed upon the principle of using detonating powder in a manner like that which had first been disclosed by the patentee, it was held that he had committed an infringement. Moreover, in the case of *Jupe* against *Pratt*, which is constantly quoted in the Courts as an authority upon this point, the rule of law was laid down by Baron Alderson in the clearest terms, to the effect that "You may take out a patent for a principle coupled with the mode of carrying the principle into effect, provided you have not only discovered the principle but invented some mode of carrying it into effect." Thus the rule against patents for abstract principles has been carefully guarded so that it shall not in effect restrict the legitimate scope of the protection afforded to an inventor, however large may be the scope and reach of his invention, while, on the other hand, it has been effectively asserted in such a sense as prevents any would-be monopolist from laying hands upon the forces of nature by the shallow device of inventing new phrases by which to describe them.

There is one point which, though really involved in what has been already said, may be usefully stated in express terms, as it is perhaps otherwise apt to become a source of doubt and even of perplexity. It is this—an invention is none the less invention in the sense of being new because the novelty consists in the putting together of old parts in a new combination. This was decided long ago, and one of the early cases affords a striking illustration of the point. There the patentee invented a machine for cutting cloth *crosswise* by means of rotary cutters. The use of rotary cutters for cutting cloth *lengthwise* had been known and practised before the date of this invention, but for cutting across its breadth shears only had been employed. It was held that a patent limited to the particular use of rotary cutters in the new way was valid, for although the materials were old the application of them and the mode of that application were new. Indeed, it is obvious that in a broad sense almost every invention consists, and must of necessity consist, in the combination of old parts in a new manner. The case mentioned shows that the novelty is sufficient, although the departure from what has been done before be very slight, if at the same time it be perfectly definite.

So also an invention is not the less original because it is grounded upon another distinct invention as a foundation. A case of this sort was heard by the great Lord Eldon, who said, "If the petitioners have invented certain improvements upon an engine for which a patent has been granted, and those improvements could not be used without the original engine, at the end of fourteen years" (that is, fourteen years from the date of the patent for the engine) "the petitioners could make use of a patent taken out under their improvements, though before that period expired they would have no right to make use of the other's substratum. At the end of that time, the public has a choice between the patents." This dictum expresses what is now the undoubted law upon this head.

The foregoing remarks will have conveyed to the reader's mind what may be made the subject of a patent. Perhaps it is safer not to attempt to summarise their effect in any accurate definition, but, subject to the curious question about inventions which are directed not to the production of useful articles, but to the amelioration of such as are mischievous, it may be broadly said that all inventions which are capable of becoming property in the hands of their inventors may be protected, and that, save in so far as they are subject to the laws relating to literary or artistic copyright, or the registration of designs and trade marks, they may be protected by letters patent.

So much must suffice under the head of what inventions are patentable. It is plain that the inventor of a patentable invention may apply and actually obtain protection for something less or for something other than he has invented. In other words, an important difference comes into view as soon as we pass from the consideration of what is a *patentable* to the consideration of what is an actually *patented* invention. But this further point we must reserve for our next article.

(*To be continued.*)

Notices of Meetings.

THIS WEEK.

DECIMAL ASSOCIATION.—Friday, May 1st, at 3 p.m. General meeting.

ROYAL INSTITUTION.—Saturday, May 2nd, at 3 p.m. Lecture IV., on "The Dynamo," by Professor S. P. Thompson.

NEXT WEEK.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday May 4th, at 8 p.m. Annual general meeting.

SOCIETY OF ENGINEERS.—Monday, May 4th, at 7.30 p.m. Paper to be read: "Modern Coal Gas Manufacture," by Mr. C. C. Carpenter.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, May 4th, at 8 p.m. Papers to be read: "An Improved Process for Softening and Clarifying Water," by Mr. L. Archbutt and Mr. R. M. Decley; "The Chemistry of Whisky and Allied Products," by Mr. A. H. Allen.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 5th, at 8 p.m. Ordinary meeting. Paper to be read, with a view to discussion: "On Railway Train Lighting," by Mr. W. Langdon; also monthly ballot for members and (at 9 p.m.) reception by the President and Council.

IRON AND STEEL INSTUTUTE.—Wednesday, May 6th, Thursday, May 7th, and (if required) Friday, May 8th, at 10 a.m. Papers to be read: "On the Ironmaking Resources of the Southern States," by Professor J. R. Procter; "On the Coke Industry of the United States," by Mr. J. D. Weeks; "On the Manufacture of War Material in the United States," by Mr. W. H. Jaques; "On Tests for Steel used in the Manufacture of Artillery," by Mr. Wm. Anderson; "On Certain Pyrometric Measurements and the Method of Recording Them," by Professor Roberts-Austen, F.R.S.; "On the Changes in Iron Produced by Thermal Treatment" (supplementary paper), by Dr. E. J. Ball; "On a Graphic Method of Calculating the Composition of Furnace Charges," by Mr. H. C. Jenkins; "On the Calorific Efficiency of the Puddling Furnace," by Major L. Cubillo; "On Economical Puddling and Puddling Cinder," by Mr. Thos. Turner; and "On the Micro-Structure of Steel," by M. Osmond.

SOCIETY OF ARTS.—Wednesday, May 6th, at 8 p.m. Paper to be read: "The Sources and Applications of Borax," by Mr. E. L. Fleming.

INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, May 7th, at 8 p.m. Papers to be read: "On Some Effects of Alternating-Current Flow in Conductors having Capacity and Self-Induction," by Dr. J. A. Fleming; "Some Points Connected with Mains for Electric Lighting," by Mr. W. H. Preece, F.R.S.

CHEMICAL SOCIETY.—Thursday, May 7th, at 8 p.m. Papers to be read: "The Action of Alkalies on the Nitro-Compounds of the Paraffin Series," by Professor Dunstan and Mr. T. S. Dymond; "The Addition of the Elements of Alcohol to the Ethereal Salts of Unsaturated Acids," by Professor Purdie and Mr. W. Marshall; "On Some New Addition Compounds of Thiocarbamide affording Evidence of its Constitution," by Professor E. Reynolds; "On the Action of Acetic Anhydride on Substituted Thiocarbamides, and an Improved Method of Preparing Aromatic Mustard Oils."

PRICES CURRENT, 29TH APRIL, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 10 0	.....	7 0 0	London.
" Angles	6 12 6	.....	7 2 6	"
Crown Sheets	7 0 0	.....	7 10 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			7 5 0	"
" Ship and Girder			6 10 0	"

PIG IRON.

Middlesbro' Warrants, No. 3.		38/10½	Cash.
Scotch Warrants, m/n		45/4½	"
Hematite Warrants, m/n		48/7½	"
Stocks in Stores. Scotch	513,189—Dec. for week	2,684	Tons.
Middlesbro'	118,280—Inc. "	38	"
Hematite	163,878—Dec. "	5,697	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	64/6	.....	57/-	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	" "
Langloan	62/6	.....	57/-	" "
Summerlee	60/6	.....	56/-	" "
Glengarnock	60/-	.....	51/-	" "
G.M.B. ex store	...	.....	...	" "

METALS.

		£ s. d.		£ s. d.
Spelter: Ordinary	£23 17 6	to	24 2 6	
Copper: British Cakes and Ingots	56 0 0	"	56 5 0	
" Chili Bars, G.O.B.'s	51 2 6	"	51 10 0	
" Other sorts, G.M.B.'s (equal to Chili Bars)	51 2 6	"	51 10 0	
" Manufactured (strong)	64 0 0			
Lead: Common Pig	13 5 0	"	13 10 0	
" English Sheet	14 0 0	"	14 5 0	
Tin: Straits	90 5 0	"	90 15 0	
" Australian	90 10 0	"	91 0 0	
" English Ingots	94 0 0		.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER continues inactive, with small business. No change of importance has taken place during the week, although values of Chili bars have been unsteady. On the 27th inst. prices touched as low as £50 12s. 6d. cash, but have since improved, and are to-day £51 2s. 6d. to £51 10s., with firm market. Manufactured £64, "strong," with small demand.

TIN: Strong, at advancing rates, values of spot foreign being about 17s. 6d. to 20s. higher on the week.

LEAD: Steady, with practically no change in prices.

SPELTER: Again easier.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
" " Liquid	gal.	0 1 0	—	.....
" Citric	lb.	0 1 8½	—	.....
" Oxalic	"	0 0 3½	—	.....
" Sulphuric	ton	1 15 0	—	.....
" Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	23 10 0	—	.....
" " (White)	"	26 10 0	—	.....
" Sulphate	"	11 2 6	—	11 5 0
" Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	"	6 12 6	—	.....
Bisulphide of Carbon	"	13 0 0	—	.....
Borax	"	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 4	—	.....
" (50/90 %)	"	0 3 2	—	.....
Copper Sulphate	ton	15 15 0	—	.....
Copperas	"	2 0 0	—	.....
Kieserit	"	.....	—	.....
Lead: Nitrate	"	21 10 0	—	.....
" White Sugar	"	26 0 0	—	.....
" Brown "	"	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
" Caustic	ton	22 0 0	—	.....
" Carbonate	"	20 10 0	—	.....
" Chlorate	lb.	0 0 5½	—	.....
" Prussiate (Yellow)	"	0 0 10½	—	.....
" Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
" White	"	0 3 6	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Epsom Casks	"	3 15 0	—	.....
" Glauber	"	1 10 0	—	.....
Sulphur: Sublimed Flowers	"	10 10 0	—	.....
" Recovered	"	7 0 0	—	.....
Soda: Ash	deg.	0 0 1⅝	—	.....
" Caustic (White 70%)	ton	10 17 6	—	.....
" " " 60%)	"	9 12 6	—	.....
" " (Cream 60%)	"	9 5 0	—	.....
" Crystals	"	3 7 6	—	.....
" Bicarbonate	"	7 0 0	—	.....
" Hyposulphite	"	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 7	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: The demand for bleaching powder is well maintained, but for caustic soda there is less inquiry, and for large lots some concessions in price may be obtained. Soda ash of all qualities moves off steadily. Sulphate of copper is again lower, supplies being very plentiful and buyers few. Oxalic acid is more freely offered. Yellow prussiate of potash is firm at the advance.

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	35 10 0
" Ceylon	"	29 10 0
Cottonseed	"	22 10 0
Cod	"	24 0 0
Lard	"	34 0 0
Linseed	"	22 7 6
Olive, Spanish	"	45 0 0
Palm, Lagos	"	25 10 0
Rapeseed: English	"	30 0 0
Seal: Pale	"	26 0 0
" Brown	"	.....
Sperm	"	50 0 0
Whale	"	22 0 0
Turpentine	per cwt.	1 10 3
Coal	per gal.	.....
Petroleum (Refined)	"	0 0 5¾
Spirit	...	0 0 7¾

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HOME INDUSTRIES.

LONDON, 30th April, 1891.

The Money Market.—Money has been growing steadily dearer all the week, though gold began to arrive at the Bank in considerable quantities. The Bank was in the market taking what steps it could to make the official rate effective in drawing money to this centre. Now that the outside market is fairly in line with the central institution, the probabilities are that, though the half-yearly drain to Scotland will weaken the position, no serious increase in monetary tightness need be feared. The stock markets have been fairly active, though the amount of business is still on a restricted scale. This week the Stock Exchange is closed on Friday and Saturday, and a week that begins with a settlement and ends with a holiday is not the most favourable for encouraging new commitments. Besides, there was a severe check at the start—a set-back in Wall Street, and a recrudescence of rather alarming rumours about the position of the Paris Bourse—which depressed all values. The market managed to get over the scare pretty soon, and American securities above all have shown a good deal of staying power. The "boom" in them seems fairly established, and should be maintained, with occasional reactions, for a month or two, if we may judge from the prevailing conditions in New York. Home railways have exhibited a somewhat firmer tendency, but are still far from brisk. In foreign securities there is little interest and less animation. In the minor departments business is almost neglected, the greater activity in mining shares having diminished again. Miscellaneous securities are virtually idle.

The Coal Trade of London.—The enormous growth of the coal trade of the metropolis has been brought out very prominently in the evidence submitted in support of the Manchester and Sheffield Railway extension to London. In 1863, the year when the extension of the Midland line to London was sanctioned, the total amount of coal brought into London by all the railways was 1,775,000 tons. The Midland line was completed to London in 1868, and in the following year the quantity of railway-borne coal entering London was 3,341,000 tons. In 1879 this quantity had increased to 6,547,000 tons, and in 1889 it had risen still further to 7,877,000 tons. The sea-borne coal has not increased at anything like the same rate, but still it has materially expanded. In 1863 the amount which came into London by sea was 3,335,000 tons, and in 1889 it was 4,765,000 tons. We have thus a total of 12,637,000 tons coming into the metropolis in a year.

The Wool Trade.—Messrs. Helmuth, Schwartze, & Co., in their report on the wool trade, state that in the second series of London sales of colonial wool which commenced on the 2nd inst., and closed on the 28th inst., a total of 284,292 bales were catalogued, as against 305,906 bales in the corresponding series of last year. The quantity held over from the preceding sales amounted to 10,000 bales, and the new arrivals to 346,500 bales, of which 73,500 bales were forwarded direct. The total of first-hand wool actually available was therefore 283,000 bales, of which 274,000 bales have been sold (119,000 bales for home consumption, and 155,000 bales, including 9,000 bales for America, for export), leaving 9,000 bales to be carried forward to next series.

The Institution of Mechanical Engineers.—The annual dinner of the above Institution was held yesterday evening at the Criterion, Piccadilly, and was presided over by Mr. Joseph Tomlinson, President of the Institution. There was a very large attendance. Among those present were Sir James Douglass, Sir James Kitson, Sir John Coode, Sir Frederick Abel, Sir Douglas Galton, Sir R. Rawlinson, Mr. Alfred Giles, M.P., Mr. George Berkley, and Professor Kennedy.

Report on Injurious Insects and Fungi.—In the annual report of the Intelligence Department on Injurious Insects and Fungi, which has recently been issued by the Board of Agriculture, it is stated that arrangements had been made with the Post Office for the distribution of leaflets on crop attacks in country districts. Recourse has been had to this method during the past year in the case of the Hessian fly leaflet, and in that on the winter moth. Posters and enlarged illustrations of the insects whose detection is desired have been exhibited by the post offices in country districts. Reference is made in the report to the use of sulphate of copper as a remedy for the potato disease, which is recommended by reason of its success in some American experiments made last year. The report suggests that the sulphate of copper washes should be tried in Great Britain and Ireland, not in a half-hearted manner and when the disease is established, but as a preventive measure adopted as the Continental wine producers adopt it, and as the English hop-growers adopt sulphur, as almost a necessary part of cultivation.

Business Announcements.—The Duke of Marlborough has been appointed chairman of the Brush Electrical Engineering Company, Limited, in succession to Lord Thurlow, who has resigned his seat at the Board of that company. The Secretary of State has appointed Mr. A. A. Campbell Swinton to be permanent consulting electrical engineer to the Metropolitan Police.

Decimal Association.—A general meeting of the members of this Association will be held at the London Chamber of Commerce, Botolph House, Eastcheap, to-morrow, at 3 p.m. Mr. S. Montagu, M.P., President of the Association, will preside.

MANCHESTER, 30th April, 1891.

The Ship Canal.—The negotiations have been proceeding with the Salford Borough Council with reference to the promotion of a Bill empowering them to subscribe £1,000,000 towards the amount necessary to complete the Ship Canal. The Manchester authorities had expressed their opinion that it would be hazardous to introduce any new clauses into the Bill, but were willing to aid Salford to obtain a separate Bill. To this course the Salford Corporation has finally objected, and the Manchester scheme will therefore be pushed forward with all speed.

Cheap Gas.—A determined effort is being made to arouse public interest in the question of supplying gas at cost price. This subject has been discussed for some time and has been received with much public favour. It is desired to develop the use of gas for heating and motive power, the present price charged in the city being too high to permit of economical employment. The movement is a part of the general scheme for the purification of the atmosphere in Manchester.

The Engineering Trades.—Although the prevailing topic in engineering circles is the shortening of the working hours, the demand of the workmen has been so far conceded by a number of the largest employers that the question may be considered practically settled. There has been a partial cessation of work, but this has only applied to a few concerns, and, the majority of the Manchester engineers having agreed, it is felt that the others must follow. At present the movement is confined to the immediate vicinity of Manchester, but the outside towns will probably have to follow suit. In spite of the disturbances in the labour market engineers continue to be well employed. Although there is a general feeling that the best of the trade has gone, there is yet ample employment for many months, and no trace of depression is as yet perceptible. Boiler makers and bridge builders within the district are fully employed, and general ironfounders are also well engaged. Machine tool makers do not experience much falling off in the demand, inquiries both for home and abroad being numerous. Textile machinists are still exceptionally busy, there being a number of orders unexecuted. All the various firms engaged in this industry are so full that the execution of orders is much delayed. Messrs. John Hetherington & Sons, Limited, have acquired a large plot of land, with the buildings upon it, in order to extend their premises. Many other firms could usefully employ more plant and space than at present. There does not appear to be quite as much activity in the floating of new mills, although the results of the recent stocktakings have not been unsatisfactory. It is felt, however, that for the present the extension has been large enough, and it is a remarkable testimony to the vitality of the cotton trade that notwithstanding the increased competition new spindles are still being started.

The Linen and Jute Trades.—There has been a continuance of that firm feeling to which reference has been made in previous reports. Although merchants are not specially busy manufacturers will not make concessions in yarns, which have been dear for some time past. Prices for some descriptions are stiffer, both home and continental spinners being determined to hold out for better prices. Concerning piece goods, coarse Forfar makes are steady, but sales in this market display no feature of special interest. Hessians move off quietly. Handkerchiefs are in very fair demand, both in the L.C. and cotton end. The embroidery of these goods by the Swiss machine is said to be increasing in the St. Gall district, but goods so ornamented have not been placed to any extent on the local market. During the past three months extensive sales of Dundee printed jute carpets have been made in this district. The trade is a rapidly growing one, the sale of these carpets and of tapestries having been to a large extent responsible for the decline in the popularity of the old-fashioned "Kidder" or ingrain carpets. Other descriptions of fancy jute fabrics also sell well just now, their cheapness being a recommendation during times of general dulness when the more costly floor coverings cannot readily be sold. Linen threads have a steady sale. Shipments have fallen off slightly of late, but not in proportion to the decline in other branches of the export trade.

GLASGOW, 30th April, 1891.

Scottish Railways.—The sudden death in London on the 25th inst. of Mr. John Walker, the general manager of the North British Railway Company, has led to a fall of about 20s. in North British Railway stock. Mr. G. B. Wieland, secretary of the company, has been appointed general manager, pro tem. The difficulties that have arisen in connection with the construction of the Central Railway, which is at present being constructed through the centre of the city, seem in a fair way to be removed. The relative powers of the railway company under their Acts of Parliament and of the Corporation have been referred to arbitration, and in the meantime, separate plans are being lodged and separate applications for authority to deal with each street that requires to be opened up, as occasion arises.—The Lanarkshire and Dumbartonshire Railway Company has come to an arrangement with the authorities in Glasgow and in Partick with reference to their utilisation of an old bridge across the River Kelvin. The arrangement involves the payment to the railway company by the Bridge Trustees of £1,000, for which sum the railway undertakes to provide a new bridge 50ft. wide with an approach of the same width.

Telephony.—The National Telephone Company are about to carry a direct trunk wire from Glasgow to Carlisle *vid* Dumfries. This extension of the telephone system will place Glasgow in communication with Cumberland and Westmoreland, the system having been already extended into the mineral districts from Carlisle. In view of the intimate connection between Glasgow and the North of England, especially as regards the iron trade, this extension of facilities for the use of the telephone ought to be a great advantage.

Minerals.—In the beginning of the week pig iron rose sharply, on the 27th inst. 7½d. per ton, and on the 28th inst. another 7½d., making 1s. 3d. in two days.—Preparations are being made at Paisley Harbour for the discharge of iron ore. Coal shipments from the Scottish ports are still increasing, last week's increase being 30,044 tons. The shipments at Glasgow, however, again show a falling off, the East Coast ports and some of the smaller ports on the West Coast having succeeded in diverting some of the trade and in securing the increase.

Labour Questions.—A very singular dispute has arisen in Greenock in connection with the lengthening of the steamer "Rome" by Messrs. Caird & Co. for the Peninsular and Oriental Company. The plan hitherto adopted in lengthening steamers has consisted in cutting the vessel in two, separating the halves, and in inserting frames and plates to join the pieces, thus making up the required length. In the present case, however, the forward part of the vessel has been cut off, and an entirely new bow built. The rates for rivet work are 30 per cent. higher for old than for new work, and the dispute centres upon the question whether the construction of the bow is old work or new. Messrs. Caird & Co. hold the view that the riveting of the new part is new work, and should be paid for as such, while the riveting necessary to join the new part to the old is old work, and should be paid for at the advanced rate. The men, on the other hand, regard the whole of the work as old work, and demand payment for it as such. The Greenock branch of the Boiler Makers' Society has decided that the matter is one which Messrs. Caird's men must decide for themselves, but that, if they should decide to strike, the society would support them. Messrs. Caird's men thereupon, by a majority, decided to strike. New questions frequently arise in connection with trade union restrictions in consequence of rapid developments of industrial methods. This is the first instance of a dispute precisely of this kind. The dispute that threatened to disturb the local iron founding industry seems likely to be settled. The men have, it is stated, expressed their willingness to agree to a reduction of ¼d. per hour on time wages and 2½ per cent. on piece wages. This is a compromise which, if accepted by the employers, will avert a strike. The employers had intimated a reduction of 5 per cent. upon piece work. At a meeting held in Glasgow last week it was announced that 30 per cent. fewer men were employed than at this time last year.

Freights.—The freight market in Glasgow is fairly strong. The unfixed tonnage of sailing vessels for Calcutta is only 3,000 tons, and from Calcutta, 5,000 tons. Freights: Calcutta to U.K. or Continent, 36s. 3d. deadweight, 38s. 9d. for linseed. June sailing: Cardiff to San Francisco, 10s. 6d.; San Francisco home, November, 44s. 6d., and December, 43s. 9d. Steamers: Rangoon to Levant, 36s 3d.; Manila to U.K., 42s. 6d.; Bombay to U.K., May, 25s. 6d., June, 24s. 6d.

(From our own Correspondents.)

LIVERPOOL, 29th April, 1891.

The Vyrnwy Pipe Line.—The Board of Trade has sanctioned the laying of the temporary pipe line across the Mersey bed at Fidler's Ferry, notwithstanding the strong protest of the Warrington Corporation. The construction of the pipes is now well advanced, and they will soon be ready for laying, so that there is every prospect of the Vyrnwy water being supplied in time to prevent the dangers of the threatened drought. The permanent work under the river is now progressing more favourably, most of the obstacles having been overcome or removed. The condition laid down by the Board of Trade is that the temporary pipe line must be removed before the end of December, 1892.

The Cold Storage and Refrigerating Company.—The new premises of this company, which are being built on the site of the old Theatre Royal, are now far advanced. The building is nearly completed, and most of the machinery and apparatus, which has been designed by Mr. M. C. Bannister, Assoc.M.Inst.C.E., is either erected in position or is ready for erection. The works, when completed, will be one of the most extensive in the country, and will be fitted with all the most recent appliances.

SHEFFIELD, 29th April, 1891.

The Iron and Steel Trades.—A very quiet tone prevails throughout the steel trade, and few new orders have come in lately to replace the old ones, which are being completed. For the last two weeks there has been a considerable reduction in the output generally, which is due to the fact that quite one-quarter of the workmen are off work owing to the prevalence of the influenza. Prices for finished material have not much decreased, although it is confidently expected that a reduction must soon be made. There is a

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fair amount of business in general blooms for ordinary trade purposes, and also in special forgings suitable for millwork. The steel casting business is quite stagnant, with the exception of a few details for agricultural machinery and odd parts required by marine engineers for repairs. Pattern makers are working short time, and engineers have little new work in progress. The cutlery trades are very quiet, and there are two serious disputes unsettled. File makers are only moderately busy, while cutters are now feeling the effects of so much machine-cut work. The building trades are brisk all round, and the contract for a new Town Hall has been placed, the total cost of the structure being estimated at £100,000.

COAL.—There is practically no change in the coal trade. The demand continues brisk at recent prices. Gas coke is selling at 14s. to 16s. per ton, and the harder and better qualities at increased rates.

THE FIFTY-THREE HOURS' MOVEMENT.—It is not anticipated that any strike will occur here in reference to this question, as most of the works in other districts have already conceded the demands of the men. The result of the meeting of the employers will be made known shortly.

NORTH STAFFORDSHIRE, 29TH APRIL, 1891.

THE IRON TRADE.—Great competition still prevails for any orders on the market, and prices are weak in consequence. Bars are being sold at from £5 17s. 6d. to £6 per ton, delivered at Liverpool or port of equal facility, and pig iron is not worth more than about 42s. 6d. at works. Notice for a reduction in wages has been given to the blast furnace men, and expires on May 2nd. Several forges have stopped work owing to the unremunerative state of the trade.

THE COAL TRADE.—There is still a large demand for house coal, and prices remain the same. For pottery and manufacturing fuel lower rates are being quoted.

THE APEDALE EXPLOSION.—The coroner's jury returned the following verdict as the result of their inquiry:—"That the men met their deaths from an explosion caused by a blown-out shot," and they wished the foreman to state that they were strongly of opinion that the management of the colliery had been most lax and negligent, leading, in the opinion of the jury, to the gross carelessness shown by their subordinates. They further decided "That the mine was not a dry and dusty one."

SWANSEA, 29TH APRIL, 1891.

TINPLATES.—The dependence of the tinplate of South Wales on the American market is shown by the resolution of the Tinplate Makers' Association, unanimously passed, to close their works for twenty-eight days from the 28th of June next. This measure was resolved upon in order to enable buyers to dispose of their large accumulated stocks in anticipation of the operation of the McKinley Tariff Act. Some idea of the amount of these stocks may be formed from the fact that the shipments of tinplate from Swansea in the month of March were 22,703 tons, as against a little over 10,000 tons in the corresponding month of last year. The stoppage, which, as regards 298 mills, was definitely agreed upon at the recent meeting, will involve, if made general, a reduction of about one million boxes in stocks. The tinplate makers have, during the recent busy period, been making very large profits, and one maker indeed estimates the total for the last seven months at not less than £1,000,000. They can therefore afford to wait, but the case is different with the steel makers, especially those owning blast furnaces, who have had to pay very high prices for fuel and ore. Messrs. Wright, Butler, & Co. have already put out their two blast furnaces at Carnarvon, and are preparing to do the same with their two furnaces at Landore, finding it cheaper to buy the necessary pig iron. The effect of the month's stoppage on the men must also be deplorable, not only through the loss in wages, which will amount to nearly £150,000, but also because it will aid the development of the tinplate making industry in the United States. Altogether the immediate outlook for the 30,000 hands employed at the 500 mills owned by the trade is not reassuring.

CARDIFF, 29TH APRIL, 1891.

THE IRON AND STEEL TRADE.—A slight improvement is observable in the hematite pig iron trade, and, in addition, makers are finding some relief in rather lower prices for fuel with reduced wages. There is nothing new to report in the steel rail trade. One or two inquiries have come to hand, but transactions have been limited. Quotations for heavy sections range from £4 10s. to £4 15s. Consequent upon the proposed stoppage for a few weeks in the tinplate industry, there is only a small demand for Bessemer steel bars, the price for which, however, has not been changed. In the iron ore trade a few cargoes have changed hands at rather lower prices on account of the low freights, but for quantities prices are maintained at 13s. 3d. to 13. 9d. c.i.f. Cardiff and Newport, 50 per cent. basis. Manganiferous ore finds a better outlet on account of an extra furnace being turned on to spiegel.

COAL AND COKE.—Exports of coal last week reached 288,000 tons, which is very little short of the highest total recorded. With such heavy shipments prices are maintained at the recent level, a fact contrary to the general anticipation, which was evidently based upon the theory that with the depression in the iron, steel, and shipbuilding industries the prices of coal would certainly recede also. It should be remembered that Welsh steam coal finds its way to all quarters of the globe and is used for various purposes, and hence, the dulness pervading kindred industries is unable to effect coal. Colliery property is still eagerly sought after and there seems every prospect of a steady year's trade. Large steam coal is quoted at:—1st quality, 14s. 6d. to 14s. 9d.; 2nd, 13s. 9d. to 14s. 3d.; 3rd, 13s. to 13s. 6d.; 4th, 12s. 6d. to 12s. 9d.; and small steam, at 5s. 3d. to 5s. 6d. The house coal market is easier with prices for No. 3 Rhondda 14s. 6d., and No. 2 Rhondda 13s. The prices of coke are, furnace, 17s. 6d. to 19s.; foundry, 20s. 6d. to 21s. 6d.; best foundry, 23s. to 25s.

BARROW-IN-FURNESS, 29TH APRIL, 1891.

HEMATITE.—There is a rather better tone in the hematite pig iron trade this week, and although the amount of business has not increased there is every reason to expect that it will do so shortly. In the meantime prices are firm at 48s. 6d. per ton for hematite warrants net cash, while makers are asking 49s. 6d. to 51s. 6d. for Bessemer parcels in mixed numbers net f.o.b. There are still 40 furnaces in blast, and 37 are standing idle. The stocks of iron have been decreased this week to the extent of 2,560 tons, leaving the stocks still in hand at 167,417 tons. Further reductions in stocks are likely to take place, as the consumption is maintained at a point a few thousand tons greater than the actual rate of production. The business in forge iron is quiet, but there are better prospects of trade in the Bessemer department by reason of a fuller demand.

STEEL.—The steel trade is very fairly employed, and during the week some good orders have been secured, including a large contract from the Cape Government, by the Barrow Company, and an equally large contract on American account, received by Messrs. Cammel & Co., of Workington. Heavy rails are quoted at £4 12s. 6d. per ton net, but business has been done for large parcels at £4 11s. per ton. There is not much doing in light rails, which are quoted at £5 15s., or in colliery rails, which are at £6 10s. per ton. The trade in steel shipbuilding material is quiet, although makers have still some orders to deliver. This trade depends naturally on the activity of shipbuilding, and it is considered probable that some large orders will soon be placed. In blooms, billets, and tinplate bars the business is comparatively easy, and slabs are quiet, but in hoops there is a steady trade, and there is still plenty of activity in heavy steel forgings.

THE "EMPRESS OF INDIA."—A telegram received from Vancouver, B.C., says that the steamer "Empress of India" arrived there on the 28th inst. from Yokohama. She made the passage in 10 days 14 hours 34 minutes, thus beating all former records between Yokohama and this port by over two days. The "Empress of India" was built at Barrow-in-Furness by the Naval Construction and Armaments Company, Limited, and sailed from the Mersey in the beginning of February with a full complement of passengers for a round-the-world tour. Her maiden trip has been a great success, and her first achievement on the Pacific, which represents a speed of 18 knots an hour, marks a revolution in the passenger service between Canada and Japan and China.

BUSINESS ANNOUNCEMENT.—Mr. Alexander Adamson, formerly shipyard manager of the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, has just been appointed to a seat at the Board of that company, and will occupy the position of managing director of the company in room of the late Mr. A. D. Bryce-Douglas.

MIDDLESBROUGH, 29TH APRIL, 1891.

PIG IRON.—There is little business in pig iron, except in the way of speculation. Warrants are strong at 39s. 2d. sellers, buyers being 39s. cash. West Coast hematite has been sold at 49s., and East Coast is quoted at 51s., but the price is merely nominal. Some makers of pig iron have not sold under 40s. per ton, but the majority would be willing to take 39s. 6d., and even 39s. would be acceptable to some. The stock in Connal's store on the 27th inst. amounted to 118,215 tons, having decreased during the month 4,479 tons. It is expected that there will be a decrease in stocks at the end of the month by at least 5,000 tons.

SHIPMENTS OF PIG IRON.—The shipments to Scotland are larger than ever, but the shipments abroad are just about half what they were this time last year. Those to Scotland up to the 27th inst. amounted to 34,945 tons, against 9,025 last year, but those abroad only amounted to 27,410 tons, against 52,089 last year. The total shipments amounted to 71,013 tons, against 65,744 last year, so that the increased shipments to Scotland have more than made up for the decreased shipments abroad.

MANUFACTURED IRON AND STEEL.—Business is very dull, and works are beginning to be slackly employed. Prices are much the same, but concessions could be got readily. Iron ship plates are £5 12s. 6d.; angles, £5 10s.; and bars, £5 12s. 6d. Steel ship plates are £6 2s. 6d.; angles, £5 17s. 6d.; and rails (heavy section), £4 10s. per ton, all except the last, which are net, being liable to the usual discount of 2½ per cent., and f.o.t. at works.

SHIPBUILDING.—This industry is steady at present, but it is thought that as the year advances it will fall off somewhat. Another shipyard, however, is to be opened on the opposite side of the Tees near to Haverton Hill, and this fact looks promising. There is plenty of work in all the yards at present. There is also another marine engineering works being started in Middlesbrough on the premises of the late Cleveland Bolt and Nut Works.

SUNDERLAND, 29TH APRIL, 1891.

SHIPBUILDING AND ENGINEERING.—Shipbuilders have many inquiries, but these appear to be merely tentative. It is not likely that many orders will be received until quotations fall, and this is dependent upon the labour market. Engineering establishments are beginning to reduce the number of their employés. This industry will locally feel the pending slackness to the greatest extent, as so many sailing vessels are being built. There have been eight vessels, of 17,780 tons, launched during this month, making a total of 25 vessels (of 53,787 tons) for the current year. There are 52 vessels (of 120,945 tons) under construction, as compared with 59 vessels (of 127,552 tons) a year ago. On the 25th inst. there were three steamers launched—viz., the "Venango," for the Neptune Steam Navigation Company, Limited, by Mr. James Laing, Deptford; the "Nerano," for the Pinkney & Sons Steamship Company, by Messrs. Short Bros., Pallion; and the "Wallarah," built to the order of Mr. William Lund, of London, by the Sunderland Shipbuilding Company, Limited. On the 27th inst. Messrs. William Doxford & Sons, Limited, Pallion, launched the s.s. "Clan McIntyre," for the Clan Line of steamships, and the s.s. "Clan McLeod, for the same company, has nearly been completed.

SHIPPING.—The freight market is still unsatisfactory. The improvement effected in homeward rates is being discounted by a fall in outward freights. The lowest point has almost been touched again in the rate from Tyne to Genoa. During the month of March there was again a falling off in the income of the River Wear Commissioners. As compared with March, 1890, the total decrease is £1,643 5s. 9d. This is largely due to the decreased coal shipments, which are 53,623 tons less than for the same period of last year. During last week 69,641 tons of coals were shipped, a decrease of 16,676 tons as compared with the corresponding week last year.

NEWCASTLE, 29TH APRIL, 1891.

THE COAL TRADE.—The Northumberland coal owners have intimated to the miners' representatives their intention to claim a wages reduction of 3¾ per cent., the average selling price of coal having declined 6·22 per cent. during the quarter ending the 31st ult. The shipments of coal and coke at Tyne Dock during the week ending the 25th inst. amounted to 114,497 tons, being an increase as compared with the shipments for the corresponding week last year of 1,303 tons.

SHIPBUILDING.—Several launches have taken place on the Tyne this week, but the vessels have not been replaced by keels for others, a circumstance which indicates an approaching slackness in the yards. The Tyne Shipbuilding Company have been commissioned by a Newcastle firm to build a steamer of large tonnage, and it is rumoured that one or two other orders for vessels are about to be placed. Almost the whole of the graving docks are now occupied, there being a large amount of repairing work to be done. At many of the shipbuilding establishments advantage is being taken of the present lull in business to make necessary changes in the plant and general working arrangements.

ENGINEERING.—Marine engine shops continue to be fairly busy, though few new orders are being received. Messrs. John Abbott & Co. have many orders on hand for hydraulic machinery to be shipped to New Zealand and Australia, and the whole of their departments are kept well employed. Messrs. Watson & Sons, of the High Bridge Works, have secured a portion of the order for the requirements of the current year in gun-metal articles at the Government dockyards. The firm are also carrying out many orders for gun-metal accessories required in the equipment of war vessels which are being built by private firms. Messrs. Hawthorn, Leslie, & Co.'s branch engineering establishment at Forth Banks is at present somewhat slack, as no new contracts have been secured. The St. Peter's Works of the firm are, however, exceedingly busy.

TRADE DISPUTES.—The engineers employed at the works of Messrs. Palmer & Co., Jarrow, have come out on strike, owing to an alleged appropriation by the plumbers of certain work which the engineers claim should be done by themselves exclusively. These disputes regarding the apportionment of work are recurring very frequently, and, unless some method is found of putting a stop to them, they will cause much trouble in the future. The smiths at Messrs. Stephenson's Hepburn works and the chainmakers at Messrs. Abbott's works, Gateshead, have disputes with their employers with reference to the prices paid for piecework.

THE LATE MR. JOHN WALKER.—On the 24th inst. Mr. John Walker, general manager of the North British Railway, died suddenly in London. Mr. Walker was at first in the service of the Edinburgh, Perth, and Dundee Railway Company, and on the amalgamation of that company with the North British Railway he was transferred to the head office. Some years afterwards he was appointed secretary to the North British Company, and he held that office till about 1872, when he was elected a director. He continued on the board till 1874, when he was appointed general manager of the company in succession to the late Mr. Mason.

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NEW TOOL GRINDER.

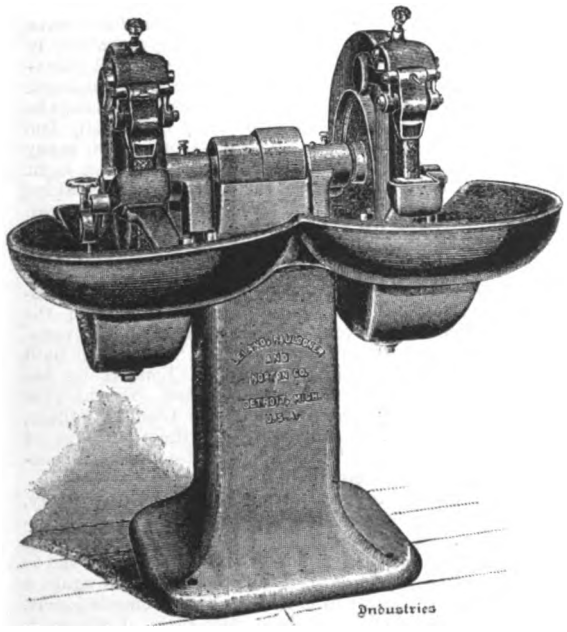


Fig. 1.

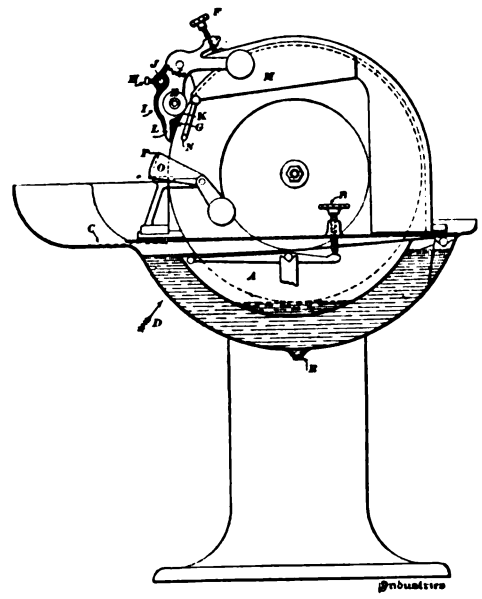


Fig. 2.

THE NICARAGUA CANAL.

III.

(*Continued from page* 363.)

PROPOSED ROUTE.

The central section of the canal, from Ochoa to Lake Nicaragua, follows the River San Juan, and has a length of 64·54 miles. For this little excavation is required, but to make it navigable a dam is to be constructed at Ochoa, which will have the effect of flooding the valley of the river for a great proportion of its length and maintaining the water at a level of 106ft. above the sea. The dam will abut against two steep hills, have an average height of 61ft. above the river bed, a width of 25ft. at the top, and 500ft. at the base. The length of the weir crest is fixed at 1,250ft., and that of the abutments at 650ft. It is estimated that, with a mean flow of 20,000 cubic feet per second in the river, the depth of water above the weir will be about 3½ft. Between the Toro Rapids—indicated on the plan Fig. 4 on page 362—and the lake, a distance of 28 miles, blasting under water and dredging will be necessary in several places to an average depth of 4½ft., equivalent to about 24 miles in length. Below the rapids the width of the navigable channel will nowhere be less than 1,000ft., with depths ranging from 28ft. to 130ft. The average minimum depth of the water, as raised by the dam, in the shallowest places is to be 23ft. The Ochoa dam it is proposed to construct in the same manner as those previously mentioned—namely, of "rock fill" and earth backing. As described in Mr. Menocal's report, "the core of the rock portion will be made of smaller stones, gravel, and refuse from the rock cuts, with three rows of sheet piling from abutment to abutment, and substantial concrete core walls from the ends of the sheet piling carried well into the abutment hills and up along the slope beyond the maximum flood level. The upper portion and long flat apron will be composed of stones of the largest dimensions that can be handled and arranged, the interstices being filled from behind with small stones, gravel, and earth dumped from suitable trestles."

A short distance above the site of the Ochoa dam is the confluence of the San Carlos with the San Juan River. To the east of the former river is a ridge running in a direction south by west, but this ridge is interrupted by gaps which at certain points are below the water level. Such gaps will be closed by embankments, the top of the latter having a height of 112ft. above the sea level. In the ridge in question it is intended also to provide a large waste weir, which will discharge the flood waters of the San Carlos into the San Juan River below the Ochoa dam, where a natural channel exists in the Cureño Creek. Across Lake Nicaragua itself the distance to be traversed by vessels will be 56·5 miles. From the mouth of the canal on the east side of the lake it will be necessary to dredge for a distance of about 14 miles in soft mud in order to maintain a depth of 30ft., but the average depth of the artificial channel required is only 9·8ft., with a width of 150ft. at the bottom, the sides having a slope of 3 to 1. No further excavation in the lake is necessary from the end of this channel to within 1,400ft. of the west shore, but here a cutting has to be constructed in rock. It is considered advisable to provide for the building of two breakwaters at the entrance of the canal on the west shore of the lake, one on either side, for the purpose of protection against prevailing winds, of arresting débris drifting along the coast, and of serving as guides to approaching vessels.

We now come to the western division, extending from Lake Nicaragua to the Pacific port of Brito, and having a length of 17·04 miles. Of this distance, 11·44 miles will have to be excavated entirely, while the remainder, 5·60 miles, passes through the Tola Basin, situated in the valleys of the Grande and Tola Rivers. Like the other basins in the course of the canal, the Tola Basin will be formed by the erection of a dam. From its estuary on Lake Nicaragua the projected channel follows the valley of the Lajas River for 8,260ft. Here the river turns southward, while the canal continues its course in the same straight line, and at 4·7 miles from the lake crosses the "Western Divide," which has an elevation of 152ft. above the mean tide in the Pacific. Descending at the rate of about 9ft. per mile, in 1¾ miles it meets the Rio Grande, and follows generally for some distance the course of this mountain stream, cutting through some of its sharp bends. Nine miles from the lake the basin of the Tola is reached. The embankment by which the basin is formed is to have a length of 1,800ft., and a height of 70ft., and its structure will be exactly similar to that of the Ochoa dam. The top of the embankment will be 112ft. above sea level, so that the level of Lake Nicaragua will be extended through the divide and the basin to the embankment. The estimated area of the Tola Basin is 4,000 acres, and for over 4½ miles its depth will range from not less than 30ft. to 70ft. The rock excavated in forming Locks 4 and 5 will be utilised in the construction of the embankment, as well as the earth removed in constructing the canal to the east of the basin. A weir, 1,300ft. long, and the lock culverts are relied on for controlling the lake level, even during exceptional floods, but to make assurance doubly sure it is proposed to construct a "guard gate" in the canal between the lake and the "Divide," by means of which, on an emergency, the water can be shut off from the former. Westward of Locks 4 and 5 the canal will flow through a broad flat district to the port of Brito. 1·58 miles below Lock 5 is the sixth and last lock, between which and Brito the canal will be at the sea level.

Greytown Harbour Improvements. — An essential preliminary to the construction of the canal is the improvement of Greytown Harbour, with which considerable progress has already been made. Between the inner bay, on the shore of which Greytown is situated, and the sea, there existed thirty years ago a narrow but safe channel, through which the largest vessels could pass. The action of the waves has, however, thrown up a sand bank, closing the entrance to this channel, so that at present—or at any rate previous to the commencement of the works now in progress—the bay is converted into a fresh water lagoon. The plan adopted for restoring the harbour consists, first, in the construction of a breakwater nearly at right angles to the shore of the sand bank referred to, having a length of about 2,000ft. and extending to a depth of six fathoms; and, secondly, in dredging from this depth through the sand bank into the inner bay. As the shifting sand arrested by the breakwater begins to silt up the new entrance, the breakwater will be extended, the process being repeated until a new coast line is formed perpendicular to the direction of the prevailing wind. The new entrance channel will have a depth of 30ft., and a width at the bottom of 500ft. To a depth of 15ft. of water the jetty will be constructed of creosoted timber, fascinage, and stone; beyond this, in deep water, of rubble, the stone for which will be furnished from the excavation of the "Eastern Divide."

The inner basin of the harbour will have an excavated area of 206 acres, which, with the enlarged section of the canal as far as Lock No. 1, gives a total area of 341 acres of water, 28ft. deep, exclusive of the slopes of 2 to 1, and the natural accommodation afforded by the rest of the bay, which is sufficient for a considerable number of vessels of ordinary size.

Brito Harbour.—At Brito also harbour improvements are required. The main portion of the harbour will have to be excavated in the alluvial valley of the Rio Grande, which here debouches on the coast, but a part of it will also be in deep water protected by two breakwaters, one 900ft. long, projecting from the shore at the western extremity of the range of hills which extends along the Pacific coast, the other 830ft. long, normal to the beach on the opposite side of the basin, as indicated in Fig. 5 in our issue of the 17th ult. The new harbour will penetrate about 3,000ft. inland from the present shore line, while its whole length, measured from the entrance between the breakwaters, will be 3,900ft. In addition to this, the canal itself, being here constructed of enlarged section as compared with its average dimensions, will form an extension of the harbour for another 3,000ft. The total harbour area, including the wider portion of the canal itself, will be about 103 acres, with a depth of 30ft.

(*To be continued.*)

NEW TOOL GRINDER.

The accompanying illustrations, Figs. 1 and 2, represent a general view and side elevation of a new tool grinder, made bythe Leland, Faulconer, & Norton Company, Detroit, Michigan, U.S.A., which is of novel construction. A wheel is carried at each end of the spindle, and the two wheels are so arranged that they may be removed from or put on the spindle with little trouble, and without disturbing the spindle or boxes.

The front of the water pan is in the form of two part circles, so that no matter where the operator stands he will be about the same distance from the wheel. There are guards, which effectually prevent the throwing of water about the machine. They are adjustable to the wheels, and held in position by bronze bolts, so that there is no trouble from rust when they are to be moved. Upon the rest is pivoted the guard *O*, which is counterbalanced, so that when not in use it rises above the rest; but when the tool is placed upon the guard at *P* it descends until the tool bears upon the rest, in either position doing much to prevent throwing of water, while at the same time it also prevents sudden gouging of the wheel. Provision is made for keeping the wheels true, and in the best possible condition for effective work, by the adjusting device seen attached to the wheel guard above the rest. This consists of a threaded roll of steel running upon a hardened and ground arbor in bronze bearings, and brought into contact with the wheel by turning the small hand-wheel *F*. It is intended to be used in keeping the wheel true whilst running rather than remedying its defects. The surface *G* is of chilled iron, and is held to the stone by gravity only, so that it does not bear hard upon it. For a water supply no pumps, valves, or other similar devices are made use of, yet the supply is under perfect control by simply turning the hand-wheel *B*, which, as will be seen, is on a screw, which bears upon one end of a lever, which is fulcrumed as shown, and supports the front end of the tank *A*, the other end being pivoted at the back, as shown.

The wheel spindle is of crucible steel, ground accurately to size with the collars turned all over, to ensure exact balance, and has bearings 2⅛in. diameter, 8in. long. The wheels are 24in. diameter, 1½in. face, and are 25½in. apart.

We are indebted to our esteemed contemporary the *American Machinist* for the illustrations.

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THE NEW DALMARNOCK

ENGINEERS: MESSRS. CROUCH & HOGG, HOPE STREET, GLASGOW.

(*For description*

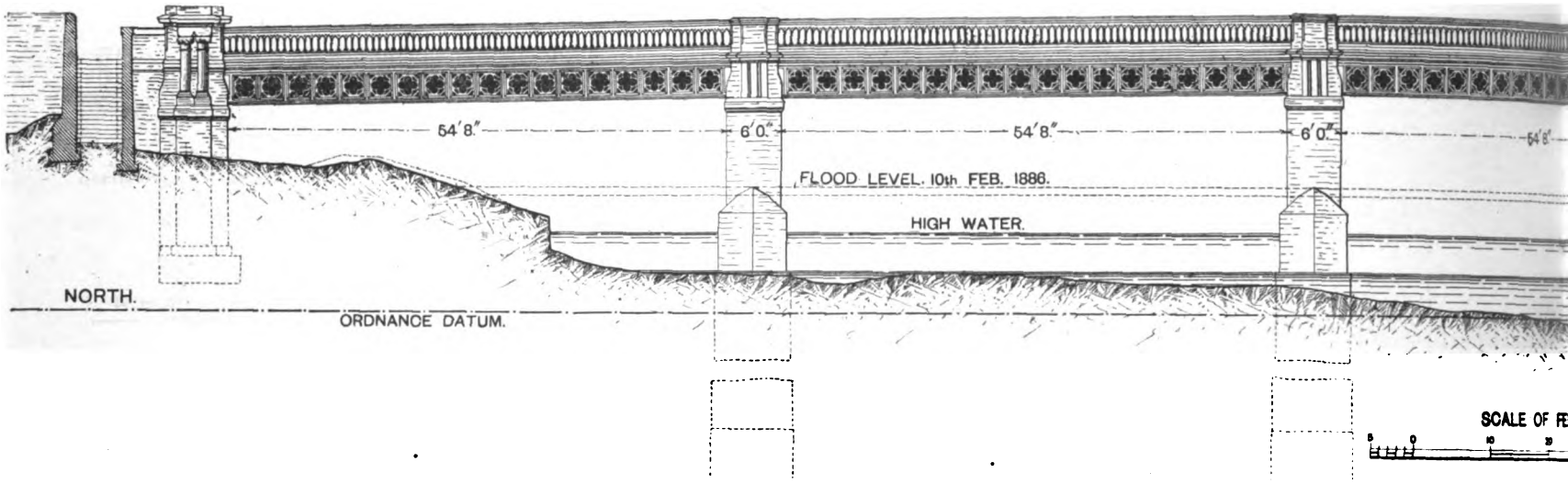


FIG. 3.—GENERAL ELEVATION O

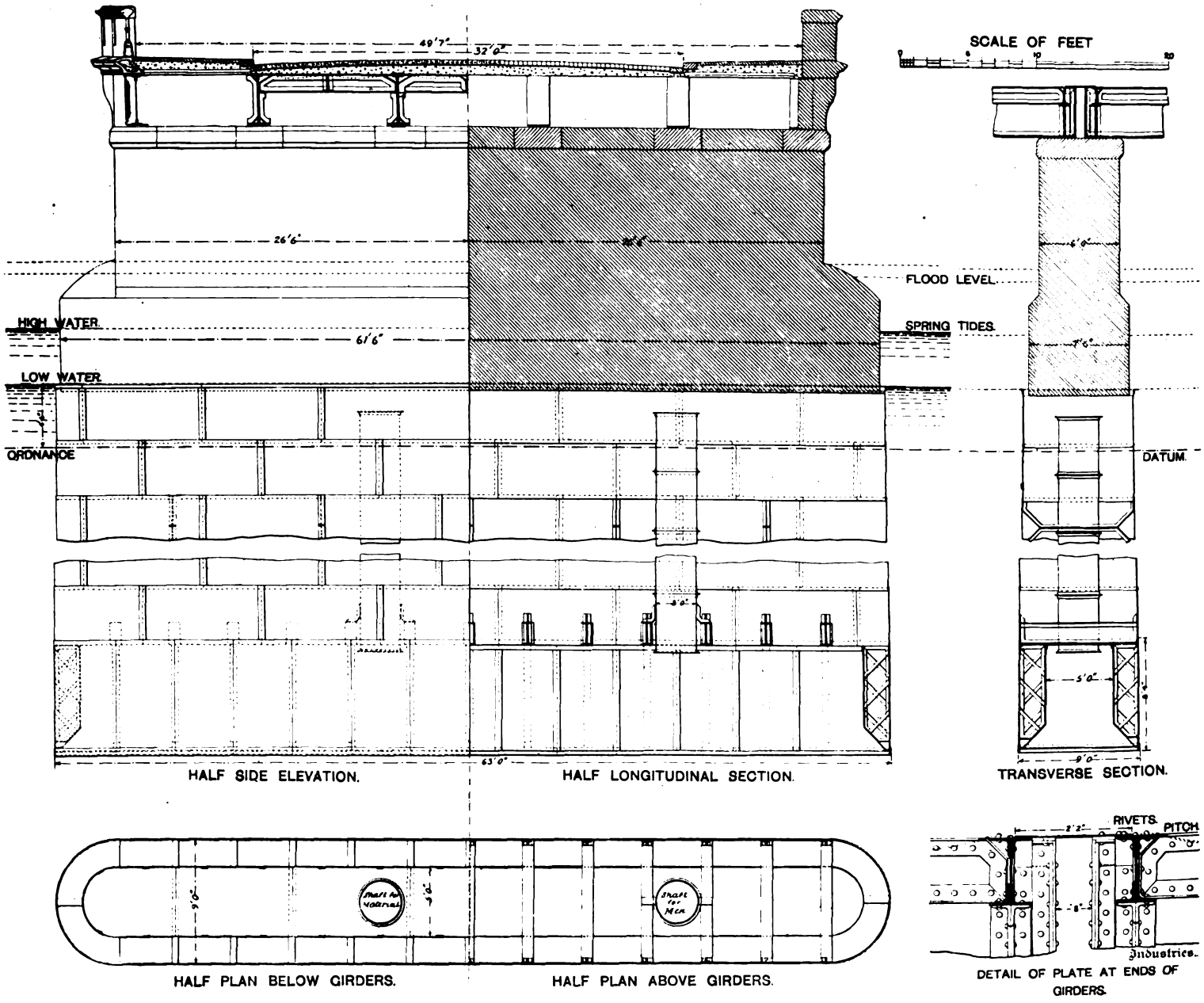


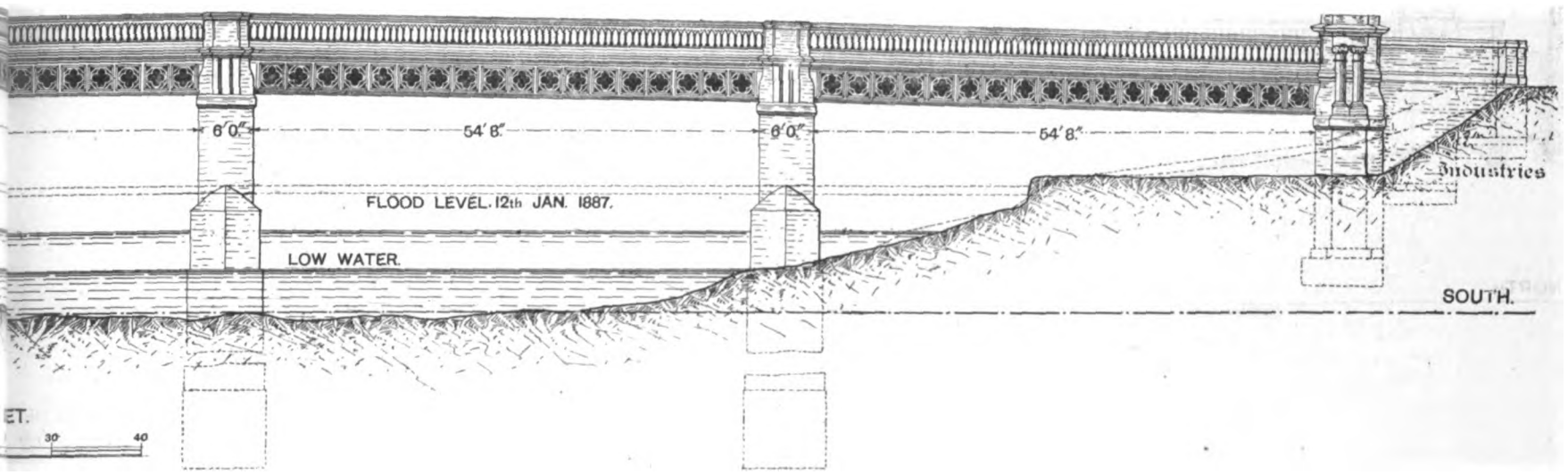
FIG. 4.—SECTIONAL VIEWS OF PIER AND CAISSON.

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BRIDGE AT GLASGOW.

Contractor: Mr. A. H. Boyle, Banknock, Bonnybridge, N.B.

page 412.)



Bridge as Completed.

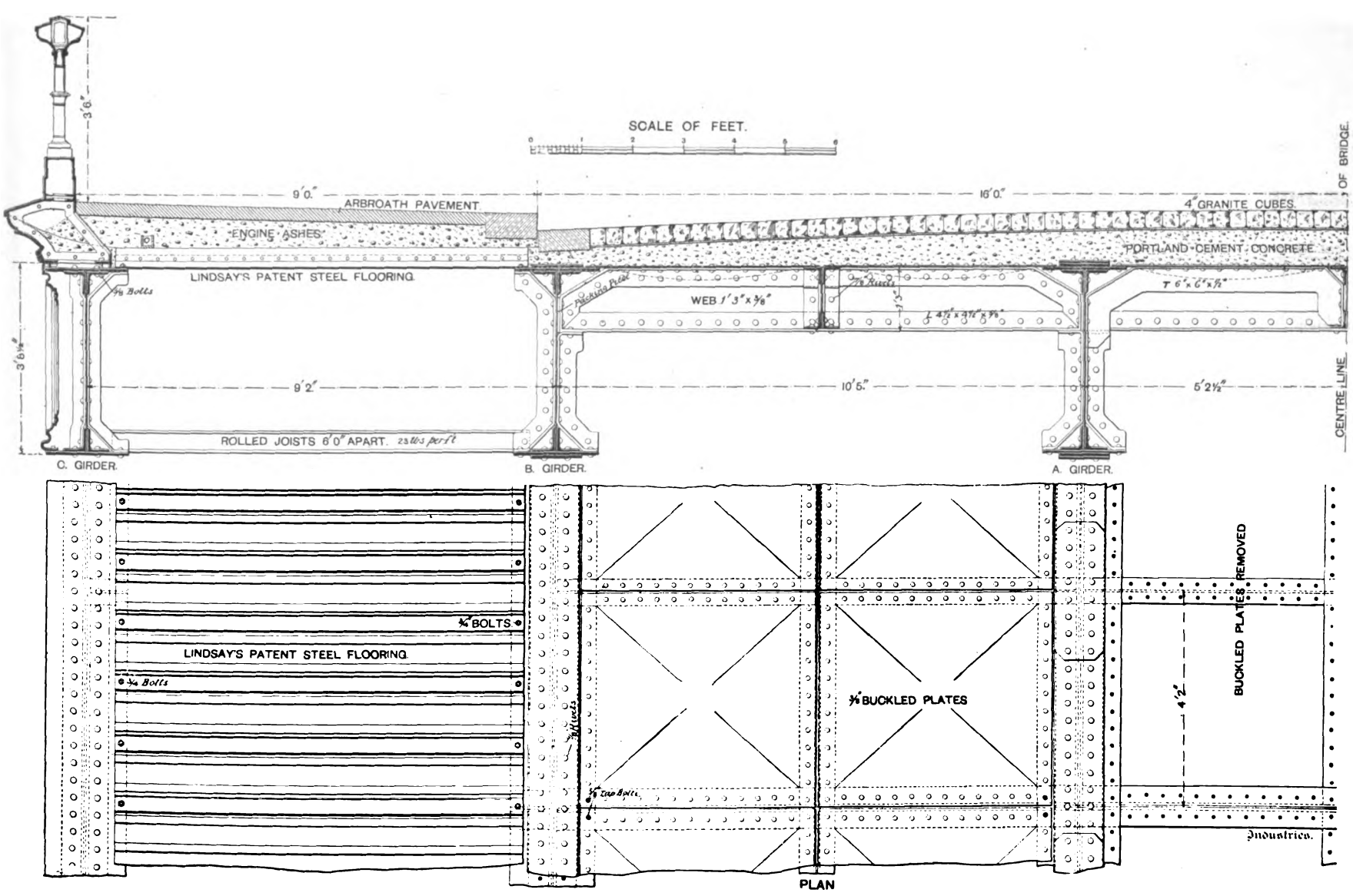


Fig. 5.—Half Transverse Section and Part Plan of Superstructure.

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Double-page Supplement illustrating THE NEW DALMARNOCK BRIDGE AT GLASGOW.

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FRIDAY, 1ST MAY, 1891.

MR. GOSCHEN'S BUDGET.

THE Budget speeches of Mr. Goschen are received annually with scarcely less public interest than were those of Mr. Gladstone during the best period of his career as a public financier. The reputation of Mr. Goschen has relieved him of the burden of the carping criticism which is generally directed against the statements of less famous Chancellors; but it has also militated to some extent against adequate examination of his financial proposals. His authority as a practical financier on a considerable scale has, indeed, helped to obscure some of the less sound of his devices, and has helped to reconcile the public mind to many fresh departures which, if they had been proposed by lesser men, might have been universally reprobated. Again, he has had the good fortune to occupy the position of Chancellor of the Exchequer during a period of prosperity which followed a period of unexampled depression. In his recitals of the results of the finance of the past years he has thus always been in the agreeable position of being able to congratulate himself and the country upon a revenue which had expanded at a rate greater than his estimates, and upon an expenditure which had fallen short of these. On the present occasion he has been equally fortunate, although there is an unpleasant reservation that if the whole of the expenditure of the year had been debited in the accounts of the year, so agreeable a result could not have been reached. Mr. Goschen is, of course, not without the excuse that such a state of matters is not unknown in previous Budgets, and that the records of both parties are not without examples of similar expedients whenever occasion arose that seemed to demand their adoption. More serious, however, in the finances of the past year, is the discovery that some of the spending Departments have asked for much more money than they have spent during the year. It is well, certainly, that departmental estimates should make a complete disclosure of projected expenditure; but there is something seriously wrong when rather more than a million of money is taken from the pockets of the taxpayer, and therefore from the resources available for industrial purposes, in excess of the amount actually required by the spending Departments. Either gross blunders must have been made in the estimates, in which case the permanent officials are to blame, or Mr. Goschen has succeeded in compelling the spending Departments to reduce their expenditure by an amount so large as to suggest gross extravagance in the past. It is also open to question whether the reduction in expenditure has not been accomplished, to some extent, at least, at the expense of efficiency. The details which Mr. Goschen gave of the industry of the year were at once valuable and encouraging. The great and sudden increase of the profits from several important industries is a noticeable feature in a year which has been characterised by considerable financial disturbance, by not a few serious strikes, and by a general feeling of uneasiness as to the immediate future. The long-delayed return of prosperity to the cotton trade will be noticed with satisfaction. The increase in the earnings of a set of collieries between 1887 and 1889 is, however, so large as to suggest that these collieries have been exceptionally fortunate. It can hardly be supposed that an increase in profits in three years of 300 per cent. was universal throughout the kingdom. Basing his estimate for the coming year upon considerations suggested by these figures, Mr. Goschen regards an increase in the revenue of the year of £1,200,000 as a fair expectation. He estimates the total revenue at £90,430,000, and the expenditure at £88,440,000. The estimated surplus is thus nearly two millions. Mr. Goschen's plan for dealing with this surplus must come before Parliament in another form, and from a certain section of the people is not unlikely to receive strenuous opposition. He proposes to devote one-half of the surplus to the payment of the increased charge upon the Exchequer that will be entailed should the Government succeed in passing a measure for the granting of "free" education to England. The remainder of the surplus he devotes to the extent of £500,000 to the erection of barracks, and to the extent of £400,000 to the withdrawal of light gold coin now in circulation. As regards the last of these proposals, it would have been interesting—indeed, highly advisable—to know how much of the £600,000 granted last year for this operation has been expended, and also whether it is to be supposed that the sum now asked for will suffice to complete it. As regards the destination of the bulk of the surplus, and apart altogether from party politics, which are inadmissible in these columns, it may be doubted whether there is any real demand for free education at the moment. It is not very clear whether the addition of a sum of £2,000,000 a-year, proposed for the future needs under this head, will suffice to make education free, even so far as it is compulsory. There will thus be a tendency either to cheapen the cost of education, which is already being done in Scotland, where fees have practically been abolished, or there must be a considerable addition to local rates. The Government, no doubt, feels itself committed to legislate in this direction. Meanwhile it may be well to note that our national Budget is gradually creeping up to a hundred millions a year. Although in times of prosperity taxpayers may accept the inevitable and forbear to grumble, a time of depression may come when even the present burden may become excessive. Moreover, there is at least one highly uncertain item in the annual receipts to which Chancellors of the Exchequer have hitherto always looked for support—that is, the revenue from spirits. The revenue from this source has almost always been in excess of the estimates; but no possible assurance can be given that it will continue to be so. It is, indeed, a most uncertain source of revenue, and is liable to fall away all the more seriously during a period of depression as it increases more rapidly during a period of prosperity. One item in Mr. Goschen's statement is questionable enough to have already led to much criticism. This is his proposal to set apart the dividends which, after the year 1894, will accrue from the Suez Canal shares, in order to provide for an addition to our national defences. The provision of national defences is a matter by itself, and there is no more special need for setting apart the dividends on the Canal shares, than there is for setting apart the duty on snuff or a farthing of the sixth penny of the income-tax. The device is, indeed, like the childish one of wrapping in special parcels the money intended to be devoted to separate uses.

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The argument, too, that the taxpayer is not called upon to provide this annual sum of £600,000 because it is derived from the Suez Canal is a mere subterfuge. It is impossible by any method of financing to get over the circumstance that there are but two sides to the taxpayer's ledger—viz., debit and credit—and that, whatever appears on one side is paid out, and whatever appears on the other side is received. Besides, it is entirely beyond the power of Mr. Goschen to limit the range of choice as to the disposal of national funds of the Chancellors of the Exchequer and the Parliaments of the future. Even sinking funds have not escaped the exigencies of changes in Administrations, and there have been cases in which Ministers have suspended sinking funds of their own creation. Some surprise has naturally been felt that Mr. Goschen made no reference to the proposals as to the gold reserves and to the issue of £1 and 10s. notes made in his speech at Leeds in January last. Perhaps the hint that the currency proposals hung on the question of light gold may be taken to mean that when the motion on the withdrawal of light gold is made he will refer to them. It may be that Mr. Goschen is meeting with unforeseen difficulties in perfecting his plan, either through the obstinate attitude of the banks, or through difficulties inherent in the nature of his proposals. It is interesting to note in this connection two points in Mr. Goschen's speech—first, that bankers have been reaping during the three past years a very heavy increase of profits, and that the amount passed through the bankers' clearing houses has enormously increased. This constitutes an argument in favour of causing the banks to defray the cost of the new gold reserve since they enjoy privileges so extensive and profitable. The second point is that the profit on silver, due to the difference between the price of silver in the market and the face value of coined silver, has brought in £200,000 over the amount received on this account in the previous year, and that the demand for silver is increasing rapidly. This increased demand for silver may probably be set down to an increase in wages, and suggests also that the present is a favourable moment for the passing into circulation of 10s. notes based on silver. The cost of coinage would be saved, and the trouble of circulating the silver, and subsequently withdrawing it or withdrawing half sovereigns, might be avoided by promptly placing the 10s. note within reach of those who require to use small change.

The Budget, if it be taken as a whole, may be set down as colourless: it neither increases nor remits taxation, although it shows a surplus of a couple of millions. Its leading feature, the provision in anticipation of funds for granting free education, certainly wears the aspect in which it seems to have been generally regarded in the country—namely, that of a Dissolution Budget, in which the Government, feeling certain of the support of the upper and middle classes, makes a bold bid for the support of the masses. Whether the Government is offering them a boon which they do not want, or do not care to have, remains to be seen. It is probable that if they had been consulted they would have voted by preference for a reduction in the duties upon tea, coffee, or tobacco.

FLASHING SIGNALS IN THE NAVY.

The Parliamentary paper which was recently issued, giving the whole of the official correspondence relating to Rear-Admiral Colomb's system of flashing signals, is interesting from several points of view. It gives a fairly good account of the services of a highly distinguished naval officer, and also enlightens the public on some of the official methods of looking at things. The student of the history of scientific inventions will, on reading the correspondence, be struck with an illustration of the fact that no one man is the sole inventor of any mechanical or physical arrangement. Most discoveries or inventions have been evolved from the conditions of the times or the environment of the nominal inventor, who very often seized on the speculations or imperfectly developed designs of some previous workers. Some time since we received a pamphlet written by Major-General Babbage, son of the late Charles Babbage, which was written for the purpose of showing that the latter was the real inventor of the occulting system of telegraphing known in the army as the heliograph, and in the navy as "Colomb's signals." The writer showed that his father, as early as 1851, published a description of the system in his work entitled "The Exposition of 1851." At pages 103 and 111 he gave full details of his system of telegraphing by occultation for use in fleets and lighthouses. He made many experiments, and expended not a little money, in perfecting it, and during 1851 he exhibited an occulting light at a window in his own house in London, which attracted attention, and was seen by many. The pamphlet was published on the occasion of a deputation to the First Lord of the Admiralty urging the claims of Admiral Colomb for some form of recognition as the inventor of the flashing systems of night and fog signals, and the writer urges that if the Government thinks fit to recognise the usefulness of the invention and the claim of the inventor, its liberality should be extended to the representatives of Charles Babbage, both as a recognition of his scientific claims, and of his services in the matter. Admiral Colomb's patent is dated May, 1862, and there cannot be the slightest doubt that the method has been much improved by his exertions. Although we cannot enter into a discussion of the relative claims of Babbage and Colomb, we think it is only right that the work of the former should not be overlooked, while that of the latter has at least received the honour of being recorded in a continuous form in a Parliamentary paper. Babbage's life, and a great part of his fortune, was spent in attempts to work out various mechanical problems, and although the results may not have been of much practical utility, still they are worthy of recognition, not only on account of their value to science, but also because of his unselfish devotion and unwearied perseverance to objects beyond the sphere of ordinary occupations.

The correspondence which has been published shows that Admiral Colomb has for twenty years been seeking for what he considers a proper recognition of his claims, and, like many ingenious men, he has been kept all that time in a state of suspense. Early in his career he received a gratuity of £500, and before payment the Treasury wished to be assured that no further claims could be with justice made for similar remuneration in connection with the invention. After considerable correspondence a receipt was given by Captain Colomb, which seems definite enough, as it is "in final and absolute discharge of all claims on Her Majesty's Government on account of signal arrangements for land service, and in respect of signals for joint naval and military use," but Admiral Colomb states that the form of receipt signed was specially prepared in order to leave his naval claims open. Almost immediately after the payment the flashing system was fully adopted and introduced into every ship in the service. In 1876, when he was serving as flag captain on the "Audacious" in the China seas, he presented a petition to the Government, proposing that his claims for recompense should be referred to arbitration. He expressed the opinion that there never had been in the modern navy so considerable a service so ill-requited as his had been. For, instead of being rewarded, after excessive labour in maturing the invention, and after still more excessive labour and anxiety in obtaining its adoption by the Navy—after complete success in both efforts he found himself a poorer man than if he had never made them; behind in his profession, and with no prospect before him except a compulsory retirement from the service which he had benefited. His application was supported by Admiral Ryder, who expressed the opinion that the former award was utterly insignificant, and could only be considered as a small instalment paid while the invention was still in its infancy. He thought that impartial arbitrators would not offer him less than £10,000, although he said he had reason to believe that Captain Colomb would be satisfied with a payment of £5,000. He pointed out the great value of the system of flashing signals, and the high services rendered by Captain Colomb. Both the Admiralty and the Treasury, however, fell back on the receipt which had formerly been given, but, looking at the great development of the system of signalling which had taken place, the Admiralty proposed to the Treasury that Captain Colomb should be paid a further sum of £1,000 on account of his system of signals, and £250 for services in connection with the compilation of a manual to the general signal books. To this proposal the Treasury declined to agree, holding that the previous receipt barred all further consideration of the matter. No further progress was made until May, 1886, when Captain Colomb was compulsorily retired from the Navy and became free to take steps which he could not take while a serving officer. We cannot enter into details here, but may briefly state that in November last the Admiralty proposed to pay Admiral Colomb a further grant of £2,000 on account of his flashing signals, which he, in a very lengthy reply, giving a *résumé* of the whole subject, declined, and there the matter at present rests, although the Admiralty made a special disclaimer of any intention to undervalue either his services or the merits of his invention. It seems to us, however, that by making this last offer the Admiralty admitted the whole principle for which Admiral Colomb has been contending—namely, that some further recognition of his services was necessary. Having done this, we think that it is a comparatively simple matter to arrive at a decision as to what a fair amount should be. Possibly both the Admiralty and the Treasury felt that if they were liberal with Admiral Colomb many other claims would be made. In any further discussion on this matter, we hope that the claims of the family of Charles Babbage will not be overlooked.

THE PIG IRON WARRANTS BILL.

The second reading of the Pig Iron Warrants Bill has been postponed till the 8th inst., but, considering the fact that no fewer than ten notices of motion for its rejection stand in the order book of the House of Commons, by members who represent all parties, its chances of passing are very small. The members of the pig iron "ring" are up in arms against it, but, of course, that in itself does not prove that the Bill is bad, although it may affect their methods of doing business. The other day they were represented by a deputation, which waited on the First Lord of the Treasury and the Attorney-General, and urged that, while the professed objects of the Bill were to put down gambling speculations, its results would really be to shake the pig iron trade to its foundations, and possibly destroy the supremacy of Glasgow as its central market. We think this latter argument should have been omitted. The business of Parliament is to endeavour to allow justice to be done, without regard to the conveniences or even the interests of a very small body of men who have managed to get things pretty well into their own hands. The Attorney-General stated that he understood that the Bill was not intended to interfere with such contracts as were in ordinary use in the trade, and that if it was found that the provisions of the measure would affect such interests the Government would oppose the Bill. On the other hand, the supporters of the Bill are doing all they can to advance its progress. They have issued a statement of their views, and their answer to some of the objections which have been raised against the Bill. They state that it does not call in question the utility of warrant stores or the validity of warrants. On the contrary, it recognises the value of warrants as documents representing pig iron deposited in a public store to be delivered at any time to the holder or presenter of the warrant. The Bill is intended to prevent and to render illegal fictitious and illusory purchases, and sales of warrants where no warrants exist—what is aimed at being the pretence or practice of selling warrants which the individual who sells has not in his possession or under his control. The Bill, in their opinion, will not hinder or interfere with genuine transactions. It will not prevent contracts for future delivery of iron, neither will it prevent a consumer or buyer of iron from obtaining from a maker or merchant a binding tender or contract to supply a quantity of iron on agreed conditions. Its promoters say that the Bill is intended to encourage and facilitate genuine transactions, and to prohibit mere speculative dealings, which dealings are ostensibly in warrants, but are really gambling for differences in value. They think the sound and legitimate trade of the country is injured thereby, and the wages of the industrial classes are subjected to needless fluctuations. This is a very important subject, and it is well that it should be looked at in all its aspects.

THE PANAMA CANAL.

In view of the articles which are appearing in our columns on the Nicaragua Canal, and of the progress which is being made by that undertaking, it is well not to allow the older undertaking of Panama to be entirely lost sight of, for its completion would, of course, have a most important bearing on the other. We have often expressed our own opinions on the subject, but it is so difficult to obtain exact information regarding this great project that it is well to give careful consideration to all opinions which appear to be trustworthy, or at least deserving of attention. M. Lucien Bonaparte-Wyse has forwarded a report on the Panama Canal, and the prospects of its completion, to the official liquidator of the old company, and this will be found more encouraging reading to those interested in the concern than some of the others which have preceded it. He certainly has gone about his work in a most exhaustive manner, and with every appearance of wishing to be impartial. He gives a detailed account of the negotiations connected

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with the prolongation of the contract, but into these we need not enter. It is sufficient to note that in December last the new contract was ratified by the Columbian Government, and M. Bonaparte-Wyse hopes that this will hasten the advent of the day when the good name of France will have its revenge, and when the narrow but formidable barrier separating the Atlantic and the Pacific will be removed for the benefit of international trade. Referring to the technical and practical aspects of the work, the opinions of the engineers are quoted to the effect that the excavation could be completed in five, or at the most six, years' time. From his own observations on the spot, the author of the report again recommends the formation of a central artificial lake, approached on either side by conjoined locks with double chambers, and then discusses a great many other details connected with the work. The capital necessary for the completion of the undertaking is roughly estimated at 600,000,000fr., or £24,000,000 sterling. He hints that there may be pleasant surprises in store for those who still believe in the completion of the canal, which, in his opinion, is not so impossible as many continue to think, and he expresses the hope that it will be carried out by French hands alone.

THE LATE MR. JOHN WALKER.

The sudden death of Mr. John Walker, general manager of the North British Railway Company, has removed one of the most remarkable figures in the world of railway administration. Mr. Walker had been in London attending the House of Commons Committee which was sitting to consider the railway Bills projected by his company. On Friday last he had left the committee room with the intention of going to Ventnor till Monday. On the way to the station he became ill, and almost immediately after reaching the Waterloo Station of the London and South-Western Railway he expired in the waiting room of the station, the cause of death being an apoplectic stroke. Mr. Walker, who, when he died, was in his sixty-second year, began his connection with the North British Railway in 1862, on the amalgamation between that company and the Edinburgh, Perth, and Dundee Railway Company, in whose service Mr. Walker had spent his earlier years. Since 1874 Mr. Walker had been practical dictator of the company, for in that year he became general manager. Some years previously the company had passed through a serious crisis, having been rescued from bankruptcy by the strenuous efforts of a committee mainly composed of Glasgow gentlemen, led by the late Mr. James White, of Overtown. After this crisis had passed away Mr. Walker conceived the most ambitious designs for the future of his company, and it was mainly through his far-seeing sagacity and boldness that the company secured a practical monopoly of the coal districts in the East of Scotland and paramount control of the great route to the North. The Tay Bridge and the Forth Bridge were integral parts of his extensive schemes, and the initiation of these remarkable enterprises, as well as the large measure of financial success which they have already attained, is due for the most part to Mr. Walker. The past fifteen months have been very eventful for the North British Railway. They have seen the opening of the Forth Bridge, and its connecting lines to the north and the south of the Forth; the consequent enormous increase of traffic, the congestion of the Waverley Station and its proved incapacity for the service of the railway; the promotion of Bills in Parliament for the acquisition of an extended area for the station and its approaches; the unsuccessful Parliamentary campaign for the acquisition of the Glasgow and South-Western Railway; the opposition to the Caledonian Railway Bills for access to Edinburgh; the great strike which lasted five weeks, and cost the company upwards of a quarter of a million, involving the total loss of half a year's income to the ordinary shareholders; and, lastly, the extensive schemes for securing access to the mineral districts of Lanarkshire now before Parliament. All these events crowded into so short a time, and all of them due in a greater or lesser degree to the activity of Mr. Walker, afford evidence enough of the immense grasp of his administrative powers; but they involved a strain which has as evidently broken down an iron physique. It cannot be said that the strain of any one of these events actually hastened Mr. Walker's end, but the burden of them all, involving as some of them did successive disappointments, was fatal. The effect upon the future of the company is hard to foresee. For some years Mr. Walker has in the eyes of the trading community represented the North British Railway, and it is impossible as yet to say what changes may be rendered necessary in the policy of the company by the removal of the master mind that controlled it. Since Hudson, the English, and Hodgson, the Scottish Railway King, no single figure in railway history has stood out so prominently as that of Mr. Walker. Alike for his most single-minded loyalty to the interests of his company, and for his enthusiasm for the development of the mineral resources of Scotland, Mr. Walker will be remembered as one of the most remarkable railway men of his time.

Letters to the Editor.

ENGINEERS IN THE ROYAL NAVY.

To the Editor of "Industries."

Sir,—Your correspondent, "M.I.N.A.," who—I presume I am justified from his remarks in saying—has never served in the Navy, describes himself as "a marine engineer who is acquainted with the requirements both of the Navy and the mercantile marine," and goes on to controvert my statement.

I was very careful, never having served in the mercantile marine, not to claim full knowledge of its requirements, merely stating what my conception of it was — which statement "M.I.N.A." does not controvert—and with all due deference to "M.I.N.A.'s" description of himself, I submit that he is not acquainted with the requirements of the Royal Navy.

If "M.I.N.A.'s" remarks as to artificers, &c., refer to an ideal service in which the able seamen become captains and admirals, then I quite agree that the engineer officers may be drawn from the artificers, and perhaps also the surgeons from the sick berth attendants; into the desirability or otherwise of such an arrangement I decline to enter. But if "M.I.N.A." refers, as I did, to the naval service as at present constituted, and maintains, as I understood your article to recommend, that the ordinary workman should be the source for supplying *any appreciable number* of engineer officers to the Navy, then he does not understand naval requirements.

"M.I.N.A." introduces Mr. Bryce-Douglas's name, which I fully expected would be done. Might I suggest that Mr. Douglas commenced his career *thirty years ago*, a very palpable fact, but one which I fancy "M.I.N.A." and others have not fully grasped the meaning of. As to whether Mr. Douglas would have made a good naval engineer, I can only say that, in my opinion, he would very probably have left the service had he ever joined it.

With regard to "M.I.N.A.'s" last paragraph, does it not seem that, when the best men leave a service and young engineers will not join it, the proper remedy is to improve the conditions of that service, not to lower the qualifications required for joining it? That, at any rate, is how it appears to,

Yours, &c.,
A. E.

Portsmouth, 28th April, 1891.

THE SINKING OF THE "BLANCO ENCALADA."

To the Editor of "Industries."

Sir,—The numerous friends in this country of the Revolutionary Forces in Chili will have learned with profound regret of the loss of the ironclad "Blanco Encalada," which was blown up by a Whitehead torpedo discharged from the Government cruiser, "Almirante Lynch," in the Bay of Caldera, on the 23rd inst.

The "Blanco Encalada" was a sea-going ironclad, of about 3,500 tons, of the central battery type, designed by Sir Edward Reed, and built in Hull. After taking an important part, in company with her consort and sister ship the "Almirante Cochrane," in the late war with Peru, she returned to England in 1885 to be completely overhauled and re-armed at Elswick, taking up her station again on the South Pacific in 1887. Her new armament consisted of Armstrong breechloading guns, Hotchkiss and Nordenfelt rapid-firing guns, Whitehead torpedoes, and all the equipment of a modern ironclad. Her speed before alterations was about 10 knots, and it might probably have been increased to 12 knots. Her adversaries, the "Almirante Condell" and the "Almirante Lynch," belong to a type of vessels the immense value of which has been only too tardily recognised by our own Admiralty—torpedo cruisers of very high speed, lightly armoured, but heavily armed with rapid-firing artillery and self-acting torpedoes. These two vessels, recently built in England, set out from Valparaiso, commanded by an experienced officer, Captain Moraga, and, sailing into the Bay of Caldera, surprised the "Blanco Encalada," and struck her with a lucky (!) or unlucky torpedo, destroying the ironclad.

It appears that the "Blanco Encalada" was lying at anchor, and that the attack took place in the early morning, at a time when, by the routine of a Chilian man-of-war, it would be most fatal, one experienced officer only being on deck, while the crew would be occupied in the peaceful operations of scouring brass and holystoning. Quartermasters are often sleepy in the morning, and probably the officer may have been preoccupied in his chartroom, little expecting that two of the latest and most perfect machines of destruction produced by the naval genius of England were appearing as enemies over the horizon. Once well in view, all hope for the ironclad, moored and unprotected as she appears to have been, was lost. The two torpedo boats circled into the bay, and it is said that seven torpedoes were discharged, one of them sinking the vessel.

Torpedo warfare has probably been more extensively and more fatally practised on the West Coast of South America than anywhere else; and the Chilians and Peruvians have both proved themselves to possess, at least in attack, all the vigilance, resource, and ingenuity upon which these operations are dependent. So far as our present information goes, however, this latest incident seems to indicate nothing new excepting negligence on the part of the officers in having the ship at anchor and unprotected in the present state of affairs—if she were at all able to steam. There can be little doubt that if the vessel had been at sea, and could have chosen a duelling ground with the two cruisers, we should have had news of another tenour. Opposed to an ironclad thoroughly armed with Hotchkiss and Nordenfelt guns, and a powerful battery of artillery worked by hydraulic power, and directed and controlled by electricity, the "Almirante Lynch" and "Almirante Condell" would have required even more than the heroism of the names they bear before they could have achieved such a feat as the sinking of the "Blanco Encalada."

It would be a great mistake for speculators and others in this country to assume that by the loss of this ship the Revolutionary Forces in Chili have received a death blow. On the contrary, we may be perfectly certain that there will now be war to the knife, and that unless the Government of the autocratic President sees its way to submit themselves to the judgement of their country they will eventually have to capitulate before superior resources. There still remains with the Chilian revolutionary fleet the sister ship to the "Blanco Encalada," even more modern than the latter vessel, also a number of well-armed corvettes and—most significant of all—the protected cruiser "Esmeralda," which, swift and powerfully armed as she is, could give a very good account of any of her enemies before they could come within effective torpedo range.

There can be little doubt that we should have heard ere now of stirring incidents in connection with this ship had she not apparently been detailed off for some special service. The nature of this we can only speculate, but I have little doubt that she has gone to the Straits of Magellan to await the arrival of the new cruisers from Europe which are on their way out to succour the Government. The issue may be another practical and deadly experiment in modern naval warfare unless—and this is equally probable—the two cruisers are escorted up the coast as new allies for the revolution. In any event I think that those who know Chili best will agree with me that from the fact that the greater part of the youth, energy, and enthusiasm of the country is on the side of the revolutionists, the Government of the day will sooner or later be obliged to capitulate.

I am personally acquainted, and have been a messmate of a number of the officers whose names are now appearing in the Chilian despatches. The leaders of the naval forces, or nearly all of them, are exceedingly able and experienced sailors, and not a few have gained their experience under our own flag. The best of them are men keenly interested in South American progress, and with European ideas and European experiences. With the control of a powerful fleet it is not surprising that they resist the attempts of an unscrupulous adventurer to demoralise and override the institutions of their country.

Yours, &c.,
Alfred E. Mayor.

32, Victoria Street, London, S.W.,
30th April, 1891.

TUCKER *v.* KAYE.

To the Editor of "Industries."

Sir,—I have seen your reports of "Tucker *v.* Kaye" in your issues of the 27th ult. and the 18th inst., and I conclude from your remarks that you have by some means got a wrong impression, which I hope, in fairness to Mr. Justice Romer and myself, you will allow me to dispel.

You did not state in your report that I had a patent, but I may state that we had been making my patent automatic railway wedge lock for some time, when I got a letter from Mr. Tucker's solicitors, charging me with infringement of Tucker's patent. I got Tucker's specification, and, on examining his patent, I found that the only part which I had in my lock which Tucker had in his was old, and I had not claimed it—my firm, and also many others, having made it before Tucker's patent. I wrote Mr. Tucker, stating that I was not infringing his patent, and his solicitors replied, saying that they had received my admissions, and they issued the writ. I also sent the specifications to Lord Grimthorpe for his lordship's opinion, who wrote me, showing Tucker was wrong, as he had pointed out Tucker's principle in his book on "Clocks and Locks," about the year 1846.

You seem to think there is a value in Tucker's lock on account of having no projection at its face, but perhaps you do not know that I patented a lock in 1880 which has no projection at its face, and which will do for either hand of door, and we have been making them all the time.

The action before Mr. Justice Romer was for infringement, but Tucker had patented no projection, while I had patented the automatically wedging of a door, to prevent it rattling, and also to prevent the door handle being in the fast position if the door was open or not wedged fast.

Mr Justice Romer, no doubt, saw clearly that my main bolt, leaving the striking plate last in opening the door, and coming in contact with the striking plate first in closing the door, both increased the lasting qualities and prevented the wedge bolt being shot out and the handle being in the fast position when the door was open.

Yours, &c.,
Joseph Kaye.

Patent Lock Works, South Accommodation Road,
Leeds, 24th April, 1891.

THE ROYAL NAVAL EXHIBITION.

Since we last referred to this Exhibition great progress has been made, and, judging from a recent visit, it is not improbable that it will be quite ready for the opening ceremony, which is fixed to take place to-morrow.

At the time of our visit most of the galleries were practically finished, and some of the exhibits were in position. Water has been let into the new lake, which is a well-constructed cement-lined basin, 250ft. long, 150ft. wide, and 5ft. deep, in which will be shown in action miniature ironclads, complete with guns and machinery, torpedoes, lifeboats, &c. Amongst numerous other things of interest which will be found in the extensive grounds we may mention a North Sea trawler, which has been brought as it stands, and with some difficulty, from Yarmouth, and a full-size model of Nelson's historic ship "Victory." There is also a pavilion, in which models of the magnificent fleet of steamers owned by the P. & O. Company will be exhibited.

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The model of the Eddystone Lighthouse, which we illustrated in our issue of the 10th ult., is completed as regards the exterior. About a thousand men are at present engaged in the work of putting the Exhibition in readiness for the opening.

Altogether the authorities are to be congratulated on the progress which has been made in the work of organising what promises to be a most interesting Exhibition. We intend at a later date to refer to some of the principal exhibits in detail.

TRIAL OF H.M.S. "VULCAN."

On Thursday, the 23rd ult. the trial of the above ship took place at Spithead. Perhaps rather unusual interest attaches to this trial as the "Vulcan" occupies a unique position in the Navy, the ship which she is to supersede —viz., the "Hecla"—not having been designed especially for her present service, but being originally a merchant steamer, and adapted to her present use after having been purchased for the Navy.

The official designation of the "Vulcan" is "Torpedo Depôt Ship," but this hardly conveys a full idea of her capabilities, which would be better described by "Torpedo Boat Depôt and Floating Workshop." She is a vessel of 350ft. length by 58ft. beam, displacement 6,620 tons, carrying 6 second-class torpedo boats, 1 vidette boat, and 2 ordinary service steamboats. These boats would in action, be despatched supplied with their torpedoes, which they could replenish when required from the stock carried on board. The workshop is for the purpose of effecting any repairs necessary either in the "Vulcan's" own boats, or in those of the fleet to which she would be attached. The ship herself, although not primarily intended for fighting, has considerable powers of defence and offence, being supplied with eight 4·7in. quick-firing guns and twelve 3in. ditto; in addition she has for the discharge of torpedoes a stern tube and bow tube, and also two submerged tubes in the torpedo room. The fitting of these latter was not provided for in the original design, and has caused some delay in the trials, the ship having been otherwise ready some months ago.

In the "Hecla" the means of hoisting the boats in and out are provided by the masts and derricks, but in the "Vulcan" special arrangements are provided in two cranes, worked by hydraulic gear, by Messrs. Sir W. Armstrong & Co. These cranes are pivoted close to the side of the ship, passing through the decks between rollers, and bearing on a footstep attached to a bearer built into the bottom of the ship. Their height is 63ft., and overhang 38ft., and when not in use they are turned inboard and connected together by a link. It can be imagined that they give a somewhat strange appearance to the ship—so much so, that one might imagine that a piece of the dockyard had got out to sea. The hoisting is effected by two rams, 17½in. diameter and 10ft. stroke, having a lifting power of about 30 tons, the weight of a boat complete being about 17 tons. The cranes will be tested to hold 40 tons. For slueing, rams, 16in. diameter and 6ft. 9in. stroke, are provided. These cranes afford, of course, a much readier method of dealing with the boats than the masts and booms of the "Hecla," but they are looked upon with some distrust by naval men. In one particular there certainly seems reason for this, in that no control is provided for other than that afforded by the rams. These apply their power to the vertical post, and not far from its axis, and it is quite conceivable that in a seaway the rolling of the ship might cause the crane to give trouble. To prevent this it is proposed to fit guys to the ends of the cranes, but as they are at the side of the ship, considerable difficulty will be found in devising any guy which can check an inboard roll. The subject is, however, now under consideration.

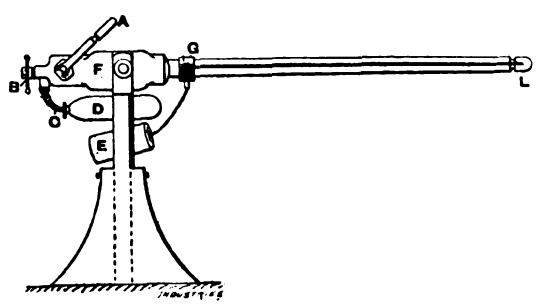
The workshop would be sufficient for quite an average size establishment on shore, containing, as it does, five lathes, two shaping and two drilling machines, slotting, shearing, and punching machines, a circular saw and bench, a blacksmith's shop, moulder's shop with hot-air furnace, and about a dozen vices, all of which, judging by the experience of the "Hecla," will be kept well employed. The workshop machinery is driven by its own engine, and it contains, in addition, a dynamo driven by one of Willans' engines. Of these there are three altogether provided, each capable of developing 400 amperes at 80 volts, at 400 revolutions, and self-regulating from 10 to 400 amperes. Messrs. Willans claim that these engines and dynamos develop an electrical horse-power for 29lb. of water per hour, which is a remarkably good result.

The main engines are by Messrs. Humphreys & Tennant, and are of the type of which they have supplied so many good examples to Her Majesty's Navy. They are triple-expansion, with cylinder diameters 40in., 59in., and 88in.; stroke, 4ft. 3in.; and were estimated to develop 12,000 i.h.p.—*i.e.*, 6,000 each set—at 100 revolutions with steam of 150lb. pressure. This result was to be obtained with forced draught of 2in. air pressure, and, with open stokeholds, 7,200 i.h.p. was to be maintained for twelve hours continuously. The manner in which modifications of the original conditions for these and other engines have been made necessary has been well discussed lately, so it will be sufficient to say that the task set in the recent trial was to obtain 8,000 i.h.p. for eight consecutive hours with not more than ½in. air pressure. The boilers are five in number—four main boilers, double-ended, each containing six furnaces, and one auxiliary boiler, single-ended, with three furnaces. The main boilers had each originally one common combustion chamber for the six furnaces, but brick partitions have now been erected, dividing the combustion chamber into six parts. The furnaces have also been shortened by bricking up the ends of the bars, so that the total grate surface of the main boilers has been reduced from 600 square feet to 488 square feet. The reasons for these alterations have been already discussed in our account of H.M.S. "Pallas"—see *Industries* of the 27th February.

The result of the trial on the 23rd ult. must, on the modified conditions, be considered satisfactory, the mean indicated horse-power obtained being 8,166, and the machinery working in a perfectly satisfactory manner. No doubt, so far as the engines are concerned, they could develop the 12,000 h.p. for four consecutive hours, as in the original contract, and for the causes which have necessitated the alteration of the boilers they cannot be held responsible. The speed obtained was 18½ knots, the engines at the time developing 8,300 h.p. A further series of trials at progressive speeds of 10, 12, 14, 16, 18, and 20 knots are taking place at the date of going to press, during the latter of which the use of forced draught will, of course, be necessary. In this case also the whole of the five boilers will be used, giving an extra 55 square feet of grate area, and after this trial the engines will, if found satisfactory on opening up, be accepted.

A PNEUMATIC LINE-THROWING GUN.

Visitors to the forthcoming Naval Exhibition will be able to see an exhibit by Commander John D'Arcy Irvine, R.N., in the Sepping Gallery, who will have on view his pneumatic gun, which is particularly intended for saving life at sea, but which can also be put to various other uses. The accompanying illustration represents a side elevation of this gun, in which A represents the firing lever, B is a screw jamb valve, C and D are a connecting tube and compressed air reservoir, E is a cop for holding the line, F is the air chamber, G is a collar upon the barrel, to which is connected the rope by means of a wire, and L is the projectile. To operate the gun it is first necessary to admit a supply of air under a pressure of 2,400lb. per square inch into the air chamber F by means of the valve B, a process which occupies only a short period of time. The valve B is then closed again, and the lever A pulled towards the operator, thereby admitting the air pressure to the



rear of the projectile, which is carried forward at a great velocity. The rear end of this projectile is tubular and externally threaded to fit a pair of gripping jaws inside the barrel, which hold the projectile against the pressure of the air until the desired moment when the aforesaid movement of the hand lever A releases the grip. The head of the projectile shown is solid, and has a transverse perforation, through which a cord is passed having its ends joined to form a rearwardly extending loop. It is found essential for the successful flight of the projectile that the pull of the line should be exerted at its rear end, and in order to achieve this the loose slide collar G is used, having attached to it the cord above referred to. This in turn is connected to the line proper.

Many opportunities for the successful use of such an apparatus will readily suggest themselves. It might be successfully applied, for instance, in cases of fire on land, for throwing a rope to the rescue of persons in the upper floors of a burning building. The apparatus, we are informed, has been put to various kinds of tests, and has given general satisfaction. The inventor is also bringing out a shoulder gun for similar purposes, but the propelling power of this is to be derived from gunpowder.

SHIPBUILDING NOTES.

On the 20th ult. there was launched from the yard of the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, a dredger, for the European Commission of the Danube. Her dimensions are:—Length, 124ft.; breadth, 28ft.; and depth, 10ft. She was named, after the President of the Commission, the "Sir William Hartley." She is furnished with the latest improvements, and will be fitted with a set of triple-expansion engines.

On the 21st ult. the s.s. "Coringa" (late P. & O. "Bangalore") went down the river for loaded speed trial over the measured mile. The old engines of the "Coringa" have been replaced by a new set supplied by Messrs. Fleming & Ferguson, engineers, Paisley, of their patent improved quadruple-expansion type, having cylinders 22in., 30in., 40in., and 60in., by 36in. stroke. At the trial the vessel carried a deadweight cargo of 3,000 tons, and drew 22ft. mean. The engines indicated 1,500 h.p. on trial, and the speed obtained was 10½ knots over the measured mile at Skelmorlie, a speed considerably in excess of contract.

On the 23rd ult. the s.s. "Pembridge," a steel screw steamer built by Messrs. Sir Raylton Dixon & Co., Middlesbrough, took her trial trip from the Tees. This vessel, which has been built to the order of Messrs. J. Temperley & Co., of London and Newcastle, is built on the web-frame principle. Her leading dimensions are:—Length, over all, 323ft. 6in.; breadth, 41ft.; depth, moulded, 23ft. 1½in., with a deadweight capacity of about 4,300 tons. Her engines have been fitted by Messrs. S. Richardson & Sons, of Hartlepool, on the triple-expansion system, with cylinders 23in., 38in., and 62in., by 42in. stroke.

On the 25th ult. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay-on-Tyne, the steel screw steamer "Cape Corrientes," of the following dimensions:—Length, 300ft.; breadth, 38ft. 8in.; depth, 23ft. 2in. amidships; and to class 100 A1 at Lloyd's. This vessel has water ballast fitted on the cellular system. The engines, which are to be supplied by the North-Eastern Marine Engineering Company, Limited, are of the triple-expansion type, having cylinders 23in., 38in., and 63in., by 42in. stroke, and working at a pressure of 150lb.

On the 25th ult. Messrs. Richardson, Duck, & Co. launched from their building yard, South Stockton-on-Tees, the steel screw steamer "Nutfield," of the following dimensions:—Length, over all, 307ft. 3in.; breadth, extreme, 40ft.; depth, moulded, 21ft. 8½in.; tonnage, gross, about 2,550 tons. This vessel, which has been built to the order of Messrs. Tyler, Bright, & Woods, Leadenhall Street, London, is classed 100 A1 at Lloyd's, and has been built under special survey. The vessel is fitted with water ballast on the cellular principle. The engines are by Messrs. Thos. Richardson & Son, of about 200 n.h.p.

On the 25th ult. Messrs. Ropner & Son launched the steel screw steamer "Phyllis," of the following dimensions, viz.:—Length, over all, 301ft.; breadth, 39ft.; depth, moulded, 21ft. 10in. The vessel has a cellular bottom for water ballast, is built on the web-frame principle, classed 100 A1 at Lloyd's, and will carry 3,600 tons. Her engines are triple-expansion, by Messrs. T. Richardson & Sons, Hartlepool, having cylinders 22in., 36in., and 59in., by 39in. stroke, with two large steel boilers working at 160lb. The steamer has been built to the order of Messrs. J. S. Allison & Co., West Hartlepool.

Reviews.

Handbook for Mechanical Engineers. By Henry Adams. Second Edition. London: E. & F. N. Spon.

In the preface to the first edition of this work, which was issued seven years ago, it was described as an effort to write out a part of the student's notes for him, in the hope that he might thereby be enabled to give more undivided attention to the illustrations and descriptions of mechanical details and operations put before him in the lectures, and was not intended in any way to supersede the ordinary text-books, but simply to supplement them. The favourable reception which was given to the work has induced the author, or, more correctly, the editor, to re-cast the whole under a new title, and to include additional matter, with the object of rendering the work still more acceptable to engineers in practice. He points out that busy men must have facts and opinions put before them briefly, and he has endeavoured to convey his information in as condensed a form as is compatible with accuracy. The work is, of course, largely a compilation, but the names of the sources from which it is extracted are always given, and these seem to have been selected with great care. All the ordinary branches of mechanical engineering are

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THE ELECTRIC LIGHTING PLANT OF THE METROPOLITAN POLICE OFFICES.

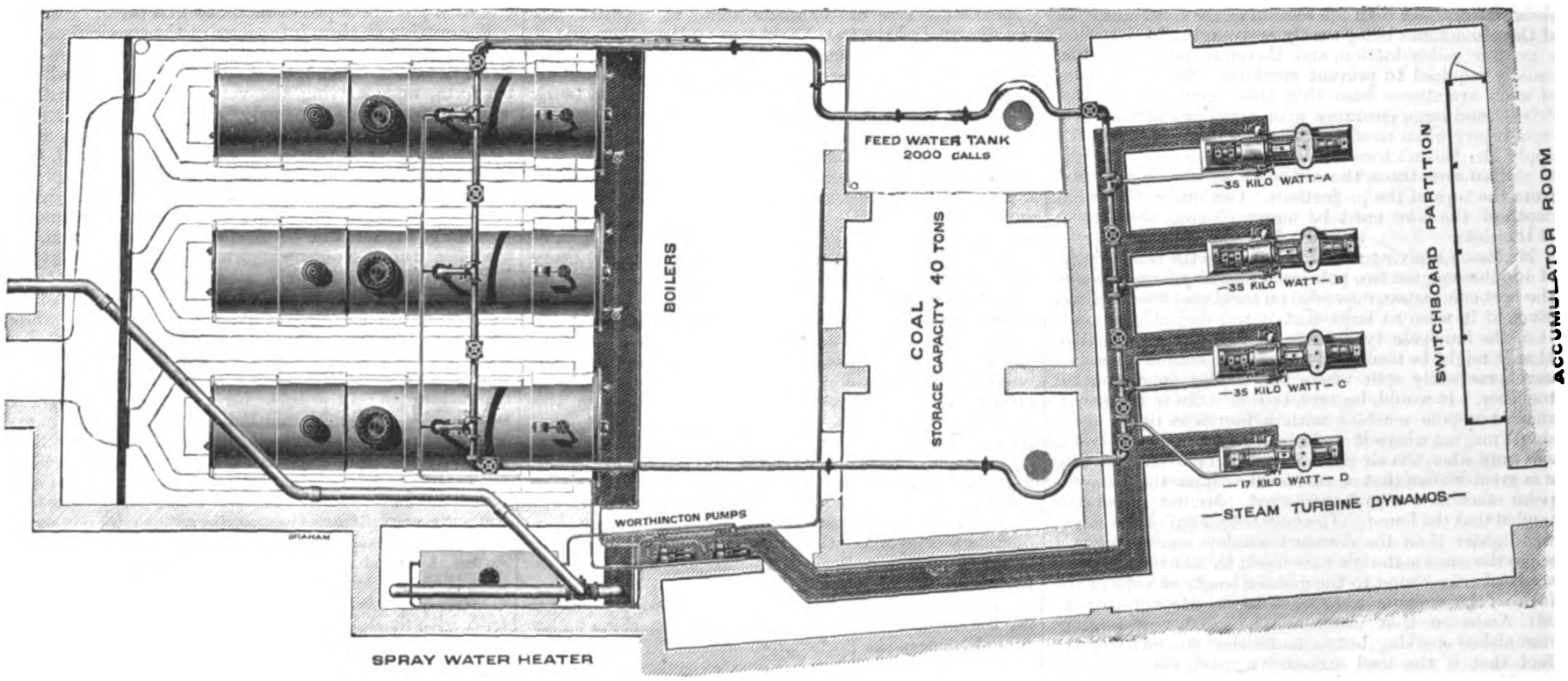


FIG. 1.—PLAN OF ENGINE ROOM.

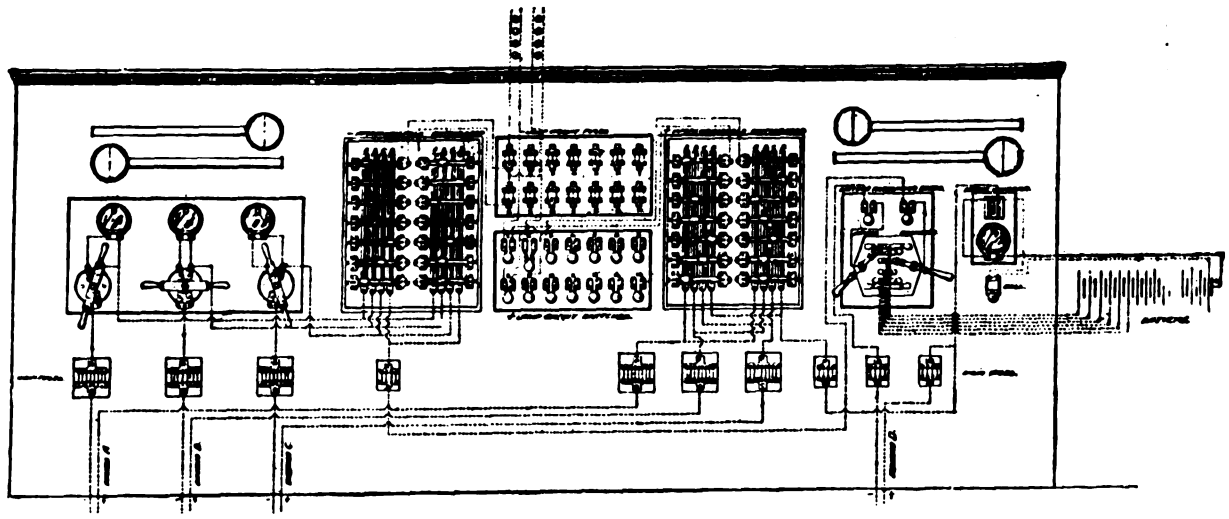


FIG. 2.—DIAGRAM OF THE SWITCH BOARD.

The engine-house has been excavated in the yard, between the main building and Whitehall, and the whole of the generating plant has been placed well away from the offices. The steam plant consists of three Lancashire boilers by Messrs. Davey, Paxman, & Co. The feed-water heater is of a special type, consisting of a tank into which the feed-water is admitted by a ball valve, the water being blown into a spray by the exhaust steam from the engines, which enters immediately under the ball valve. Worthington steam pumps are so arranged as to draw water from the feed-water heater or direct from the main feed-water tanks.

The electrical power is obtained from four of the latest radial type of Parsons steam turbines and dynamos, three of these being capable of giving an output of 35,000 watts each, and a smaller generator, giving an output of 120 amperes by 130 volts, for the charging of accumulators. The accumulators consist of 106 cells, capable of discharging at a rate of 120 amperes for nine hours for the supply of 200 lamps of 16 c.p. each. The ordinary lighting for the building is supplied direct from the steam turbine dynamos. The battery for supplying lamps at night is charged from the smaller generator during the day, and excepting cases of emergency. Every alternate lamp throughout the building is supplied from a different circuit, so that, in event of a breakdown, only half the lights would be extinguished. The generating plant also provides electrical power to the printing office, where the police reports and notices are now all printed by a machine worked by an electro-motor.

New Scotland Yard is, it is believed, the first Government office lighted entirely and exclusively with the electric light. The whole installation is now practically complete, and the new illuminant is giving general satisfaction to the occupants. The whole of the work has been carried out in the most complete way by Messrs. Drake & Gorham, under the supervision of Mr. A. Campbell-Swinton as consulting engineer.

We give above, in Figs. 1 and 2, a plan of the engine-room and a diagram of the switch board, which explain themselves.

fairly well covered, and a copious index of subjects makes the contents easily available for reference. We have much pleasure in commending it.

MANUAL TRAINING IN EDUCATION. By Professor C. M. Woodward. London: WALTER SCOTT.

This book forms one of the convenient and interesting series published by Mr. Walter Scott in the "Contemporary Science Series," and at the present time, when the subject of technical and manual instruction is being so much discussed, will be found valuable in many respects. Notwithstanding all that has been said and written on the subject of technical education, the majority of people have still a very hazy idea of either its meaning or scope. Mr. Woodward's book will be most useful in showing how a system of manual training is to be carried out, especially in those departments which will be of most use to young engineers, such as turning, carpentry, and smithing. We must confess, however, that the title of the book is rather misleading, as there are many other exercises in manual training which would be of great use to scholars of both sexes, beginning with those which are usually given in a Kindergarten school. So far, however, as he goes, Professor Woodward gives many useful hints about drawing and its relations to woodwork, and examples of the work which may be done in joinery, wood turning, pattern making, moulding, and smith work. The book, however, is not a complete text-book on these subjects, but a great part of it is taken up with discussions on the educational aspects of the question, the defective nature of the traditional curriculum, the remedies proposed, the scope of manual training and its results. The author is somewhat combative, and states what he considers the fallacies connected with manual training, and replies with vigour to criticisms which have been made on his proposals. On one point we are glad to see he is quite clear. He comes to the conclusion "that the more a shop becomes a factory the less it is a school. Instead of planning the shop to turn out merchandise, it should be planned to turn out well-trained boys. Clear-headed, intelligent boys should be the only article put upon the market."

THE ELECTRIC LIGHTING PLANT OF THE METROPOLITAN POLICE OFFICES.

THE whole of the new Metropolitan Police Offices at New Scotland Yard have been fitted with the electric light. There are about 1,100 lamps at present fixed, and the total number will eventually be about 1,250.

INSTITUTION OF ELECTRICAL ENGINEERS.

AT a meeting of this Institution on the 23rd ult. the discussion on the paper entitled "The Design of Multipolar Dynamos," by Mr. W. B. Esson, was continued.

Mr. Mordey read a communication from Mr. W. B. Sayers, in which it was pointed out that Mr. Esson had

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made no mention of slotted armatures in his paper, although many of the results contained in it could, by suitable modification, be applied to them. A mistake made by nearly all designers in considering this kind of machine was to assume that they required much less magnetising power than ordinary smooth core machines. The *sine quâ non* of a good slotted armature machine was that the sum of the areas of the teeth under a pole piece was not less than the section of the core. The coils of these machines being nearly surrounded by iron had a greater self-induction, and therefore more lead was usually required to prevent sparking. The advantages of such armatures were that they combined positive driving and large clearance with considerable immunity from injury when removed for inspection or repair. To apply Mr. Esson's formulæ for the "volume of current" to slotted armatures, the air space should be reckoned from the tops of the projections. Obviously, the radial depth of the core must be measured from the bottom of the slots.

Mr. Esson, replying, said with regard to the comparisons of a double-magnet two-pole machine with a four-pole one, the best comparison depended on the size of the machine. Even if it were so large that it was desirable to make it of the four-pole type, there was still the alternative that it might be made two-pole if the double horseshoe were practically split where the similar poles abutted together. It would, he said, be a mistake to compare a small two-pole machine with a four-pole one, since a single magnet where it could be used was better; and it was only when the air gap necessary to prevent sparking was greater than that needed for the copper that a multipolar machine was to be preferred. Mr. Kapp had contended that the four-pole Gramme field (Fig. 7 of the paper) was lighter than the double horseshoe shown in Fig. 4 when the same materials were used; this, he thought, was a mistake, for owing to the greater length of yoke in the former, the weights were as 4 to 3. He agreed with Mr. Andersen that increasing the number of sections diminished sparking, but he had wished to emphasise the fact that if the load exceeded a given value, no non-sparking position could be found for the brushes whatever the number of sections might be. He had then pointed out that in no actual machine did the load exceed half the limiting value. He entirely agreed with Mr. Crompton about the economy of material effected by making multipolar machines, for his own experience showed the saving to approach very closely the 40 per cent. mentioned by Mr. Crompton.

THE PHYSICAL SOCIETY.

At a meeting of this Society on the 17th ult., Professor W. E. Ayrton, F.R.S., President, being in the chair, a paper was read "On a Property of Magnetic Shunts," by Professor S. P. Thompson. After referring to a few instances in which magnetic shunts are employed—as, for example, the ordinary magnetic medical coil, and Trotter's constant-current dynamo—the author said that the particular property he wished to speak of was the time taken for such a shunt to lose its magnetism as compared with the other branch of the magnetic circuit. If these times were very different, unexpected results might be produced, and these might be regarded as being due to a kind of magnetic time-constants. Short pieces, as was well known, demagnetise much more rapidly than long ones, particularly if the latter form, or be part of, a closed magnetic circuit. Hence, in alternators such as Kingdon's keeper dynamo, in which both magnets and armature are stationary it was important that the revolving keepers should be short. The most important application of a magnetic shunt occurred, he said, in d'Arlincourt's relay.

Professor Perry asked if any experiments had been made to test whether throwing back actually occurred. He also inquired whether such action would be augmented or otherwise by having a thick copper tube round the yoke, or by laminating the iron.

Mr. Blakesley asked if placing a yoke across A B in the diagram shown would not improve the action.

The President said he would be glad to know whether the relay was any more sensitive than an ordinary one as regards the ampere-turns or the watts required to actuate the instrument. In India he remembered that they used inductive coils shunting the ordinary relays, in order to expedite the action and to avoid confused signals arising from the electrostatic capacity of long lines.

In reply, Professor Thompson said he had tried an experiment on a horse-shoe electromagnet, and found evidence of throwing back when working near the bend or yoke. Putting a yoke across A B would, he thought, tend to neutralise the effect desired.

Afterwards a paper on "An Alternating Current Influence Machine" was read by Mr. James Wimshurst. This machine consists of a varnished glass disc, with or without metallic sectors, mounted on an axis and rotating within a square wooden frame fixed in the plane of the disc. The frame carries four square glass plates, each of which has one corner cut away so as to clear the boss of the disc. These plates are placed one at each corner of the frame, alternately on the two sides, and the disc revolves between them. There are thus two plates on one side of the disc situated at opposite ends of a diagonal of the frame, and two on the other side of the disc at opposite ends of the other diagonal. Tinfoil sectors fixed to the outer sides of the plates act as inductors, and wire brushes connected with them touch the disc about 90 degrees behind the centre of the inductors. The peculiarity of the machine is that, although sparks can be readily obtained from it, a Leyden jar cannot be charged by bringing it to one of the terminals. From this the author concluded that the electricity produced was alternately of positive and negative sign, and this he showed to be the case by means of an electroscope. The alternations, he said, occurred about every three-fourths of a revolution, the suspended paper discs which he used as an electroscope remaining apart for that period and collapsing during the next quarter of a turn. Using discs with various numbers and sizes of sectors the author finds that the smaller the sector and the fewer the number the greater the quantity of electricity produced. Plain varnished glass is the best in this respect. Such a disc, however, does not excite itself quite so freely as one having numerous metallic sectors. By removing two of the inductors, and placing an insulating rod carrying collecting brushes at its ends across a diameter of the disc, the machine was used to produce direct currents. Numerous discs and various shaped inductors accompanied the machine, by means of which a Holtz, Voss, or ordinary influence machine could be imitated.

Professor S. P. Thompson congratulated the author on the most interesting and puzzling machine he had brought before the Society. He inquired if the machine would work if the direction of rotation was reversed or if two of the inductors were removed, and also whether all the four inductors are electrically of the same sign at the same instant.

In reply, Mr. Wimshurst said the machine would not excite if the direction of rotation be changed without also changing the direction of the brush arm, but it would work as a direct-current machine when two inductors were removed.

The next paper was "On Erecting Prisms for the Optical Lantern, and on a New Form of Erecting Prism made by Mr. Ahrens," by Professor S. P. Thompson. The ordinary form of erecting prism—viz., a right-angled isosceles one—was, the author pointed out, open to the objection that the top halves of the faces enclosing the right angle were nearly useless, for only the light which, after the first refraction, is totally reflected by the hypothenuse face, can be utilised. The fraction of the side which is useful varies with the refractive index, being ·46 when $\mu = 1{\cdot}5$, and ·525 when $\mu = 1{\cdot}65$. To increase these proportions, prisms with angles of 105 degrees and 126 degrees have been used by Wright and others, and in some cases the prisms have been truncated. With such large angles much light is lost by reflection. Bertin employed two truncated right-angled prisms placed base to base, with an air film between them. Nachet has also made erecting prisms for microscopes, in which internal reflections occur from faces inclined at an angle of 81 degrees to each other. This form of prism suggested to Mr. Ahrens the new form now shown, and which may be described as a long right-angled prism whose ends are cut off so as to be parallel to each other and inclined at 45 degrees to the hypothenuse face. The longitudinal acute angles, not being required, are truncated. Light falling parallel to the axis on one end of the prism is refracted, and after internal reflections emerges parallel, but perverted. It is claimed that this form of prism gives, weight for weight, a larger angular field than any previously made. The performance of the new form of prism, and also of the ordinary forms, was tested before the Society.

At the close of the meeting it was announced that the next meeting would be held at Cambridge on May 9th, instead of May 8th, as previously intended.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

VI.

(*Continued from page* 403.)

Stamping and Packing.—The soap bars, after standing in open pile for a day, are either packed at once in boxes, or, if not required immediately for packing, are "close piled" or packed together in solid blocks. Before placing in the boxes, the bars are usually stamped in the centre and at both ends of one face, corresponding to the three separate pounds into which the bar may be divided by the retailer, with an impression of the name of the soap and of the maker. This is done either by a small hand stamp, with which the bar is struck, or by a lever press giving the three impressions at one stroke. Many kinds of household soaps are, however, sent out in the form of moulded tablets, the bars being divided into 1lb. pieces, and each piece stamped or moulded in a press.

For cutting the bars into pieces of the required weight or size, various machines are used, the most common consisting of an upright frame placed in front of a table or platform, and carrying the vertical, stretched cutting wires, against which the bars of soap are pressed, and so divided. A number of bars are laid side by side on the platform, and the rearmost one is pushed forward, thus forcing the remainder, one after the other, through the wires. Another machine, on a similar principle, has a moveable wooden back-piece, which is worked forward by means of chain or toothed wheel gearing, and, the back-board and wire-carrying frame both being tall, there is the advantage, with this machine, of being able to cut three or four layers of bars at once. In this way, from forty to sixty bars can be cut each time the travelling back-piece is wound forward. Some time is, however, lost while drawing back the pushing board to its original position, which has to be done before a fresh supply of soap bars can be stacked on the table for cutting; but a machine supplied by Messrs. Martin Perls & Co., of London, and shown in Fig. 9, overcomes this difficulty to some extent, by the frame or gauge carrying the wires travelling backwards and forwards along the table, a row of soap bars being laid at one end of the table during the time the wires are cutting others at the other end.

One of the best machines I have seen is perhaps that in use at the Sunlight Works of Messrs. Lever Brothers, as it is simple, automatic, and capable of rapidly cutting a large quantity of soap. It consists of the ordinary table with fixed wires for cutting one layer of bars, which are pushed forward by an iron bar attached at each end to an endless chain running on rollers at each side of the table. The rollers, geared to the power shaft, are constantly kept steadily running, and the endless chain moves the pushing bar forward along the table until near the fixed cutting wires, where it falls through a slot and returns under the platform to the far end, to be again carried forward. There are two of these bars, the second appearing at the one end of the table as the first disappears through the slot at the other end, and one of these machines, working continuously in this way, will cut a large quantity of soap, the attendant merely placing the bars side by side on the table, to be pushed forward and pressed through the cutting wires by the travellers. The end of the table, where the fixed wires are placed, is

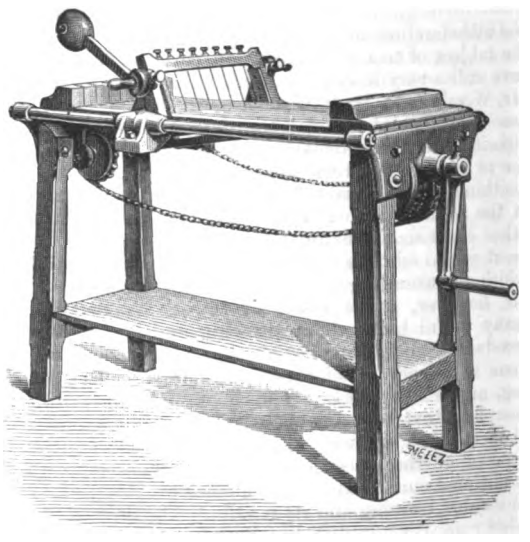


Fig. 9.

in contact with a conveyor, consisting of a pair of endless bands running on rollers and connected together by a number of flat pieces of wood about 2in. wide. The pieces of soap as they are cut are pushed on to this conveyor, and are carried by it into another room to the stamps, for compression into the required shape of tablet. These extremely useful labour-saving conveyors are largely used throughout the extensive and modern works at Port Sunlight, similar but more substantial ones, running on metal wheels, carrying the wooden boxes from the box-making machines to the packing room, and, when packed, from thence to the warehouse and to the sidings and wharfs for shipment

The stamps most commonly in use are worked by hand power, and are of various designs, the variation being generally in the method of applying the pressure. They consist essentially of two brass plates or dies, bearing in

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relief or sunk characters the impression intended to be given to the top and bottom faces of the tablet, combined with a brass ring which surrounds the soap and forms the mould in which it is compressed by the force of the blow into the desired shape. The pressure is applied generally by forcing down a lever attached to a counterbalanced wheel, the rebound of which raises the top die and ring after the stroke, and so leaves the compressed tablet free to be removed and packed. To prevent the soap from sticking to the mould and dies, they are occasionally sponged with a solution of salt. Fig. 10 is an illustration of a hand stamp made by

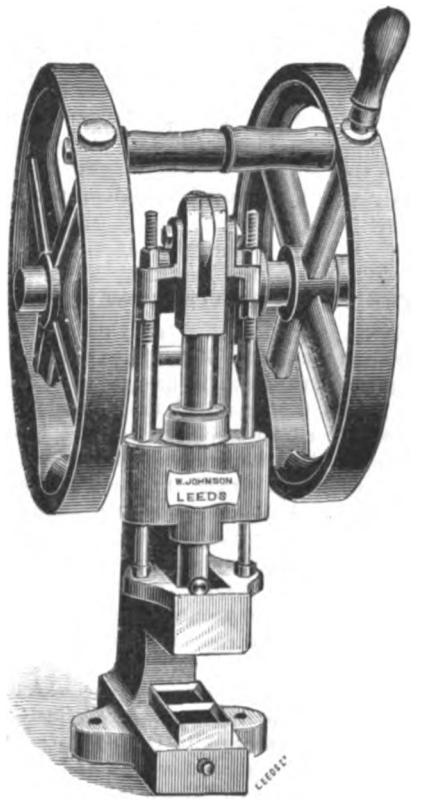


Fig. 10.

Mr. W. Johnson, of Leeds. The same maker manufactures a stamping machine to be worked by power, which is quicker than the hand machine, stamping, as it does, as many as forty tablets per minute. This is shown in Fig. 11. The cut piece of soap is placed on the table in front of the feeding arm, on the left of the illustration, which moves forward and pushes the same under the pressing head carrying the top die. The soap is then allowed to drop into the mould, which is let into the table; the press head descends with the necessary force to give the impression of the dies and mould the soap into shape, and the finished tablet is then raised to the level of the table, the act of feeding the next piece delivering it on the right of the machine, ready to be packed. In England the tablets are usually only stamped on the top and bottom faces, but in some parts of the Continent there is a demand for tablets stamped on all the six faces, and this is achieved by a special stamp, in which the dies for impressing the side and end faces of the tablet are hinged, as shown in Fig. 12, and fall back to allow the soap to be inserted or removed, but automatically close on the tablet when the down stroke is given, the ring of the mould coming down and encircling them with sufficient force to give the impressions.

The foregoing describes the general process for the manufacture of ordinary household soaps, such as "pale" or "primrose," mainly from tallow or similar fat and rosin; also brown soaps of various kinds, made from "nigre," brown tallow, palm oil, rosin, &c.; and other varieties of soap. Some of these, especially when run heavily with silicate of soda or other adulterants, are coloured slightly by the addition of aniline and other colours, to give a richer or better appearance, and several of the colours so used are objectionable on account of requiring to be dissolved in caustic soda solution before being added to the soap. A number of the better class soaps are, however, slightly tinted with perfectly harmless colours, amongst which may be mentioned chlorophyll, the green colouring matter of plants. This substance is obtained in the form of a green paste, consisting of chlorophyll ground in oil, and a weighed quantity is rubbed in a mortar with a comparatively large volume of hot cottonseed or cocoanut oil, and the whole added to the soap in the crutching machine. The amount of chlorophyll paste used, varies from $\frac{1}{8}$oz. or more down to $\frac{1}{20}$oz. per cwt. of soap, and should be added soon after the crutching pan commences to fill,

THE MANUFACTURE OF SOAP.

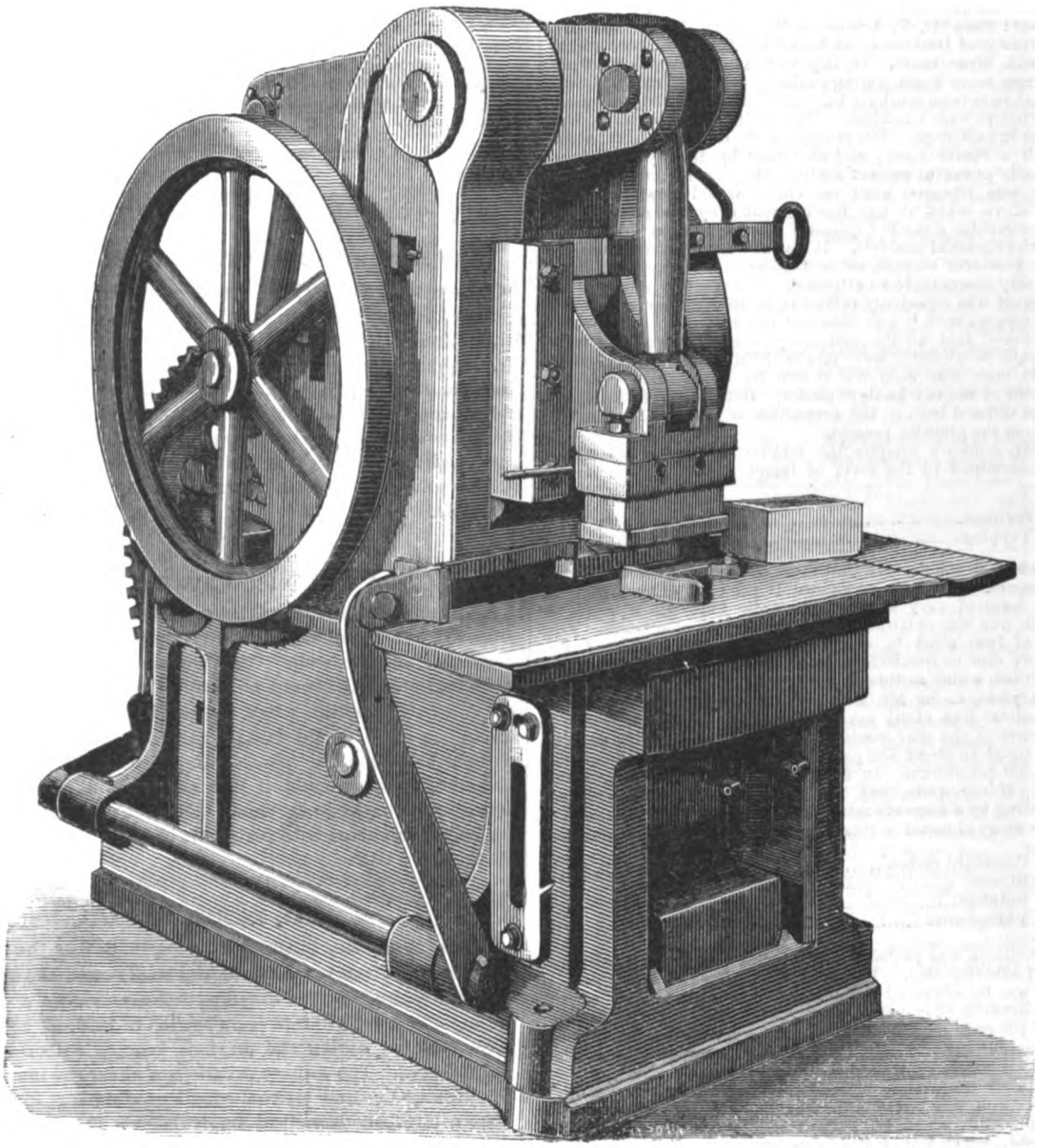


Fig. 11.—General View of Power Stamping Machine.

the mixture of chlorophyll and oil being poured, in a moderately thin stream, into the flowing soap at the orifice of the shoot, which ensures its more thorough mixing than if thrown into the crutcher in one or more separate portions. It is claimed that the addition of the small quantity of chlorophyll given above not only improves the colour of the soap, by neutralising any brownish or reddish tints, but also prevents oxidation and consequent discolouration afterwards.

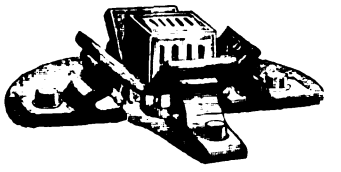


Fig. 12.

A large quantity of household and laundry soap is now made from oil, or oil mixed with a proportion of tallow and rosin, enormous quantities of cocoanut, palmnut, cottonseed, and bleached palm oil being used. The oil soaps have usually a darker, browner, and more transparent appearance than those made from tallow alone, and are apt to become darker and more discoloured by oxidation, on exposure to air; but, at the same time, they have several important advantages. They lather with facility, and the bars do not "dry in" or shrink, and consequently lose their shapes, to anything like the same extent as tallow soaps. The amount of water of constitution is, in oil soaps, greater than in tallow soaps, and, probably on this account, fitted soaps of the former class cannot be run, to any great extent, with silicate or other solution.

(To be continued.)

VARIETIES OF TAP CINDER.*

In the discussion which followed the reading of Mr. Holgate's paper before this Institute, more than a year ago, reference was made to the fact that tap cinder which boils out of the puddling furnace during the working of the charge is much more lively in the tapping waggon than the cinder which is tapped out at the end of the process, and while the latter evolves little or no gas, the former gives off considerable quantities of a combustible gas which burns in jets at the surface of the molten cinder. As some doubt was expressed as to the causes of this difference in behaviour, I asked some of my friends who are connected with the local iron trade to supply me with samples for examination, and venture to-night to bring before you some of the results of the inquiry. I am sorry that circumstances should have prevented my dealing with the matter before.

The physical properties of tap cinder vary considerably with the quality of iron used, the fettling employed, the temperature and rate of cooling, and other circumstances; but in spite of these variations it will be noticed that the two kinds of cinder, namely, "boilings" and "tappings," each possess characteristic appearances which render them easily distinguishable. Thus, while the boilings are usually more or less hollow, possessing a honeycombed or vesicular structure, frequently showing bright crystalline faces, and being more readily fractured by a blow, the tappings, on the other hand, are usually compact, heavy, and strong, requiring more force to cause fracture, and showing much less porosity than is seen in the boilings. Both the total and the relative weight of the two kinds of cinder vary considerably according to circumstances. Mr. A. E. Barrows, of Bloomfield, has been good enough to take the weights of iron used and of cinder obtained in producing best iron, and his results are as follow:—

Weight Charges.			Boilings.			Tappings.			Yield.		
Cwt.	Qs.	Lbs.	Cwt.	Qs.	Lbs.	Cwt.	Qs.	Lbs.	Cwt.	Qs.	Lbs.
4	1	18	1	1	0	1	1	0	4	2	14
4	1	18	1	0	0	1	1	12	4	2	14
4	1	18	1	0	20	1	2	0	4	2	7

These figures show that the boilings and tappings produced were of nearly equal weight, and each was in round numbers one-fourth of the yield.

* Paper read by Mr. Thomas Turner before the South Staffordshire Institute of Iron and Steel Works' Managers on the 11th ult.

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In working common iron for sheets the weight of boilings and tappings was also about equal. On the other hand, Mr. Yeomans informs me that at Old Hill he frequently boils out nearly the whole of his cinder, leaving no more in the furnace than can with advantage be used in the subsequent heat. For my experiments I obtained samples of boilings and tappings, both taken from the same heat: from Mr. T. Ashton, of Netherton, three heats; Mr. R. M. Tolley, of Darlaston, one heat; and Mr. A. E. Barrows, of Bloomfield, three heats. In this way, as the samples were obtained from seven heats, during ordinary working, with different irons and in several works it was considered that fairly representative cinders were examined. The method of procedure was the same in each case. The samples were broken up and passed through a coarse sieve, and examined by the eye and by a moderately powerful magnet for globules of iron; crushing and sieving was repeated until the cinder would pass through a No. 40 sieve, when it was finally treated by the magnet, and from the residue a smaller quantity was very finely ground for use in the chemical analysis. It was not found advisable to use a very powerful magnet, as in that case the slag was itself sufficiently magnetic to be attracted. The portion attracted by the magnet was repeatedly rubbed in an iron mortar and sorted with a magnet until it was obtained free from slag. It was at once noticed that all the boilings yielded globules of metallic iron, while no globules were met with in any of the tappings. Here at once was seen the reason for the difference in the behaviour of the two kinds of cinder. But the three samples of boilings differed both in the proportion of metallic iron and in the size of the globules present.

In Mr. Ashton's samples the relative density of the cinder was determined in the form of lumps at 17° C., the results being—

Boilings	3·71
Tappings	3·75

from which it will be seen that there was no great difference in this respect. The boilings yielded 16 per cent. of metallic iron, in the form of very small shots, while from the tappings no metallic iron was obtained, as I have before mentioned. This yield of iron must be considered abnormally high, and was probably due to insufficient heat during the beginning of the boil. Such a slag as this, if we assume it to weigh one-fourth of the yield, as in Mr. Barrows' experiments, would mean a preventible loss of 3½ per cent. of puddled bar, and this in the course of the year would entail a very considerable amount, being equal to about £50 per week on 300 tons of puddled bar, or £2,500 per annum. In fact, I believe that this slag would nearly, if not quite, pay for the expense of crushing and separating by a magneto machine to recover the metallic iron.

The shots of metal in this case were analysed and contained—

Combined carbon	·88	per cent.
Silicon	·57	,,
Sulphur	·05	,,
Phosphorus	·55	,,

The silicon was probably due in great part to the small quantity of adhering slag. The rest of the analysis shows that the metal was far advanced in the series of changes which occur in the conversion of cast iron into wrought iron, and the presence of ·88 per cent. of carbon sufficiently explains the formation of combustible gas (carbonic oxide) in the tapping waggon, where the metal was in contact with a molten oxidising slag.

Mr. Barrows' sample of boilings yielded only 3 per cent. of metallic iron, which was in the form of larger globules than in the previous case, while Mr. Tolley's boilings only contained 2 per per cent., which was in still larger shots. It appears, therefore, that the greatest loss is noticed when the iron boils over in the slag in the state of comparatively fine division, in which form also it is probably less likely to attract attention. I question whether this loss can be much reduced by the use of the tapping bar as a skimmer during the boiling over, and other similar means; but I am inclined to think that the presence of a perfectly fluid cinder assists the iron to subside more readily, and thus tends to prevent loss.

The various samples of cinder have been analysed, and I hope shortly to have an opportunity of discussing the relative economy of these slags, but it will be sufficient now to say that in my opinion Mr. Ashton's cinder was (apart from the loss of iron above mentioned, and which is unnecessary) considerably more economical than either of the others, while Mr. Barrows' was the purest and most extravagant of the three examined.

In connection with such observations it must, of course, be remembered that in some cases it may be necessary to waste fettling in order to obtain a special quality of iron. The composition of the two kinds of cinder when freed from shots of metal shown by the mean obtained from the seven heats was as follows:—

	Boilings.	Tappings.
Ferric oxide (Fe_2O_3)	6·94	12·90
Ferrous oxide (FeO)	62·61	64·62
Silica (SiO_2)	19·45	15·47
Phosphoric anhydride (P_2O_5)	6·32	3·91
Not estimated (Al_2O_3,MnO,S,&c.)	4·68	3·10
	100·00	100·00

These figures show that the boilings are distinctly more impure than the tappings. The quantity of ferric oxide, which is the most active oxidising agent, is lower in the boilings, and this points to considerable chemical action during the early part of the process. The amount of silica is higher in the boilings, and this is due to the well-known fact that silicon is eliminated very early in puddling. The proportion of phosphorus is also greater in the boilings, and this points to a fact that is, I think, not sufficiently appreciated—namely, that the greater part of the phosphorus is oxidised before the boil commences. These analyses, I think, further show that (since it is necessary to have a certain quantity of slag in order to remove the impurities present, and since, in order to produce a good iron, it is necessary to have a fairly pure tapping cinder) for economical puddling it is necessary to boil away a considerable quantity of the first impure cinder so as to be able to obtain a pure tapping cinder with the use of the smallest possible quantity of fettling. The importance of a high temperature is well known to skilful puddlers, and has been illustrated in these experiments.

I have on previous occasions expressed the opinion that the chemical composition and fluidity of the cinder is of the greatest practical importance in puddling, and at present I believe that one of the readiest and most practicable methods of judging of the economical working of the puddling furnace is to be found by paying attention to the weights and composition of the tappings and boilings. Tap cinder is the puddlers' waste product, and in these days, when waste products are being utilised in all directions, it is certainly of the greatest moment to the ironmaster that his tap cinder should be as small in quantity, and as highly charged with impurities, as is consistent with excellence of manufacture.

Notes.

COMPOUND LOCOMOTIVES IN RUSSIA.

In *Industries*, Vol. VIII., page 169, we published a paper read before the Institution of Mechanical Engineers by Mr. T. Urquhart on the above subject. We now learn from Mr. Urquhart that, out of 143 locomotives on the Grazi and Tsaritsin Railway, South-East Russia, 32 have now been compounded. These compound locomotives, which consist of three classes, all burning petroleum fuel, have made a total mileage of over one million miles since their conversion, and show a mean economy of liquid fuel of 18½ per cent.

A NEW DISINCRUSTANT.

A novelty in the ranks of boiler disincrustants has been proposed, which, unlike many of the nostrums of the kind, is at least fairly rational. The suggestion is made that a bottle of liquid CO_2 should be coupled to the boiler while the latter still contains water, the idea being that the water would become saturated with the gas and dissolve the scale without attacking the plates. Ingenious as the notion undoubtedly is, we doubt if it would work, as the solvent action would be decidedly slow. Moreover, it would only do for boilers incrusted with carbonate of lime or magnesia.

COAL IN RUSSIA.

The coal industry in the Donetz Basin during the past year has not given very satisfactory results, and the quantity transported by the different railways shows a great falling off; 1,863,170 tons were carried in 1890, as against 2,000,705 tons during the previous year, or a decrease of 137,535 tons. The colliery proprietors, under the influence of the large demand for coal experienced during 1888 and part of 1889, made radical improvements in their mines, greatly enlarging the same, and increasing their productive capabilities; but during the past year they have had to gradually retrench, and this year the output will most probably reach its normal figure. The heavy duty on foreign coal and the opening of the port at Marinpol have greatly assisted in developing the export of Donetz coal to the Black Sea ports, at which, during the past year, there is a falling off of nearly 100,000 tons in the quantity of English coal imported.

SLIDE RULE FOR ELECTRIC "WIRING" PURPOSES.

Messrs. Crompton & Co. have sent us an extremely neat slide rule for calculating out everything that has to be known in "wiring." It is the invention of Mr. A. P. Trotter, and is an ingenious combination of three logarithmic or slide-rule scales so arranged that, given, for instance, the number of lamps, say 47, of, say 67 watts each, and the pressure, say 93 volts, and the drop, say 1·5 volts, the mains being, for example, 90 yards long, one can find at once that 7/12 or 19/17 cable should be used. This calculation may be done without the observer having to study simple arithmetic. The little rule also calculates curr ent densities, resistances, maximum current densities, sectional areas, &c., with equal promptitude and accuracy. We hope Mr. Trotter will now turn his attention to a waistcoat-pocket rule for reading directly the most economical mains for a municipal network, the windings of dynamos and transformers, speed of cabling, &c.

NOVEL WEIGHING MACHINE.

Mr. Joce Soler, of Barcelona, has lately invented a novel form of weighing machine, which we recently inspected at the British Travels Agency Company's office, 13, Victoria Street, London, S.W. The machine is designed to weigh either large or small articles, two scale pans, one large and the other small, being provided, the small one weighing one-thousandth part of the other. If a light article is to be weighed, it is placed in the small scale pan and counterpoised by large weights in the large scale pan. If the weight of a heavy article is required, it is placed in the large scale pan and equipoised by a sliding weight on a compound steel-yard. In addition, the weighing machine is provided with a third scale pan, to give or check the price of the article being weighed. The upper edge of the steel-yard is engraved to show various weights, and the lower edge is graduated for money. The rate per kilogramme being known, the money scale pan is moved along the steel-yard to the proper division for the given rate; money in coins is now put into the scale pan until it balances the article to be priced; the amount of money thus put in is the price of the article. An adjustable balance weight counterbalances the weight of the money scale pan. The machine we inspected, although arranged for the metric system of weights and measures, can be adapted to the British system without much difficulty.

THE UNITED STATES POST OFFICE.

Few persons, except those directly connected with the postal service in the United States, have a fair conception of the magnitude to which it has grown within the last few years. From the Report of the United States Postmaster-General for 1890, we learn that the United States leads all the world in the number of miles of railway postal routes. The combined length of the railway postal routes of the country is 144,557 miles, while the transportation of mails on those routes last year reached the enormous total of 186,575,384 miles. Germany comes next with a total length of 24,522 miles and a total transportation of 89,267,000 miles. But the railways by no means carry all the mails in the United States. The Star route and steamboat service have a length of 251,792 miles, with a transportation annually of over 12,000,000 miles. To carry on successfully this immense service requires the work of over 90,000 persons. The postal correspondence of the United States with foreign countries falls but a little below that of Germany, which leads the lists of nations. Ninety millions of pieces were despatched by the United States to foreign countries during the year 1890. When it is known that of the 90,000,000 pieces forwarded, fully 70,000,000 were carried by vessels of foreign register, the anxiety for some measure by which American mails can be carried by American vessels will be readily understood.

POSTAL RATES TO THE COLONIES AND BRITISH INDIA.

An interesting correspondence has recently taken place between Messrs. Maconochie Brothers, Lowestoft, and the Postmaster-General respecting the reduction of the postal rates to the Colonies and British India, This firm states that they are able to effect a large saving in postage by sending their price lists and circulars to Antwerp for transmission to India and Australia. The rates from the Continent to India for printed matter not exceeding 50 grammes (nearly 2oz.) is 5 centimes, or ½d., and to Australia, New Zealand, and other parts of the world 1d., whereas the rates from England to those places are 1½d. and 2d. respectively. The saving of postage on the sending of 20,000 circulars by despatching them from the Continent has been estimated at about £100. The new postal rates, which came into force on the 1st of January last, apply only to letters, and it is suggested that British firms should be allowed to send circulars from England to other parts of the Empire at rates as low as those available to competing foreign firms. A uniform ocean postage of ½d. for 2oz. of printed matter to the whole of the Empire would enable British firms to send their circulars direct from England. It is also stated that some firms send their letters in bulk to any one colony, to be afterwards distributed in that colony at a cost of 1d. for each letter. If a uniform "ocean postage" for letters of 1d. per ½oz. to all parts of the Empire were adopted the whole of this correspondence would be sent direct from England. The postal authorities state that the question of transit rates on trade circulars is to be discussed at the Postal Congress, which is to be held at Vienna this month, but that no immediate reduction can be made on the present postage rates. It is much to be wished that the discussion at the Postal Congress will render possible such a reduction as will give British firms facilities equal to those enjoyed by foreign firms for the transmission of printed circulars.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

18th April, 1891.

6256. Bow, W. ..... Riveting apparatus.
6263. Haddon & Clayton ..... Grate bars and apparatus connected with steam boiler furnaces.
6267. Monks & Bush ..... Movable signals on engines or trains.
6277. Stopford, T. R. ..... Apparatus for consuming smoke in stationary steam boiler flues.
6279. Pallister, E. A. ..... Apparatus for feeding letter-press printing machines.
6296. Lake, W. R. ..... Apparatus for burning liquid fuel (*The Stickney Oil Burner Company*).
6302. Stehlik, A. ..... Apparatus for moistening air.
6304. Barstow, Shaw, Crone, Jun., Taylor, & Shaw Boiler furnaces.
6812. Lloyd, R. S. (of the Firm of Hayward, Tyler, & Co.). ..... High pressure cocks or valves.
6320. Wirth, J. ..... Propelling apparatus for vessels.
6322. Stevens, N. P. ..... Plug and socket cutters and chucks for same. (22nd September, 1890.)
6324. Sébillot, A. M. G. ..... Ship railways.

14th April, 1891.

6334. Martignoni, J. ..... Tools for cutting, drilling, and grooving metals.
6338. Jackson & Hoad ..... Hydrostatic weighing machines, weighbridges, and the like.
6348. Crabtree, J. ..... Sand moulding machines.
6352. Williams, J. ..... A steam wheel as a motor to drive machinery.
6353. Brewer, W. J. ..... Antifriction bearing wheels for revolving axles.
6360. Shaw & Harcourt ..... Coils employed in clutches, brakes, and the like.
6362. Carter, J. E. ..... Nut and set screw turning lathes.
6365. Gass, W. G. ..... Single-acting steam engines.
6368. Boult, A. J. ..... Air brake and signalling apparatus for railway trains (*Mason*).
6369. Thompson, W. P. ..... Horseshoe machines (*Carrington, Morris, & Bucklin*).
6375. Megill, E. L. ..... Gripper fingers for platen printing presses.
6390. Johnson, A. ..... Apparatus for communicating motion eccentrically for tool-holder for lathes, &c.
6392. Lunkenheimer, E. ..... Straight way valves.
6393. Lawrence & Ranyard... Method of examining and recording the condition of steam boilers and removing scale and sediment therefrom.
6406. Clark, A. M. ..... Mechanism for threading wires through pipes or tubes (*Wessel & Giese*).
6408. Boggett, W. ..... Means for heating water to a high temperature for producing steam.
6410. Day, J. ..... Gas engines.

15th April, 1891.

6423. Andrew, W. ..... Boilers used in the manufacture of paper pulp.
6429. Hartley, J. W. ..... Cold sawing machines.
6432. Stopford, Kilroe, Wallbank, & Johnson..... ..... Smoke consumer for locomotive and other boilers.
6434. Madeley, F. ..... Manufacture of cased tubing.
6435. Wilson, T. W. ..... Jacquard machines.
6436. Thompson, J. A..... A method of condensing steam or other fluids.
6437. Schofield & Ashworth Carding engines.
6439. Sykes, T. ..... Fuel economisers.
6451. Holbrook, W. ..... Disintegrators.
6457. Vosper, C. W. ..... Method for working multiple spindles for various purposes.
6478. Tillcock & Conning ... Oval and circular cutting machine.
6482. Bonne, C. R. ..... Dredging apparatus (*Lentz*).
6483. Von Kiester, A. ..... Pumps.
6490. Ritter, A. B. ..... The manufacture of bolts and rivets.
6497. Riemer, J. ..... Apparatus for rolling tubes, tubular rods, and cylinders.
6503. Lüthy, O ..... Shuttle-driving mechanisms.

16th April, 1891.

6507. Rymer-Jones & Westray Apparatus for heating air previous to its being forced through the furnaces of steam boilers.
6510. Sanderson & Hood ..... Feeding steam boilers.
6511. Hartcliffe, W. ..... Full way valves or stopcocks.
6520. Brown, A. F. G. ..... Sight feed lubricators.
6528. Common, A. A. ..... Method of and apparatus for determining the time of flight of projectiles.
6530. Shaw, E. A. ..... Apparatus for pulverising minerals.
6535. Weston, R. ..... Railway signalling.
6541. McNaughton, J. A. ..... Air and vapour engines.
6547. Wood, J. ..... Gas regulator or governor.
6573. Pochin, W. ..... Rotary motors and pumps.
6574. Bousfield, J. E. ..... Apparatus for indicating the names of stations in railway carriages (*Schlösser*).
6578. Barclay, A. ..... Gas engines.
6596. Gehre, M. ..... Multitubular steam boilers.

17th April, 1891.

6598. Ridealgh & Welford ... Gas or vapour engines.
6600. Green, S. ..... Carding engines.
6601. Smith & Smith ..... Apparatus for washing and scouring wool and other fibres.
6605. Smith & Drysdale ..... Machine for bending chain links.
6608. Slade, E. A. ..... The propulsion of closed buoys or tubular boats or rafts by hand power.
6615. Green, F. S. ..... Igniter tubes for gas engines.
6620. Eynon & Seaman ..... Manufacture of piles or billets for rolling mills. (29th September, 1890.)
6622. Soulerin, L. ..... Railway brakes worked by fluid pressure.
6643. Barker & Woodcock ... Apparatus for the production of gas and hot air for marine boiler and other furnaces.

18th April, 1891.

6669. Miller, I. T. ..... Rock drill.
6671. Gildemeister, F. ..... Drilling machines.
6673. Thomas, F. ..... Screw propellers of steamships.
6675. Thompson, J. ..... Slubbing intermediate and roving frames.
6678. Horrocks, J. ..... Combined safety and anti-vacuum valve.
6686. McArthur, A. ..... Steam boiler and other furnaces.
6696. Covert, D'E. S. ..... Alarm for steam generators (*Ashley*).
6702. Whiteley, J. ..... Cotton spinning machines.
6703. Syddall, S. ..... Adjustable travelling clearer roller for spinning machinery.
6717. Abel, C. D. ..... Apparatus for supplying oil and other liquids under a constant pressure (*The Gas Motoren Fabrik Deutz*).
6718. Casciaro, A. M. ..... Apparatus for registering the number of passengers and distance travelled by same in vehicles.
6726. Petit, C. ..... Cocks or valves.
6727. Van Rennes, D. W. ..... Petroleum engines.
6734. Weston, R. ..... Railway signalling.

ELECTRICITY.

13th April, 1891.

6276. Blanchard, G. W. ..... Electric locking devices for the gear wheels of motors of electric cars.
6292. Miller, H. W. ..... Electrical insulator.
6298. Wodicka, J. ..... Armatures of dynamo electric machines.

14th April, 1891.

6347. Tugwell & Mitchell ... Alternating current transformers.
6378. Van Depoele, C. J. ..... Electric motors.
6402. Collier, A. T. ..... Microphonic or telephonic transmitters.

15th April, 1891.

6485. Gravier, A. I. ..... Dynamo-electric and electro-dynamic machines.

16th April, 1891.

6517. Dorman & Smith ..... Electric light switches.

17th April, 1891.

6633. Teague, F. ..... Electric meters.
6660. De Ferranti, S. Z. ..... Distribution of electrical energy.

18th April, 1891.

6730. Mordey, W. M. ..... Dynamo-electric machines.

CHEMISTRY.

13th April, 1891.

6268. Dawson & Hirsch ..... Raw materials for production of colouring matters.

14th April, 1891.

6376. Brooke, Simpson, & Spiller, Ld., & Green The production of new bases and of azo-colouring matters therefrom.
6387. Heyes, W. ..... Apparatus for concentrating acids and other liquids.

15th April, 1891.

6415. D'Andria, M. N. ..... Utilising waste acid residues from the "pickling" of iron.
6479. Rickard, W. T. ..... The mechanical and chemico-metallurgical treatment of copper and other ores.
6500. Kolb, J. ..... Production of chlorine.
6502. Von der Poppenburg, J. Galvanic batteries.

16th April, 1891.

6509. Wilson & Harvey ..... Manufacture of ferric chloride from waste pickle.

MISCELLANEOUS.

18th April, 1891.

6253. Warneford & Turner Locking nuts on bolts.
6288. Gummer & Gummer ..... Tap valves.
6303. Darby, J. H. ..... Manufacture of steel.
6323. Taussig, E. ..... Apparatus for smelting and casting.
6326. Bousfield, J. E. ..... Locks (*Piddington*).

14th April, 1891.

6350. Mansfield, L. ..... Means for preventing loosening of the keys or wedges in the chairs of railway rails.
6377. Eyre, C. J. ..... A new motive power.
6380. Brewer & King ..... Axle lubricators.
6395. Jones, F. G. ..... Joint for soil and like pipes.
6399. Bauer, F. ..... Glands for stuffing boxes.
6400. Bowring, H. E. ..... Boats' davits.
6411. Baumotte, H. ..... Manufacture of chisel and other like cutting tools.

15th April, 1891.

6414. Phillips, H. L. ..... The manufacture of spanners or wrenches.
6430. Rayner, J. ..... Safety lamps.
6464. Munns, W. H. ..... Vehicle wheel (*Jeffery*).
6466. Munns, W. H. ..... Wrench (*Perault*).

16th April, 1891.

6529. Day, J. M. ..... Bolts and nuts with locking device.
6548. Wood & Brookfield ... Motive power.
6564. Liardet & Liardet ..... Chain shackles and lowering hooks and tackles.
6579. Hill, E. J. ..... Boat lowering tackle.
6588. Miller, E. C. .... Loose pulley lubricators (*Miller*).
6590. Walsh, T. H. ..... Car couplers. (25th September 1890.)

17th April, 1891.

6631. Ruthven-Murray, E. T Ratchet braces.
6632. Boutcher, A. G. ..... Socket or collar for stoneware drain pipes, traps, gullies, &c.
6645. Wilton & Wilton..... Furnaces.
6658. Johnson, J. Y. ..... Lubricators (*Plisson*).

18th April, 1891.

6683. White, R. J. ..... The manufacture of white lead.
6737. Billups, J. E. ..... Permanent way for railways and tramways.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

2202. Westwood & Butler.
4226. Peyton.
5560. Whitehouse.
5616. Fraser.
5781. Keller & Keller.
5917. Mackie.
6083. Gordon.
6238. Pallister.
6285. Turner, Bayliff, & Bayliff.
6557. Oertel.
6644. Johnston & Johnston.
6726. Von Hefner-Altenbeck.
7058. Johnson (*Marx & Weller*).
7215. Allport.
7372. Brockas & Irving.
7491. Birch.
7614. Hogg.
7659A. Rutter. (16th May, 1890.)
7791. Brining & Lister.
7842. Hines, Howell, & Howell.
7981. Sechehaye.
8179. Ogez.
8209. Townson.
8448. Wilson & Pirrie.
8528. Mills (*Johnson*).
8548. Kent.
8682. Calvert.
8711. Millar.
8719. The Tubular Lock Syndicate, Ld., & Biggs.
8959. Thomson.
9071. Winter.
9082. Cherry, Cherry, & Dixon.
9114. Thompson.
9128. Topley.
2901. Jones.
4330. Cummings & Peate.
5615. Whitehouse.
5623. Nelson.
5801. Corrigall.
6044. Lord.
6089. Eckersley, Calvert, & Tipping.
6300. Morley & Pletts.
6433. Davis & Davis.
6588. Fombuena.
6652. Key.
6734. Brewster.
7121. Ruffles.
7167. Morison.
7362. Tomlinson & Heppell.
7453. Green, Cross, & Bevan.
7514. Ambler.
7621. Heys (*Sourmais*).
7696. Mackay.
7700. Gorse & Gorse.
7800. Buchanan & Damaris.
7882. Clarke.
7940. Edgelow.
8166. Fenlon.
8194. Sinnette.
8339. Hook.
8454. Williams & Symons.
8535. Pitt (*Jerzmanowski*).
8681. Plimsoll.
8707. Von Langer & Cooper.
8718. The Tubular Lock Syndicate, Ld., & Biggs.
8865. Jones.
9006. Webb.
9080. Dawson & Hirsch.
9092. Tozer & Stanton.
9098. Miller.
9122. Ashley.
9131. Renouf.

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9179. Bruno.
9182. Western.
9186. Grimes.
9192. Pink.
9250. Simpson.
9361. Willson.
9299. Fowler, Benstead, & Oglesby.
9320. Travers.
9335. Wall.
9352. Young.
9381. Holt.
9431. Barker.
9455. Mallett.
9504. Phillips.
9537. Johnson (*Badische Anilin & Soda Fabrik*).
9646. Petzold.
9961. Booth.
10701. Currie.
10488. Lord.
11445. Leavesley & North.
11885. Vernon.
12104. Macdonald & Dodd.
12760. Stallaert.
14827. Field.
15011. Clark (*Middleton*).
15282. Alpe.
16452. Simmonds.
17388. Lees.
18180. Forbes.
18513. Bromley.
19135. William Blake, Henry Blake, John Alexander Bartholomew, & William Edward Walmsley.
20882. Scott.
20911. Mitton.

1891.

251. Hinsdale.
464. Thinnes. (14th August, 1890.)
1248. Peacock.
2291. Hofer.
2857. Fish.
2410. Wyman.
2457. Hopper. (14th October, 1890.)
2782. Newman.
2825. Stover.
2906. Clowes.
2970. Thompson (*La Société Coignet et Cie.*).
3140. Barber.
3159. Bertschinger.
3263. Durand, Huguenin, & D'Andiran-Koechlin.
3577. Martin.
3650. Pope.
3721. Hyde.
3746. De Pezzer.
3790. Berry & McDaniel.
3936. Walker.
4030. Anderson & Pollock.
4165. Lindemann.
4187. Tièrte.
4245. Dale & Hatt.
4267. Titus.
4275. Lake (*Stiebel*).
4292. The Brins Oxygen Company, Ld., & Murray.
4399. Mohr.
4445. Greenfield.
4470. Morris.
4490. Bird.
4499. Oppenheimer (*Actiengesellschaft Mix & Genest*).
4594. Garrow.
4638. Cooper.
4693. Sankey.
4728. Brown (*Tabor*).
4751. Imray (*Wheeler & Bradley*).
4762. Newton (*Trevor-Jones*).
4765. Simonson.
4799. Thompson (*Altham*).
4864. Rooswall.
9181. The Lucigen Light Company, Ld., & Jarmain.
9237. Lane.
9258. Imray (*Koch*).
9276. Austin.
9303. Davis.
9304. Brigg.
9334. Bachem.
9337. Fawcett.
9353. Seyfried.
9392. Lake (*Farmer*).
9441. Schlund.
9469. Afzelius.
9530. Imray (*Farbwerke vormals, Meister, Lucius & Brüning*).
9874. Bergmann.
10108. Taylor.
10342. Coomer.
11064. Lake (*Bottsford*).
11546. Read.
12029. Boult (*Fondu*).
12159. Abbott & Abbott.
13062. Herbert Cooke, Le Neveu, & George Rate.
15274. Bright & Engelbach.
16776. Paterson.
17892. Winder, Norman, & Simpson.
18550. Gehre.
19412. Hill.
19803. Smith.
20188. Lowinsky.
20602. Bonne (*Heinsdorf*).
20716. Claridge & Middleton.

457. Legavre.
670. Myers & Wells.
971. Thwaite.
2178. Davies.
2338. Brain.
2404. Broad.
2452. André.
2524. Thorp & Marsh.
2569. Griffiths, James, & Hunt.
2862. Dewey.
2908. Ramsay.
3090. Thompson (*Pirrung, Pirrung, & Torinus*).
3149. Karsten.
3219. Jones.
3288. Titus & Werner.
3324. Eddy.
3349. Dewey.
3645. Pitt & Brooks.
3720. La Croix.
3725. Wüstenhöfer.
3765. Buchanan.
3821. Thompson (*Moore*).
3965. Sutcliffe.
4078. Moorehouse.
4183. Bromhead (*The Chicago Bicycle Company*).
4264. Mentzel.
4268. Gray & Richter.
4277. Schaeffer.
4372. Lawson.
4374. Lettré.
4387. Hughes.
4422. Wall.
4458. Barker (*Massey*).
4488. Gessner. (4th September, 1890.)
4536. Boult (*Lau*).
4553. Graham. (30th August, 1890.)
4628. Cuttler.
4672. Olson.
4703. Davis.
4745. Barker (*Aikins*).
4758. Clark (*The Waddell-Entz Electric Company*).
4766. Cassidy.
4862. Lindemann.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Slide Valves.—*W. C. Church, London.*—In the valve under notice the working fluid is admitted through the middle of the cylinder facing into the interior of the slide valve, and the exhaust is discharged into the slide jacket outside the slide valve, but obviously the working fluid might be admitted by a passage in the cover of the slide case. Double-ported slides have within the body of the slide exhaust passages opening into the jacket, and operate in conjunction with exhaust ports, which alternate with the admission ports. On the upper side of the slide valve is fitted a cap, which travels with it, but which has a slight extent of free motion on an internal spring ring, the edges of which and of the interior of the cap are slightly oblique or rounded to allow a little accommodation of the valve to the working faces. The areas pressed upon by the supply and exhaust fluid are so proportioned that the pressures towards the cover nearly balance the pressures towards the face. A spring is provided between the cap and the valve, which keeps both bearing on their working faces. Chases or grooves are formed in the working faces to allow the escape of leakage fluid, and the said faces should be arranged so that the slide and cap over-pass in their travel the edges of the stationary surfaces against which they work. For large size valves a central tie-bolt, or pair of tie-bolts, are provided to pass through an opening in the slide valve to secure the slide jacket cover to the cylinder. Claims: A slide valve having an internal cavity supplied with working fluid and constituting a central port; a valve having a middle port and two end ports governing double ports for each end of the cylinder, and having in connection with the cavity eduction passages opening into the slide case; the cap, spring ring, and arrangement of the forms and dimensions of rubbing surfaces, so as to obtain an approximately balanced valve.—No. 7187. May 8th, 1890. 1*s.* 1*d.*

Finishing Machines.—*J. Kirk & B. Lee, both of Leeds.*—The invention relates to machinery for finishing worsted, woollen, and other woven fabrics. Such a machine is shown in the annexed illustrations, of which Fig. 1 is a side elevation, Fig. 2

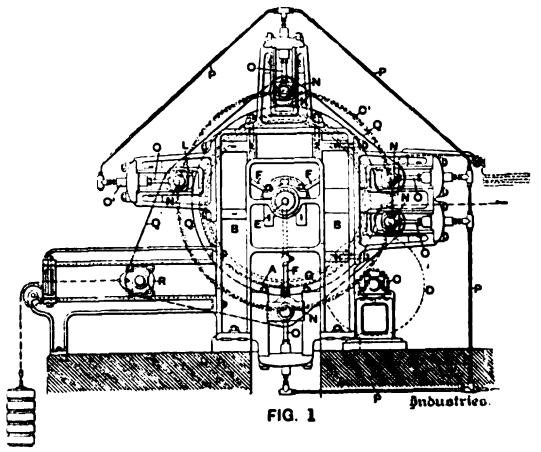


FIG. 1

a front part sectional elevation, and Fig. 3 an enlarged detail. The main cylinder A, which is journaled in suitable framework B, and driven by gearing C C¹ from D, is double rimmed, having an annular space between the two rims. The trunnions of A are hollow, and have connected to them steam supply and exhaust pipes E, governed by valve E¹ (Fig. 3), by means of which steam is supplied to and exhausted from the inner chamber in A. Pipes F, provided with taps, are also connected to pipes E, and are connected with the annular space G between the two rims of A. These pipes F are principally for forcing water of condensation out of G, which receives its main supply of steam through pipes H, governed by suitable taps from the inner chamber in A, which chamber may be cooled by water supplied through pipe F¹. Around A are pressing rollers I, J, K, L, and M, the sliding bearings N of all of which are pressed towards the main cylinder A by the hydraulic rams O of the cylinders O¹, supplied with water under pressure through pipes P. An end-

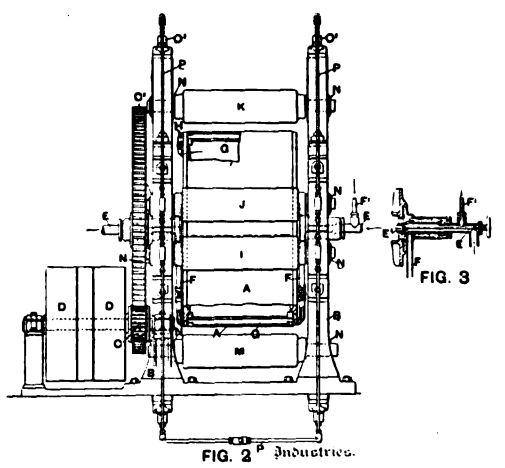


FIG. 2

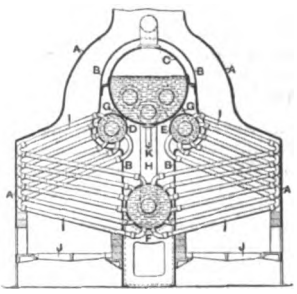
FIG. 3

less strap Q of thin metal, woven wire or other suitable material, passes partly around A, and then passes around the rollers I and J and the outside of K, L, and M and around a weighted sliding or tightening roller R. The outer wall of A may be perforated to allow of the steaming of the fabric being pressed. Five claims are made, embracing the general construction of finishing machinery as described.—No. 6258. April 24th, 1890. 8*d.*

Oil Motor Engines.—*O. Weiss, Köln-Nippes, Germany.*—An oil motor is described, together with an improved method of producing the combustible gaseous charges from petroleum or other oil. The said method consists mainly in causing a portion of the burning combustible charge in the engine cylinder, at the moment of the greatest development of pressure and heat, to effect the conversion of the oil required for the next combustible charge into vapour, which is at once utilised in the engine. This is effected by an injector apparatus, which, being supplied with the said portion of highly heated gas, draws in liquid oil, and by means of the great heat of the gas converts it first into spray and finally into combustible vapour. The injector is supplied with the hot gases by a valve, which is spring-loaded to some pressure slightly less than the maximum pressure obtaining in the cylinder during combustion; this valve lifts as the point of maximum pressure is approached, and admits a small charge to the injector, which operates as above stated, and delivers the resulting vapour into a reservoir from which the engine draws its supply. The engines described, as operated by this arrangement, consist of one or more four-cycle engines, whose series of cycles (where more than one engine is used) overlap in a manner well understood. Claims: The method of producing combustible vapour by means of an injector supplied with hot gas at a high pressure and operating as described, in conjunction with a spring-loaded valve; the oil motor, consisting of two double-acting or four single-acting cylinders, one cylinder operating the injector to provide charge for another cylinder, and so on, in turn.—No. 3261. February 23rd, 1891. 8*d.*

Joint for Metallic Pipes.—*J. Aird, Tipton.*—As a substitute for the screw coupling of metallic pipes or tubes the following arrangement is devised, which is said to be less costly to produce, easier to connect, and capable of withstanding greater pressure than other connections:—On the exterior of each of the meeting ends of the two sections of pipe to be connected together a broad flange or collar is formed, and a groove may be made in the meeting faces of each of the flanges to receive asbestos or other packing. Upon each section of the tube a loose clamping collar is placed, which takes abutment against the back of the flange on the tube, and around the clamping collars holes or slots are formed for the reception of headed screw-bolts by means of which the parts may be drawn together. One of the clamping collars is formed with an annular flange thereon, which covers the joint formed by the meeting faces of the tube flanges and renders it impossible to blow out the packing, and the other clamping collar is formed to receive the flange of its neighbour so as to form a broad bearing or guide for the parts when screwed up, the packing being compressed in the operation, as may be readily understood. Claims: The flanged pipes with clamping collars, substantially as described, and the particular details arranged as described.—No. 16896. October 23rd, 1890. 8*d.*

Multitubular Boilers.—*J. M. Stratton, London.*—The object of the inventor is to obtain a large heating surface and rapid circulation. A boiler for this purpose is shown in the annexed illustrations, of which Fig. 1 is a transverse section, and Fig. 2 is a front elevation partly in section. In the centre of the combustion chamber A is a second chamber B, in which are placed the four cylindrical water chambers C, D, E, and F. The three chambers C, D, and E are connected by means of the tubes G, and the two, C and F, are connected by tube H. The lower


FIG. 1.

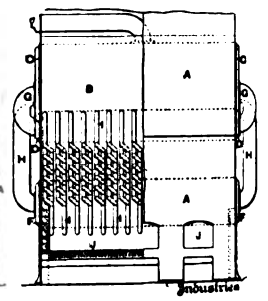


FIG. 2.

three chambers D, E, and F are connected by a number of clusters of smaller valve tubes I, which extend through each side of B across the double fire-grate J. The water is supplied to the upper chamber C through pipe K. Five claims are made embracing the boiler above described together with modifications.—No. 5633. April 14th, 1890. 11*d.*

Railway Couplings.—*H. Lacy, Middleton, Lancashire.*—This is a coupling apparatus arranged so that it may be operated by a steam or vacuum arrangement, or operated by hand without the necessity for going between the vehicles. Two horizontal shafts are arranged transversely at the end of the carriage in suitable bearings, one shaft carrying a pair of hooks and being on the level of the buffers, the other shaft being above the buffers; each shaft carries a spur wheel, and a vertical rack in gear with the said wheels gears the two shafts together. A detent is provided for the purpose of securing the gear in any position in which it may be placed. It is intended that the two hooks shall have their points downwards so as to lower into a pair of eyes on the opposite carriage. Presumably, the arrangement is fitted at one end only of each carriage. Claims: The coupling arrangement substantially as described, operated by hand, steam, or vacuum.—No. 6318. April 25th, 1890. 6*d.*

Gas Engines.—*E. & F. J. Seage, Exeter.*—In engines constructed according to this invention instead of employing the usual arrangement of valve shaft driven by bevel gearing from the crank shaft at half the speed of the latter, cams are attached to the boss of a spur wheel driven at half the speed of the crank shaft by a spur pinion thereon, and rocking levers extend from beneath the cams to a point beneath the valve chambers, being pivoted at about the centre of their length in such a manner that in addition to the oscillation in a vertical plane imparted to the levers by the cams, one of them may also receive a lateral oscillation when actuated by a link, which is controlled by the governor so that upon an increase in the speed of the engine that end of the valve lever which operates the admission valve, although continuing to rise and fall vertically, will be laterally moved out of the line of the spindle of the gas valve, which it will not operate, until, by the consequent reduction of speed, the governor brings it back into line with the valve spindle, when a tongue on the rocking arm will strike a projection formed upon the valve spindle, lifting the valve and readmitting the gas or combustible vapour to the cylinder. Claims: The use of suitably operated levers lying at right angles with the crank shaft for operating the admission and exhaust valves; a lever laterally oscillated by the governor, and controlling the admission valve, as described.—No. 8431. May 31st, 1890. 8*d.*

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FURNACES, &c.—*G. Moffatt & S. Stuttaford, both of London.*—The particular arrangements covered under this invention are means for consuming smoke and economising fuel, so designed as to occupy but little room in the furnace, and therefore suitable for use in boilers of the locomotive type. A frame is fitted horizontally across the forward end of the firebox at about the level of the bars (which are preferably shortened by the length of this frame), which frame supports vertical tubes arranged in single or double rows across the firebox at the tube-plate end. The lower ends of the tubes are open, and air from below the fire-bars can obtain access thereto through the supporting frame, admission being regulated by a hinged adjustable door. It is preferred to make the tubes of greater width, measured across the firebox, than their width measured in the line of the bars, and the tubes are also preferably tapered, their lower ends being the larger; they terminate above the fuel in the firebox and are protected from flame by a firebrick casing in which channels are formed by which the air is led from the upper ends of the air tubes in thin streams to mingle with the hot gases rising from the fire on the way to the tubes. Claims: The combination of tubes, air door frame, and brick-facing as described.—No. 8168. May 24th, 1890. 8*d.*

FORGING MACHINES.—*R. Low, Clapham, Surrey.*—The machine embraced by this invention is for the purpose of rolling forgings of a circular or other form. The machine shown in the annexed illustrations, of which Fig. 1 is a side elevation and Fig. 2 a

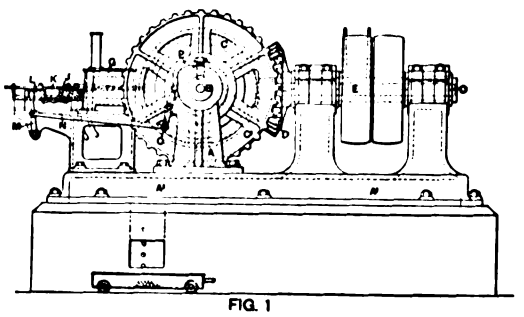


FIG. 1

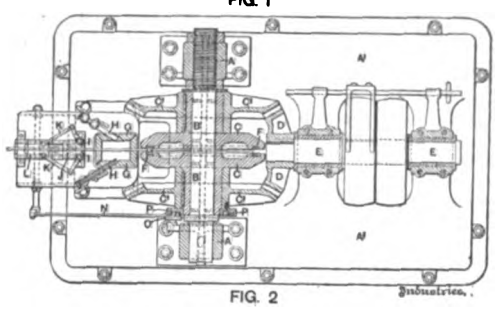


FIG. 2

sectional plan, is for the purpose of rolling spherical forgings. Mounted adjustably in supports A on base A^1 is a stationary rod B carrying upon it the two die holders C driven in opposite directions by means of gear C^1 on the hubs thereof and gear D on the driving shaft E. The dies F are formed in segments and are placed in grooves in the opposite faces of the holders C, which grooves are dovetailed, except in one part, where they are rectangular, to allow of the insertion of said segments. These dies are so formed that at one side of the holder there is a sufficient space to allow the rod from which the forging is made to be inserted. The faces, however, gradually converge towards one another until they touch (the various stages of the operation being plainly shown in Fig. 3). The bar to be operated upon is heated as it passes through a chamber C by means of burners H, and is advanced intermittently by means of gripping jaws or levers I pivoted on a slide J and connected by rods K to a second slide L receiving a reciprocating motion by rods M, N, O, and P on one

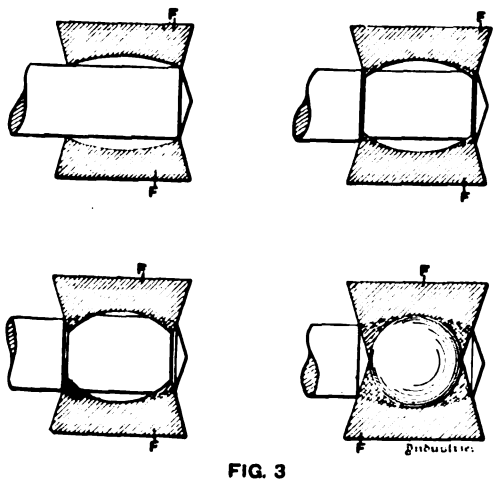


FIG. 3

of the wheels C^1. These slides are connected together by suitable bolts, but in such a manner that the actuating slide is moved a certain distance in one or the other direction before the other slide moves with it, so as to allow the grippers to grip or release the bar. Eight claims are made.—No. 6894. May 3rd, 1890. 8*d.*

VACUUM PUMPS.—*A. Berrenberg & Nickerson, both of Somerville, Mass., U.S.A.*—This invention consists in forcing into the cylinder of vacuum pumps at each suction stroke of the piston a quantity of oil from which air has been eliminated, this oil serving to fill all the clearance when the piston is at the extreme end of its stroke, thus permitting all air to be expelled. All excess of oil at the end of the stroke is forced out of the cylinder into a vacuum tank, in which any air that may have been taken into the oil during the forcing stroke of the piston will be withdrawn and the oil made ready for use again in the cylinder, this circulation and de-aëration taking place at each stroke of the piston. An arrangement of the apparatus is described wherein the reservoir of oil is in communication with a de-aërating cylinder, and, by another passage, in communication with the cylinder of the vacuum pump to which the apparatus is applied. The pump draws in during one stroke air from the vessel which it is exhausting, and also oil from the reservoir, and during the return stroke expels the air and the excess of oil together, the former passing freely away and the latter being led into a receiving chamber provided with a float valve regulating the return of the air to the reservoir. The oil feed-pipe is provided with a circulating pipe and a relief valve which prevents more than a certain pressure being put upon the oil supplied to the cylinder. Claims: Filling the clearances of a vacuum pump with de-aërated oil, as described.—No. 3352. February 24th, 1891. 6*d.*

HOT WATER SUPPLY BOILER.—*C. J. Jones, London.*—This boiler, which is intended for supplying boiling water under light pressure, is constructed as described in a prior patent, No. 13952 of 1884, and is heated from a gas burner as shown in the annexed illustrations, of which Fig. 1 is a vertical section of the boiler, Fig. 3 a plan of the gas burner A, and Fig. 2 an enlarged vertical section of the regulator valve. This regulator valve, which regulates the supply of gas to the burner A according to the pressure in the boiler, is constructed as follows:—B is a chamber covered at the top by a flexible diaphragm C, D is a second diaphragm separated from it by a ring E^3. F are screws by which a cover G is drawn towards the chamber so as to clamp the outer edges of the diaphragms and the ring E between them. E^1 is a hole formed through the ring in order that if the upper diaphragm becomes defective any water passing through it may escape outwards and not subject the lower diaphragm to pressure. G^1 is a pipe passing from the top of the cover G to the water space of the boiler. H is a filling block between the two diaphragms, and I a valve fixed to the underside of the lower diaphragm, and which, when this diaphragm is pressed downwards, comes against and closes the top of a tube J which rises up into the gas chamber B. The tube is continued downwards for a distance, and has within it a coiled spring K, which, pressed against a disc

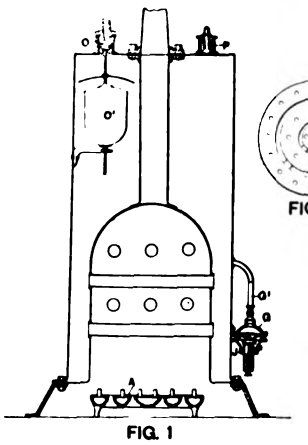


FIG. 1

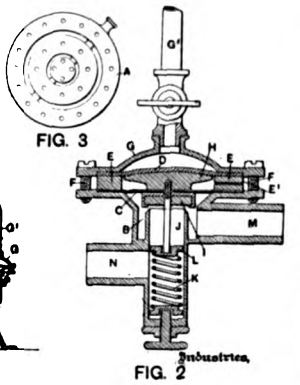


FIG. 2

L connected to the valve I, tends to keep the latter open. M is a pipe connected to the gas supply and N a pipe connected to the burner, the supply to the latter being governed, as described, by valve I. A valve O governed by a float O^1 is provided to regulate the supply of water to the boiler. P is a safety valve. Eight claims are made.—No. 4320. March 19th, 1890. 8*d.*

SMOKE PREVENTION.—*G. Moffatt & S. Stuttaford, London.*—For the purpose of consuming the smoke given off by the fuel in the furnaces of steam boilers the inventors provide a hollow casting forming a bridge, and situated as is customary in the flue, and at the rear end of the fire-grate. A partition extends downward from the rear end of the bridge and closes the lower half of the flue, preventing the admission of air from the ashpit directly into the flue, and causing it to ascend into and pass through vertical passages formed in the bridge, going out at the surface of the crown of the same into the space left between the bridge crown and the top of the flue, where it crosses the path of the furnace gases and mingles with them for the purpose aforesaid. The admission of air into the bridge passages is controlled by a hinged flap pivoted below them and operated from the front of the boiler. A firebrick facing is provided on the front of the bridge to preserve the bridge casting from the direct attack of flame, and holes for the transmission of heat extend through that portion of the casting into one of the air chambers. In the hollow spaces of the casting between the air passages are chambers, which communicate with the water space of the boiler and assist in heating its contents. Claims: The general arrangement, and the particular modification described, including the firebrick facing and holes at the rear thereof in the face of the bridge.—No. 8167. May 24th, 1890. 8*d.*

FORGINGS.—*H. Erhardt, Düsseldorf.*—According to this invention hollow forgings in iron or steel are made from solid blocks of red hot or white hot iron or steel. Several examples of the process are described, from which the following are selected:—To produce a hollow cylinder a piece of hot square metal is taken, the cross section of which, diagonally measured, corresponds to the diameter of the hollow cylinder to be produced, and is placed in a matrix, the inner cavity of which corresponds to the shape of the cylinder to be produced, and a pointed core bar is then driven into the metal by means of a hammer or press, the lid of the matrix forming a guide for the core bar. When desired, the matrices may be formed with jackets in which circulates a cooling medium. The metal is thus forced to fill the cylindrical matrix, and has an opening through its centre in the direction of its length. Hollow prismatic bodies may be produced in similar fashion, an important condition in all cases being that the metal to be operated upon shall be truly centred by the matrix. For hollow bodies of unusual length two core bars may be employed, entered into the metal from opposite ends. Where steam hammers or presses are used, their frames may form guides for the matrix. Claims: The process of simultaneous punching and shaping as described; also the matrix with cooling spaces.—No. 3116. February 20th, 1891. 6*d.*

ROTARY ENGINES.—*W. P. Thompson, London.* (*C. Bornet, Paris, France.*)—A rotary engine, such as embraced by this invention, is shown in the annexed illustrations, of which Fig. 1 is a transverse vertical section, and Fig. 2 a longitudinal section. Journaled eccentrically in the end plates of the cylinder A is the

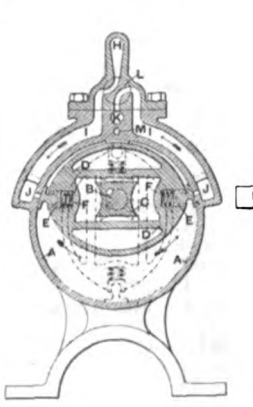


FIG. 1.

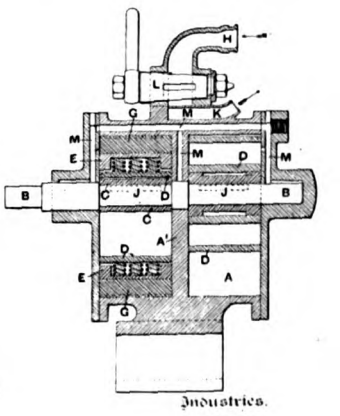


FIG. 2.

main driving shaft B carrying two blocks C, on which slide the two pistons D placed at right angles to one another and working in separate compartments in A formed by means of a division A^1. The exterior form of the pistons is determined by joining two arcs of a circle of a radius approximately equal to that of the interior of the cylinder. The ends of the pistons are furnished with recesses, in which slide the blocks E pressed forward by springs F, and fitted with joint slides G, the contact faces of which are bored cylindrically to the diameter of the cylinder. The motive fluid is supplied through pipe H, one of the circumferential passages I and ports J, the exhaust escaping through the other port and passage to outlet K. The direction of the motive fluid, and so the direction of the engine, is governed by three-way cock L. The passages M are for the supply of lubricant to the axle bearings. Three claims are made.—No. 7508. May 14th, 1890. 8*d.*

WATER TUBE BOILER.—*C. J. Galloway & J. H. Beckwith, both of Manchester.*—The inventors' object is to prevent the violent commotion of the water in water tube boilers caused by rapid circulation and to effect the better cleaning of the water tubes. Fig. 1 of the accompanying illustrations is a longitudinal section, and Fig. 2 is an end view of a boiler embodying this invention. From the fire A the flames and hot products of combustion are caused by baffle plates B to take a zigzag course between the tubes as indicated by the arrows to the flue leading to the chimney. At the top of the front water casing C where it communicates with the steam and water chamber D are formed between inclined diverging plates E a number of expanding passages dividing the currents of mixed steam and water that ascend from C, gradually retarding the divided streams and allowing the steam to separate quietly therefrom. At the top of the passage by which the rear water casing F communicates with the chamber D is provided a part G raised above the bottom of D so that impurities may become deposited in the quiescent water below without descending by G to F; these impurities may from time to time be cleared out by opening a

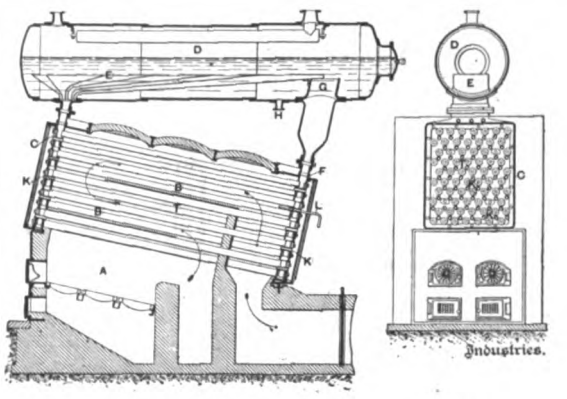


FIG. 1.

FIG. 2.

blow-off cock or valve applied at H. The stays K of the water chambers C and F are tubular, and preferably so placed that there is one between every three of the tubes T, as shown in Fig. 2. Usually these tubular stays are closed by plugs or covers, or some of them may be left open for admission of air to promote combustion. For the purpose of clearing soot off the tubes T is introduced through any of the tubular stays K a nozzle L connected by a flexible tube to a steam pipe, so that a jet of steam can be directed along the surface of the tubes within range of the jet, thus sweeping off the matters adhering to them. Claim: A water tube boiler, having tubular stays for its water chambers, having a set of divided expanding passages for the current ascending from the higher water chamber, and having the mouth of the passage from the lower water chamber raised above the bottom of the upper chamber, for the purposes set forth.—No. 7929. May 22nd, 1890. 8*d.*

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GAS ENGINES.—*F. W. Lanchester, London.*—The invention embraces improved means of starting engines of the Otto type. Referring to the annexed illustrations, Fig. 1 is a cross section of a cylinder of a gas engine showing the arrangement for the above purpose, Figs. 2 and 3 being enlarged details thereof. The end of the cylinder A is fitted with an attachment consisting of a valve box B of a stop cock C, through which communication is made between the cylinder and valve box of a valve D, which normally remains open by its own weight, but is automatically closed by pressure in the engine cylinder, and of a nozzle E, which is connected to the valve box and opens to an external flame F. The nozzle E is conical, expanding towards the direction of discharge. The external flame F can be adjusted with reference to the nozzle E, and is supplied with gas by means

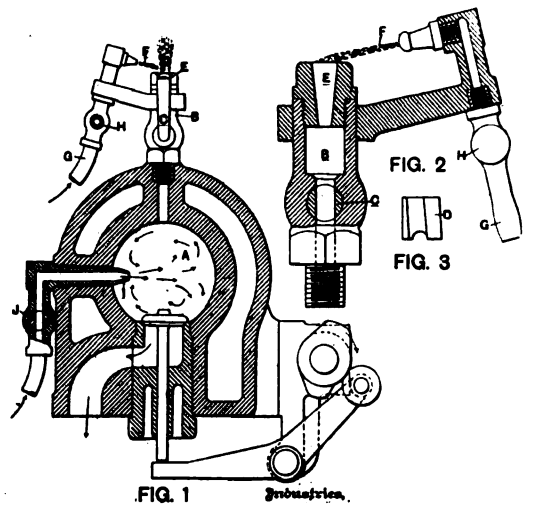


FIG. 1

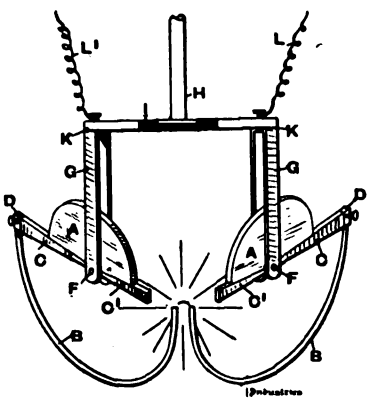
FIG. 2

FIG. 3

of a tube connected to the nipple G. A stop cock H serves to regulate or extinguish the flame F. A is also fitted with a suitable nozzle I, through which gas can be admitted to the cylinder through the supply cock J. The gas so admitted may be forced in by the ordinary pressure in the gas supply pipes as illustrated in the cross section (Fig. 1). In order to start an engine fitted with the starter, it is placed so that its crank is somewhat over the in-centre of the working stroke; the external flame F is lighted, and the gas turned on to the working cylinder through L. The pressure in the gas pipes causes the gas to flow into the cylinder and displace a portion of the air it contains through E, but the entering jet mixes with the remaining air and so produces an explosive mixture, part of which, after a time, finds its way through E; F then ignites it, and the jet burns at E through the external flame into the atmosphere, increasing in richness of gas or vapour till explosive mixture is formed. J is then shut off, and the flame passes back into the cylinder and ignites or explodes the charge to increase its pressure to start the engine. The automatic valve D in the starter closes immediately on the explosion of the charge, and then the cock C is turned to put it out of action, when the engine continues to work in the ordinary manner. Three claims are made, embracing the device as described, with modifications.—No. 5479. April 10th, 1890. 8*d.*

ELECTRICITY.

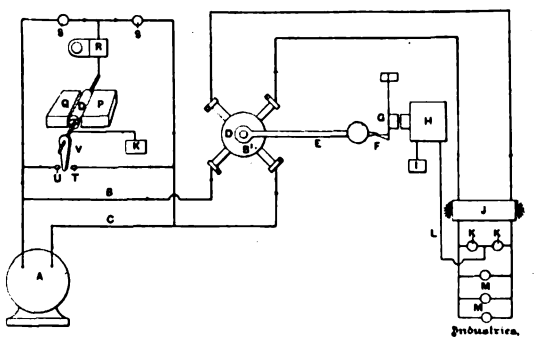
ARC LAMPS.—*S. Capilleri, of Grasse, C. Kurmeyer, J. Goldberg, & R. Latzko, all of Vienna.*—This invention relates chiefly to an entirely novel method of constructing the carbons, which are each combined with a semicircular disc and are rotatable round a horizontal axis, and are made to act in accordance with the law



of archimedean spirals, whereby the free end of the carbon is caused, on burning away, to be always maintained in the same position relatively to the other carbon by turning on its axis. In the annexed illustration is shown an elevation of a lamp with such carbons. The disc A, made of any suitable material, is connected to the semicircular carbon B by an arm C having a clamp D in which the carbon B is fixed. The weight of the arm C is balanced by a counterweight C¹ in order not to interfere with the equilibrium of the spiral, and the whole is mounted on a horizontal axis F carried by a pendant bracket G. Two such transformed archimedean spirals with their brackets are fixed to a suitable support H, and are so arranged that when the lamp is not in action the carbons are in contact, but when in action the carbons are kept the proper distance apart. For this purpose one of the brackets G is mounted on a pivot at its connection at K with the support H, and has an arm fixed to it which carries the armature of an electromagnet in a shunt to the lamp circuit, the said arm acting as the weight for bringing the carbons together. The support H is divided by an insulating piece I into two parts, each of which is connected to one of the leads L L¹ of the circuit. The current entering at L passes through H, bracket G, axis F, and arm C to the carbon B, thence to the other carbon B, arm C, axis F, bracket G, and support H to the lead L¹. Claims: The lamp as described, in two claims.—No. 5409. April 9th, 1890. 8*d.*

ELECTRICAL ALARM FOR PUMPS.—*E. Hartmann, Düsseldorf.*—This appliance is designed to put the driving power of a pump out of action upon any undesirable lowering of the water level owing to accumulations of air, or to other causes; or it may be arranged simply to give warning of the fact that the pump has stopped working. The pump communicates with a casing in which there is a perforated float which rises or falls with the rise or fall of the water level. In the lowest position of the float (which is reached before any accumulation of air or occurrence of vacuum can take place to any dangerous extent) a circuit is closed whereby an audible signal may be given, or whereby a brake or a throttle valve may be operated. The leads may be carried into the float chamber in an adjustable tube, and their separated ends, if sufficiently far apart, will not be electrically bridged together by the liquid in that chamber. Or, to achieve the same results in a manner well known to electricians, the float may be caused to open a circuit which is normally closed. In another modification the float when commencing to sink opens an air valve, which will accelerate its sinking—thus immediate warning of any small variation in working conditions may be given. Claims: The general arrangement of apparatus substantially as described.—No. 6865. May 3rd, 1890. 8*d.*

TRANSFORMERS.—*J. Swinburne, Wimbledon, Surrey.*—The inventor's object is to render an installation supplied by a transformer safe from risks of fire or danger, by earthing the middle of the secondary circuit through a fine fuse or cut-out, so that if a current passes through the fuse or cut-out the primary circuit is automatically disconnected from the whole system. An arrangement of this description is shown diagrammatically in the accompanying illustration, in which A represents the central station dynamo, B and C the high-pressure mains, J a house transformer, and D is a double-pole switch in the primary circuit. M M are lamps on the secondary circuit. K K are two resistance or choking coils, between which an earth connection L is arranged, communicating with the earth plate I. A current along L actuates the electromagnet H, thus attracting the armature G and



releasing the catch F; the weighted lever E then drops, catches on the pin B¹ and opens the switch, thus disconnecting the transformer altogether. If the leak is on one of the secondary leads nothing further happens, but if between the primary and secondary leads there will be a current at the station through the earth plate K to the armature of a piece of apparatus which puts that lead to earth and rings a bell. The apparatus thus protects both high and low pressure circuits from danger, and gives notice of any fault. Claims: In connection with a transformer the use of the automatic leak finder as described, and in an open circuit transformer a cross-shaped or equivalent backbone; insulating a transformer by placing it in a vessel of insulating material.—No. 3193. February 28th, 1890. 8*d.*

SWITCHES.—*S. F. Beevor, London.*—To protect the contact surfaces and other metallic parts of switches and contact breakers from corrosion, and to prevent loss of current or other evil results which might be produced by contact with surrounding bodies, the metallic parts as aforesaid are enclosed in a flexible or collapsible waterproof envelope of insulating material, one end of which is attached to the part which carries one of the two contacts, the other end being attached to the part carrying the remaining contact. Several switches arranged according to this invention are described, in one of which two discs of insulating material are held apart by metal rods and are encased in a metal cylinder. Between these two discs is a third disc, free to rise and fall, and guided in such movement by the metal rods. This disc carries spring contacts, which engage with plugs standing out from the face of one of the fixed discs. Around the peripheries of all three discs are deep rings of insulating material connected to each other by flexible rings of indiarubber or other waterproof insulation, the joints between the discs and the rings being formed by vulcanising. A cruciform or other suitable partition, of one piece with the vulcanite base, is arranged to separate the contacts carried thereby, and interposes a resistance to prevent sparking between adjoining conductors. A torque switch and single and double lever rocking switches are described, all on the same general principle, which is claimed, as also are the particular examples shown.—No. 8477. May 31st, 1890. 8*d.*

RECORDING AND MEASURING APPARATUS.—*F. B. Lea, Streatham.*—The inventor states that in recording instruments as hitherto constructed it has been found that the friction of a point marking a paper or card is considerable, and sufficiently variable to render the records untrustworthy. In this invention a metallic point carried at the end of the arm of a lever caused to rise and fall in close proximity to a paper-carrying drum is heated to incandescence by a shunt circuit in the case of electrically measuring instruments, or by a current from a battery in the case of a recording barometer or the like. The heating of the point may be intermittent, in which case a make and break arrangement is operated by the clock-work which drives the paper-carrying drum, and the strip or coil of paper may be chemically prepared so that the mark may be produced by a lower degree of temperature than is requisite when ordinary paper is employed. The heated point is a substitute for the pencil or siphon recorder hitherto employed, the record being burned upon the paper without the point coming into actual contact therewith. Claims: A recording measuring instrument as described, and the method of heating the index or pointer continuously or intermittently. The use of this apparatus in combination with a recording telegraphic or signalling instrument is also claimed.—No. 7902. May 22nd, 1890. 8*d.*

CHEMISTRY.

THE OBTAINMENT OF CYANIDES AND FERROCYANIDES.—*D. J. Playfair, Glasgow.*—Cyanides and ferrocyanides are obtained from sulphocyanates or from bisulphide of carbon and ammonia, and the bye-products reconverted or otherwise utilised. Cyanides are obtained by heating together in a retort or crucible the sulphocyanate of an alkali or alkaline earth with lead or zinc or a mixture thereof, these metals having a strong affinity for sulphur and forming insoluble sulphides. Ground wood charcoal or other suitable carbon may be mixed with the charge of sulphocyanate and lead or zinc, or may be merely spread over so as to cover the top of the charge, or it may be dispensed with altogether. The carbon is not essential, its function being merely to maintain a reducing temperature within the retort or crucible, to prevent oxidation of the cyanide formed to cyanate, and to reduce to cyanide any cyanate accidentally formed by access of air to the charge or in consequence of any oxygen compounds of the lead or zinc being present. The lead or zinc may, in a state of fine division produced by granulation, be thoroughly incorporated with an equivalent weight of the dry alkaline sulphocyanate, so as to produce an intimate mixture before being charged into the crucible or retort. The charge is heated to a temperature somewhat above the melting point of zinc, whereupon a reaction takes place, resulting, when sulphocyanate of sodium is used, in the production of cyanide of sodium and sulphide of zinc. When ferrocyanides are required the process described is modified by replacing part of the lead or zinc with iron, in the form of borings, turnings, or other porous form. In the fusing process the iron is converted into sulphide along with the lead or zinc, but on subsequent lixiviation reacts with the alkaline cyanide, forming a ferrocyanide of the alkali which may be crystallised. The sulphocyanates employed may be obtained from the sulphocyanate of ammonia met with in "gas liquor" or "gas lime," or obtained from any other convenient source. It is, however, preferred to obtain the sulphocyanate by heating together in a closed vessel liquid ammonia and bisulphide of carbon along with a solution of a fixed alkali or alkaline earth (preferably as a hydrate, although either a carbonate or a sulphide may be used) or by mixing in a condenser or other suitable vessel the vapours of ammonia and bisulphide of carbon, or by passing the vapour of one into the other in a liquid state, and adding a solution of the fixed alkali. The resulting solution is heated in a still to drive off any free ammonia and sulphide of ammonia and any other ammoniacal compounds that may be present, the products so volatilised being collected in condensers or absorbers for further use. The solution of sulphocyanate of the fixed alkali remaining in the still is separated from precipitated sulphur by settling, decanting, and filtering, and is then evaporated to dryness and treated as hereinbefore described to obtain cyanides and ferrocyanides. Claims: (1) The process for obtaining cyanides by fusing a sulphocyanate of a fixed alkali or alkaline earth with lead or zinc or a mixture thereof, and subsequently separating the metallic sulphide formed, substantially as described; (2) the process for obtaining ferrocyanides by fusing a sulphocyanate of a fixed alkali or alkaline earth with lead or zinc in the presence of iron, subsequently lixiviating the mass and crystallising the ferrocyanide; (3) in combination with either of the processes claimed in the first and second claims, forming the sulphocyanate employed in any of the modes hereinbefore described and reconverting or utilising the metallic sulphides as described.—No. 7764. May 19th, 1890. 6*d.*

MISCELLANEOUS.

BOAT LOWERING GEAR.—*J. Stevens, Trenton, Michigan, & G. E. Beers, New York, U.S.A.*—In this arrangement of gear each end of the boat is upheld by a single rope, the upper end of which is made fast to the davit, the lower ends of the ropes being wound round on the drums of two windlasses, operating simultaneously to raise or lower, by means of a horizontal fore-and-aft connecting spindle. The said lower ends are formed with eyes which are passed over pins or projections on the windlass drums, so that when the said drums are allowed to unwind the ropes automatically disengage themselves from the boat by slipping over the pins. Winding apparatus is fitted at the centre of the horizontal shaft or spindle, and consists of a spur pinion operated by hand and gearing into a spur wheel with a pawl or detent, for the purpose of raising the boat. To lower the boat the spur pinion is put out of engagement with the spur wheel, and the ratchet wheel is released, a brake strap being operated to retard the rotation of a pulley, with which the spur wheel is connected. To prevent the boat from tipping each rope is taken as far down in the boat as is possible, and is led through the seats. Claims: Double windlasses, with a detachable winding mechanism; the horizontal shaft and detachable ropes; the power gear, releasable pinion and ratchet, with drums and brake gear; drums at the bottom of the boat, with bearings in the seats for the rope as described.—No. 3442. February 25th, 1891. 6*d.*

Copies of the British specifications may be obtained on application to* H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.

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IMPROVED QUICK-RETURN SLOTTING MACHINE.

THE accompanying illustration represents a general view of a self-acting quick-return slotting machine, made by Messrs. Harry Bentley & Co., Excelsior Iron Works, Morley, near Leeds, which has a variable stroke up to 12in., and an adjustable feed motion for the longitudinal, transverse, and circular cuts. All the feed motions are fitted with friction clutches and act independently of each other. The table is hinged and fitted with an adjustable appliance for slotting taper keyways. The quick return motion is obtained by a pair of elliptical wheels, which the makers prefer to that obtained from the slotted link arrangement. The ram is provided with a heavy balance weight, which effectually prevents backlash and ensures steadiness of motion. The machine, which is of neat appearance, will admit work of 5ft. diameter and 2ft. high.

THE STRESSES IN BOILER SHELLS.

By J. H. SLADE, R.N.

THE following investigation was suggested by a consideration of the paper by Mr. Spence, published in *Industries*, of the 13th and 20th March,* and of the startling inferences there drawn, which are quite opposed to the present practice in boiler designing. The writer found on inquiry that these ideas as to the great support derivable from the ends were obtaining some currency in the North, and, not being aware of any previous attempt to show how to estimate, in a fairly simple manner, the values of the stresses produced, was led to inquire into them, the results obtained being set forth in the present article. For reasons set forth farther on, a full and complete investigation has not been carried through, but enough has been done to attain the end in view—viz., to show that our present practice is, for all practical purposes, perfectly correct.

We will now commence the investigation.

Let $2a$ = length of boiler,
r = radius,
t = thickness of shell plate,
t^1 = „ end plate.

Let the boiler be stayed, so that no longitudinal stress comes on the shell plates, and in accordance with the assumption in the paper referred to above, we will suppose that of the total pressure $P + p$ lbs. per square inch, p lbs. are transmitted to the end plates, leaving P lbs. to be borne by the circumferential tension. We will then try to find out what relation may exist between P and p.

The total loading is then divided into the two sets, shown in Figs. 1 and 2, of which that shown in Fig. 2 is supposed to be transferred by transverse stresses to the ends.

We will consider first the stresses produced by Fig. 2, and the first thing to note is that the reasoning adopted in Mr. Spence's appendix (see *Industries*, Vol. X., page 266), explaining how these stresses are transmitted to the ends, is fundamentally unsound. It is there stated that the stress is transmitted as a shear, which is true; but it is further stated that there is no bending, which is untrue. A B C D is spoken of as a beam, and any forces tending to bend the top are said to be balanced by equal forces tending to bend the bottom. Hence it is deduced there is no bending. This deduction is perfectly correct if we consider A B C D as a whole. There is no bending moment on it; *its axis* remains straight, and therefore it is not bent. But, then, this reasoning equally applies

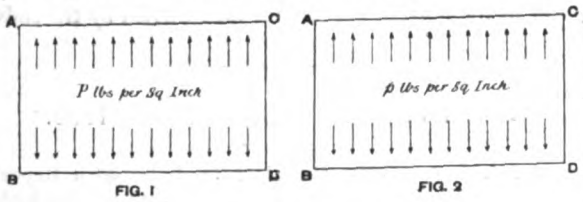


FIG. 1

FIG. 2

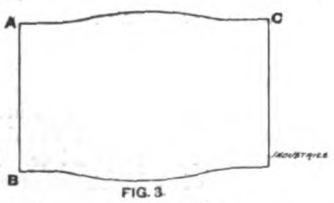


FIG. 3.

to shearing. As a whole, the beam A B C D neither shears nor bends; but, taking any longitudinal strip of the shell plate, this strip shears—which is the shearing referred to by Mr. Spence—and undoubtedly it also bends, for, if A B C D take up the shape shown in Fig. 3, evidently the originally straight top strip A C is now a bent strip.

It is important to clear up this point at the start, because, as will soon appear, the strains—*i.e.*, alterations of form—produced by the bending are far more important than those due to the shearing.

We will now examine the equilibrium of a longitudinal strip taken from Fig. 2, 1in. wide.

A C (Fig. 4, page 434) is the strip, the form it takes up under the action of the forces being shown by the dotted curve, called the curve of deflection; this is, of course, on an exaggerated scale. For the forces acting on the strip, we have its total length $2a$ inches and width 1in., so its area is $2a$ square inches, and the total load on it is hence $2pa$ lbs., whence we have at each end a supporting force of pa lbs. as shown. But the ends of the strip are more than simply supported, because they are riveted to the end plates and are thus held in a horizontal position, so that a double curvature is produced. To produce this effect the end plates must supply a resisting couple at each end in addition to the resisting force pa. These couples are marked M M.

Take now O X and O Y as axes, and take K any point on the deflection curve, its co-ordinates being x and y, then we have the general equation of deflection—

$$\text{E I} \cdot \frac{d^2y}{dx^2} = \text{the bending moment at K,}$$

$$= pa(a-x) - p(a-x)\frac{(a-x)}{2} - \text{M},$$

$$= \frac{p}{2}(a^2-x^2) - \text{M},$$

$$\therefore \text{E I}\,\frac{dy}{dx} = \frac{p}{2}\left(a^2x - \frac{x^3}{3}\right) - \text{M}x,$$

the integration constant vanishing, because when $x = 0$, dy/dx, or the slope, is also zero. Also $dy/dx = 0$ when $x = a$, since the ends are horizontal, whence—

$$0 = \frac{p}{2}\left(a^3 - \frac{a^3}{3}\right) - \text{M}a,$$

$$\text{or } \text{M} = \frac{pa^2}{3},$$

$$\therefore \text{E I}\,\frac{dy}{dx} = \frac{p}{6}(a^2x - x^3),$$

$$\therefore \text{E I}\,y = \frac{p}{6}\left\{\frac{a^2}{2}(x^2-a^2) - \frac{x^4-a^4}{4}\right\}$$

this form being taken because it satisfies the condition $y = 0$ when $x = \pm a$.

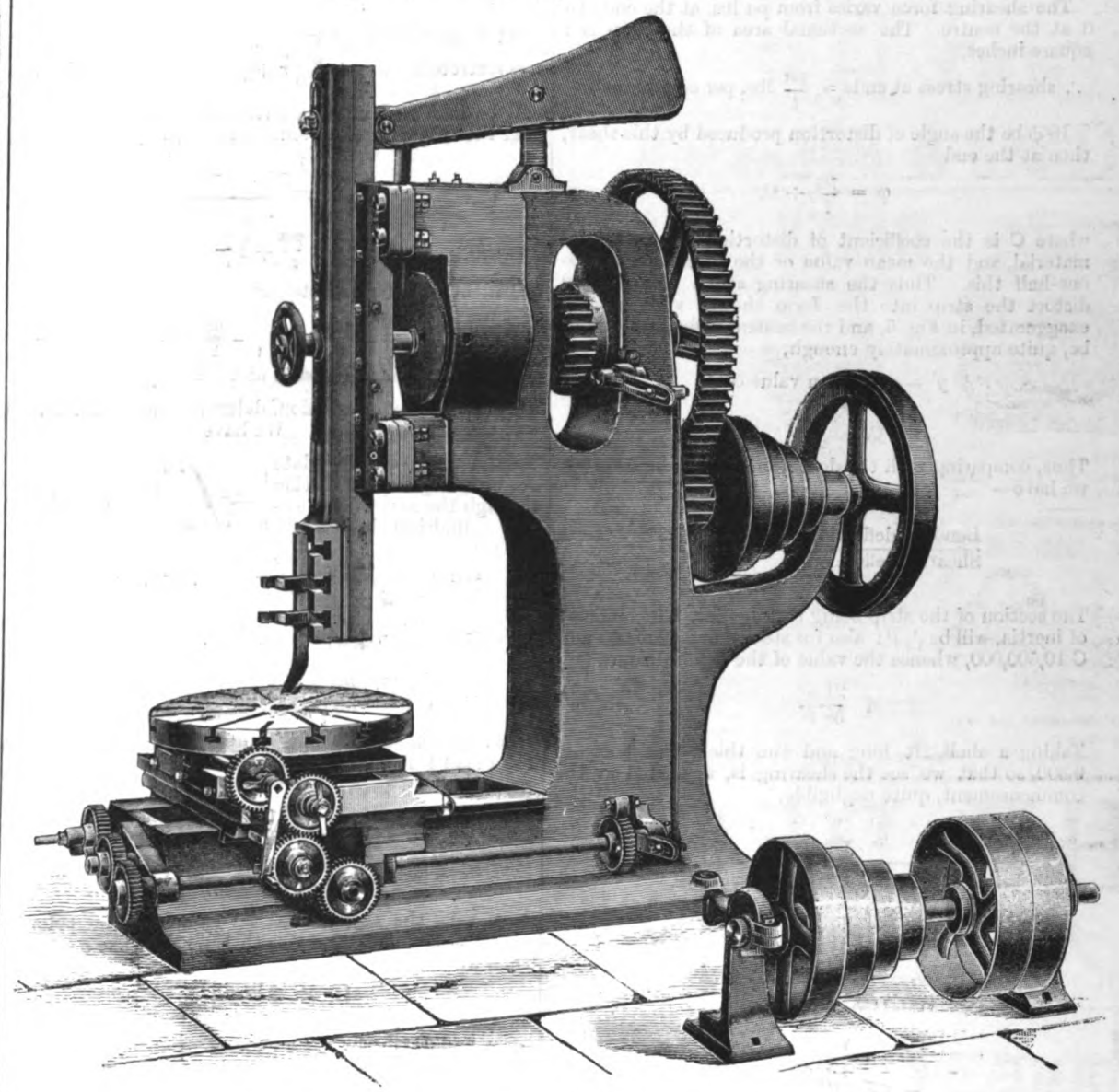
The last equation, then, is the equation to the curve formed by the bent strip, which form will also be taken by all the other strips into which we may conceive the cylindrical shell to be divided.

* It is only fair to Mr. Slade to state that his article reached us several weeks ago, and has been held over owing to the pressure upon our space. —ED. *Industries*.

IMPROVED QUICK-RETURN SLOTTING MACHINE.

CONSTRUCTED BY MESSRS. HARRY BENTLEY & CO., ENGINEERS,

MORLEY, NEAR LEEDS.



GENERAL VIEW.

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Before proceeding farther we will now show that practically the whole change of form produced is due, not to shearing, but to bending.

From the equation, the central deflection, say y_0, is given by

$$\mathrm{E\,I}\,y_0 = \frac{p}{6}\left\{-\frac{a^4}{2}+\frac{a^4}{4}\right\} = -\frac{pa^4}{24}$$

$$\therefore\ y_0 = -\frac{pa^4}{24\,\mathrm{E\,I}}.$$

We need not trouble about the sign, because the direction of the deflection is evident.

Now for shearing:

The shearing force varies from pa lbs. at the ends to 0 at the centre. The sectional area of the strip is t square inches,

$$\therefore \text{ shearing stress at ends} = \frac{pa}{t} \text{ lbs. per square inch.}$$

If ϕ be the angle of distortion produced by this shear, then at the end

$$\phi = \frac{pa}{t} \div \mathrm{C},$$

where C is the coefficient of distortion for the given material, and the mean value of the distortion will be one-half this. Thus the shearing stress alone would distort the strip into the form shown, very greatly exaggerated, in Fig. 5, and the central deflection y^1 will be, quite approximately enough,

$$y^1 = a \times \text{mean value of } \phi,$$

$$= \frac{pa^2}{2\,\mathrm{C}t}.$$

Thus, comparing with the deflection due to the bending, we have—

$$\frac{\text{Bending deflection}}{\text{Shearing deflection}} = \frac{\frac{pa^4}{24\,\mathrm{E\,I}}}{\frac{pa^2}{2\,\mathrm{C}t}}.$$

The section of the strip being rectangular, I, its moment of inertia, will be $\frac{1}{12}\,t^3$; also for steel E is 29,000,000 and C 10,500,000, whence the value of the ratio becomes

$$\frac{21\,a^2}{58\,t^2}$$

Taking a shell 2ft. long and $\frac{1}{4}$in. thick, this becomes 6,300, so that we see the shearing is, as stated at the commencement, quite negligible.

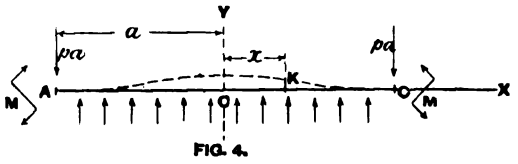


FIG. 4.

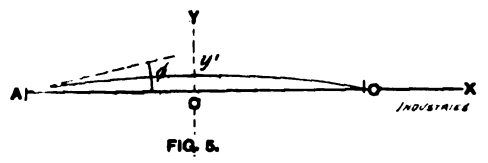


FIG. 5.

Next, we have to consider how this bending of the metal can be made consistent with the assumption that the remainder P of the load is carried by circumferential tension. We can see at once that our present assumption cannot hold in its entirety, for the bending necessitates that the central hoops or rings are more stressed than the end ones, since they are more stretched (Fig. 3, page 433) and stress is proportional to stretch. Thus, if the mean amount of the load borne by circumferential stress be P lbs., this will be more borne by the central hoops than by the end ones. But this reacts again, for it follows that less than p lbs. are left at the centre to be borne by the bending, and more than p lbs. at the ends; the effect of this being that the bending produced will be less, and the actual curve of deflection be intermediate between the curve of Fig. 4 and a straight line.

[It may be asked here whether the effects produced by these two sets of stresses may not modify each other, but fortunately they do not. The bending stresses have no resultant effect in the direction A C, and there is no alteration of length in A C, the difference between the length of the curve and the line being an indefinitely small quantity; thus, these stresses can produce no circumferential strain, and we are thus justified in taking this strain as being due simply to the accompanying stress round the circumference.]

In spite of the fact, however, that our original assumption is plainly inadmissible, we will continue with the calculation, seeing afterwards what modifications may become necessary.

We have now a load pa lbs. carried by every inch length of circumference of each end plate; thus, the thickness being t^1, the end plates are subject to a stress pa/t^1, and their radii will accordingly be increased from

r to $r + \frac{pa}{\mathrm{E}t^1}r$.

This will also be the radii of the end rings of the shell, and the radius of any other ring, say at K, will be got by adding the ordinate y of the deflection curve at that point to $r + \frac{pa}{\mathrm{E}t^1}r$.

At K, then, we have the ring, whose original diameter was r, stretched to $r + \frac{pa}{\mathrm{E}t^1}r + y$; and the circumference will be increased in the same ratio; whence it follows that the circumferential tension is given by

$$\mathrm{E}\left(\frac{r+\frac{pa}{\mathrm{E}t^1}r+y-r}{r}\right)$$

or

$$\frac{pa}{t^1}+\mathrm{E}\frac{y}{r}.$$

Substituting for y we get

$$\left.\begin{matrix}\text{Circumferential}\\ \text{tension at K}\end{matrix}\right\} = \frac{pa}{t^1}+\frac{p}{6r\mathrm{I}}\left\{-\frac{a^2}{2}(x^2-a^2)+\frac{x^4-a^4}{4}\right\}$$

(The sign is changed so as to make y positive).

We can now, by integration, determine what total load this tension will balance. We have

$$\left.\begin{matrix}\text{Total tension on the plate}\\ \text{cut by a longitudinal section}\\ \text{through the axis of the cy-}\\ \text{lindrical shell}\end{matrix}\right\} = 2\int_0^a\left(\frac{pa}{t^1}+\frac{\mathrm{E}y}{r}\right)2t.dx$$

$$= 4t\int_0^a\left\{\frac{pa}{t^1}dx+\frac{p}{6r\mathrm{I}}\left(-\frac{a^2x^2}{2}+\frac{x^4}{4}+\frac{a^4}{4}\right)dx\right\}$$

$$= 4t\left\{\frac{pa^2}{t^1}+\frac{p}{6r\mathrm{I}}\left(-\frac{a^5}{6}+\frac{a^5}{20}+\frac{a^4}{4}\right)\right\}$$

$$= 4t\left\{\frac{pa^2}{t^1}+\frac{pa^5}{45r\mathrm{I}}\right\}$$

Now, if this is sufficient, on the whole, to balance a total load P lbs. per square inch over the whole surface, we get

$$\mathrm{P}\times 2a\times 2r = 4t\left\{\frac{pa^2}{t^1}+\frac{pa^5}{45r\mathrm{I}}\right\}$$

$$\therefore \mathrm{P} = \frac{t}{r}\left\{\frac{pa}{t^1}+\frac{12pa^4}{45r^3}\right\} \text{ substituting for I.}$$

Now, take the same numerical values we did before—viz., a = 1ft., and t and t^1 both $\frac{1}{4}$in.; also take r = 1ft.—then we obtain

$$\mathrm{P} = 615p,$$

so that $\frac{1}{616}$th of the pressure would be borne by the ends, and $\frac{615}{616}$ths by the circumferential tension.

The reason is now apparent why we did not go on to make some fresh assumption as to the distribution of the portion of the load transmitted to the ends, when we had seen that our first assumption was not a consistent one. For example, it might have been assumed that the loading in Fig. 2 varied uniformly from the centre to the ends, and a solution worked out on this assumption, which would necessarily have been nearer the truth. But on first examining the question, the above work had been got out to its numerical end, and it was then apparent that it was not worth while going through the labour of examining other assumptions. Taking the above case, what we see is that the bending produced by transmitting $\frac{1}{616}$th of the load, supposed uniformly distributed, to the ends, added to the slight extension of the ends produced by this $\frac{1}{616}$, this sufficient to produce such alterations of the radii as to balance the remaining $\frac{615}{616}$ths by the usual tension. If now we commence by taking off $\frac{1}{616}$th of the load at the centre, and take off more as we go towards the ends, then we should bend the beam more than shown in Fig. 4, and also we should increase the radii of the ends by more than in our preceding; but this will not do, because then the circumferential tensions produced would be more than sufficient to balance the remaining load, which would be less than $\frac{615}{616}$ths of the total. It follows then that we must not assume so much as $\frac{1}{616}$th taken off at the centre, and this at once settles the whole question, for it follows that the plates at the centre must be made thick enough to take the whole, practically, of the load by simple tension—that is, that our present method of determining the thickness of shell plates is perfectly correct.

As regards what the actual distribution of the part of the load transferred to the end plate is, we can get a fair idea by considering that at the end the rings can only extend the same amount as the end plates, and thus a very large amount of the load on the extreme rings must be transferred to the ends; this amount will, however, rapidly fall off, and will have practically vanished at a distance, say, of about 2in. or 3in., from the ends of a shell such as we have considered.

It will be seen that the conclusion here arrived at is directly opposed to those drawn in the paper we have referred to, and it may be asked how can this be reconciled with the facts there given, because if theory—which some may be inclined to call the foregoing work—comes into contact with facts, it must give way. There is, however, no difficulty of that kind in the present case if the facts be rightly read. First, it must be noticed the preceding investigation refers to stresses inside the elastic limit; a great field of research lies open in considering the behaviour of metals outside this limit, but it is sound practice now, and is likely to remain so, not to expose structures to stresses outside their elastic strength; hence the limitation in this respect of the investigation does not detract from its value, if any. Now one principal difficulty in these experiments appears to be that circles near the end seem by the measurements there given to stretch more than those at the centre, which hardly agrees with our investigation, but on examination it seems most highly probable that these are accidental effects, and not the effect of any definite law. This especially applies to the abnormal results at the joints; if these represented a law there would be a regularity about them as the pressure increased; but we see no sign of any such a thing—the contractions appear suddenly, remain constant for varying loads, and then suddenly alter sign for no apparent reason. A similar statement to the foregoing also appears applicable to the stretching of the solid metal given—*e.g.*, No. 5, Table I., page 243. At 350 an extension of $\frac{1}{32}$ appears, which remains constant up to 500, and then at 550 doubles, and so on. Such alterations as these are such as would be expected from original deviations from a true cylindrical shape, to which the form of joint chosen contributed, for any form of lap joint necessarily implies distortion.

One result of the experiments also appears to have been overlooked, and one which has rather an important bearing, for, judging from the drawings given, the actual end plates did not stretch in the least. It appears strange that this should not have been noticed, for, if they carry such a large proportion of the load, how do they manage to avoid stretching? The same thing applies to the sketch given of Mr. Scott's boiler.

The only other result requiring explanation is the great load borne by the boilers, but this again can be accounted for by reference to known facts. The breaking load of the steel used is given at 28·3 tons per square inch, but this load is per square inch of the *original section* of the test pieces, which, it is presumed, were so constructed as to admit of a uniform stretching taking place over some 8in. or 10in. of their length. These pieces, it is seen by the Table given, contracted in area to about 60 per cent. of the original, so that the actual tenacity of the metal across the break becomes 47 tons per square inch. Now breaking through a riveted joint is one of those cases in which contraction of area is suppressed, the broken section being practically equal to the original, and in such cases it is known that the strength of the metal would approach very nearly to the 47 tons; and hence the explanation of the apparent great strength of the boiler.

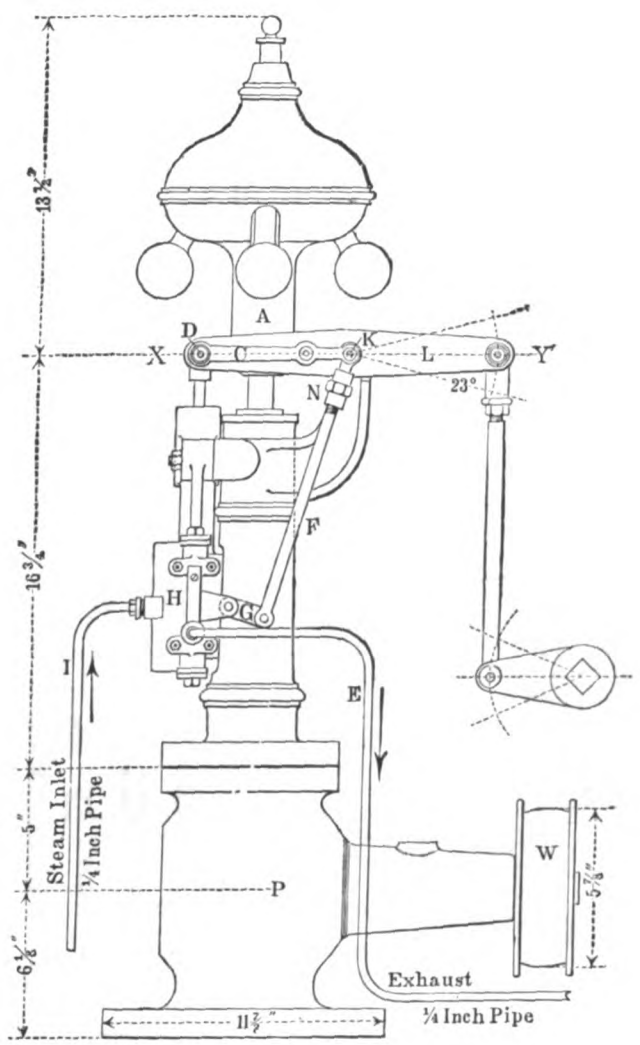
The final conclusion appears to be that the whole of the facts are susceptible of explanation according to known principles, and that it would be highly dangerous for any one to make boiler shells half the present thickness in the hope of getting the load carried by the ends.

RAILWAY ACCIDENTS IN 1890.

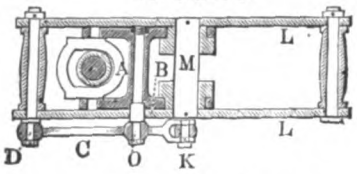
A few days ago the Board of Trade issued a Report containing a complete record of the railway accidents that occurred during 1890, taking into account not only collisions, but also all other causes of death or disablement. The deaths amounted to 1,135, and the number of the injured to 11,568. But from these numbers it is only right to make considerable deductions when inquiring into accidents for which the direct working of the railways can be held responsible. For instance a considerable number of accidents occurred in endeavouring to catch trains, in loading and unloading waggons, and attending to horses, and in working on the line. From these causes there were 59 deaths, and 6,847 injuries, which makes the figures due to the working of the traffic and passengers almost exactly the same as for the previous year. But again, for these the companies cannot be held responsible for a considerable proportion, for many of them were brought about by causes within the control of those who suffered. For example 250 were

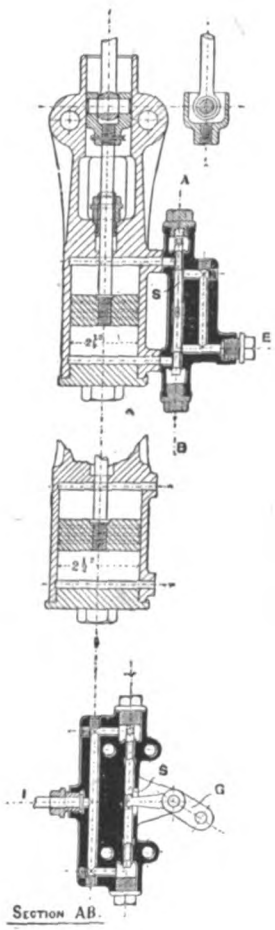
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STEAM ENGINE GOVERNORS.



Section X-Y.





Section AB.

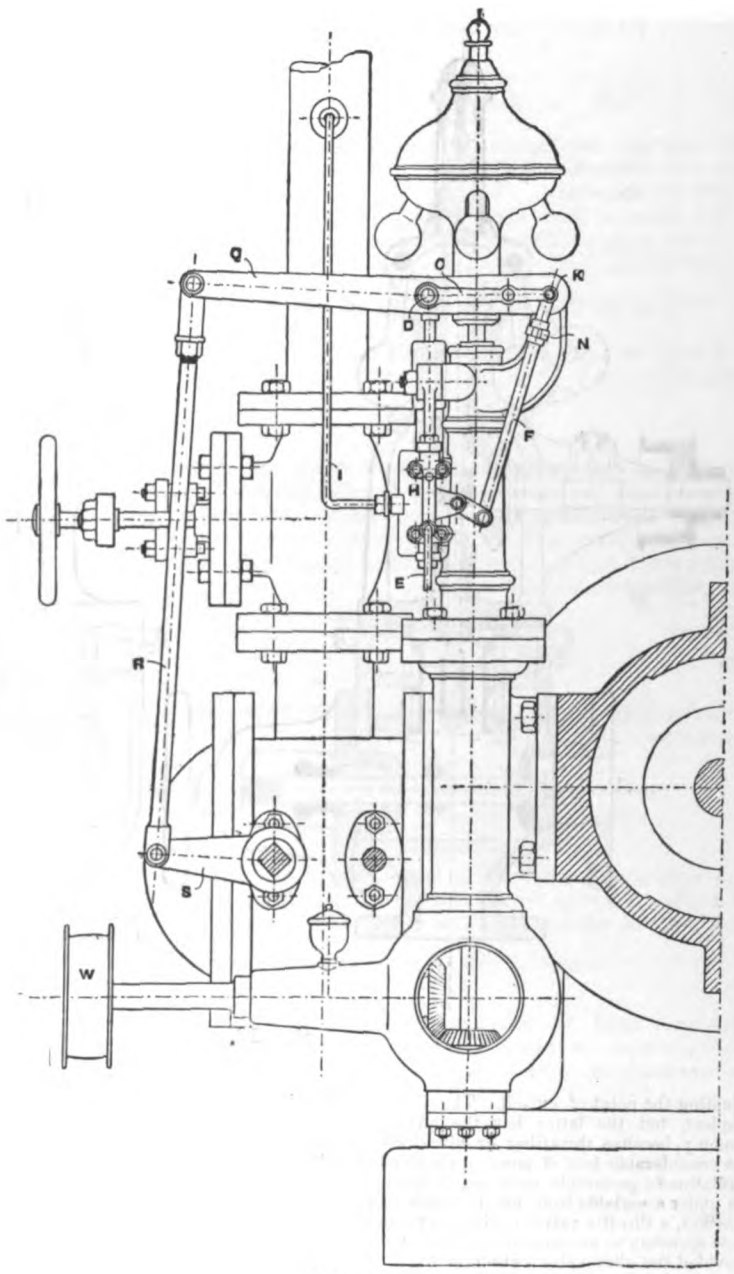


Fig. 10.

Fig. 11.

killed when trespassing on lines, and were almost as much to blame as the 70 who are reported to have committed suicide. Nearly 100 died from injuries received at level crossings, and between 20 and 30 from attempting to enter trains or to leave them before they had stopped.

When all deductions of this kind are made it is found that only 30 persons were killed—18 passengers and 12 servants of companies—from causes beyond their control. The comparison with 1889 is as follows :—

	1890. Killed.	Injured.		1889. Killed.	Injured.
Passengers	18	496	...	88	1,016
Servants of companies	12	147	...	4	117
Totals	30	643	...	92	1,133

A large proportion of the death-rate in both these years is accounted for by special disasters, and not by accidents in the ordinary working of the lines. In 1889 the Armagh disaster swelled the roll, while for last year, if the two accidents at Carlisle Station and the one at Norton Fitzwarren were put aside, it will be seen that the number of casualties which may be classified as preventible is very small indeed. This is very satisfactory, and is due in great part to the forethought and care of the railway managers and other officials, aided, no doubt, to a very considerable extent, by the inspecting officers of the Board of Trade. A bad accident is one of the worst things which can happen to railway companies, for not only do they pay very heavily for it directly in the way of damages, but also indirectly by loss of traffic. The Board of Trade inspectors do good service by the investigations they hold, and the suggestions they offer for the improvement of the arrangements for the traffic. They also promote the public safety by directing attention to the long hours which many railway servants have to work, and pointing out that a great strain on the drivers, guards, signalmen, and others cannot conduce either to the interests of the companies or to the safety of the travelling public. It is satisfactory to find that both public and official opinion is advancing on this subject, and that there is now a fair prospect of all the more serious grievances being removed.

STEAM ENGINE GOVERNORS.*

(*Continued from page* 412.)

In the application of governors for actuating heavy valve gears, it frequently becomes a matter of difficulty to obtain sufficient sensitiveness and power combined, and this circumstance has militated against the use of gears such as the Rider and Meyer gears which, in point of simplicity and efficiency, are second to none other. They are substantial and positive, and are therefore also available at the highest speeds, and if well designed, excellent diagrams can be obtained from engines fitted with this class of gear, but the force required to move the valve gear is considerable and necessitates too great a variation of speed even if a very powerful governor is employed. Various auxiliary appliances for augmenting the power have therefore been introduced, and of these one of the most ingenious and successful is that invented by Lüde, and shown in Figs. 10 and 11. In this governor the only work of the governor proper consists in controlling the piston valve of a miniature steam engine, the piston rod of which is connected with the expansion slide. By the use of an exceedingly ingenious combination of levers, the motion of the piston and connections is caused to correspond precisely with that of the governor, and even with a very slight variation of load, the expansion valve is moved over a corresponding distance with the full steam pressure. For Rider and similar gears, a cylinder having a diameter of 1½in. is employed, and with a pressure of 75lb. per square inch this will exert a force amounting to about 120lb. If applied to Corliss gears, the cylinder is made 2in. or 2½in. diameter, and the corresponding force exerted at the same pressure amounts to 230lb. or 320lb.

Referring to Fig. 10, the motion of the governor muff A is transmitted by means of the double lever B to the lever C which is pivoted at D in the main lever L. The short arm of the lever C is connected by means of the rod F to a small lever G which actuates a ¾in. equilibrium piston valve arranged in the casing H on one side of the steam cylinder. This valve controls the steam admission and exhaust ports of both cylinder ends, the arrangement being such that both sides of the piston are connected with the exhaust pipe E when the valve occupies its normal central position, while a very small displacement of the valve in either direction permits of steam entering one end of the cylinder. The resulting motion of the main piston rod and lever L with connections causes the piston valve to return to its central position so as to again open both sides of the piston to the exhaust, when the lever L has been turned through an angle corresponding to the displacement of the governor muff. Normally the centre of the joint K corresponds with the turning axis of the lever L. When the governor muff is displaced, the lever C is caused to turn about the centre D, thereby raising or lowering the centre K. The resulting displacement of the lever L causes the lever C to turn about the centre O, and the centre K is consequently returned into agreement with the axis M of the lever L. It is therefore evident that the motion of the lever L and connections will always correspond precisely to the motion of the governor muff, and owing to the high velocity of steam this action is practically instantaneous. The diameter of the steam supply and exhaust pipes should be ¾in. The work of the governor proper is almost *nil*, and consists only in overcoming the friction of the distributing valve or spindle in its guide. The friction of this is very small, as there are no stuffing boxes or other packings, and the movement of the valve is less than 1/32in. Owing to the smallness of the "work" of the governor proper, the wear of the parts connected with the governor—that is, the distributing valve and the small levers—is also quite insignificant. Fig. 11 shows one method of fitting this governor to an engine with Rider gear.

A governor can be applied to actuate either a throttle valve, so as to vary the *pressure* of steam on the engine, or a variable expansion gear to vary the *volume* of steam by automatically

* Paper read before the Manchester Association of Engineers on the 11th ult., by Mr. C. F. Budenberg, M.Sc.

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STEAM ENGINE GOVERNORS.

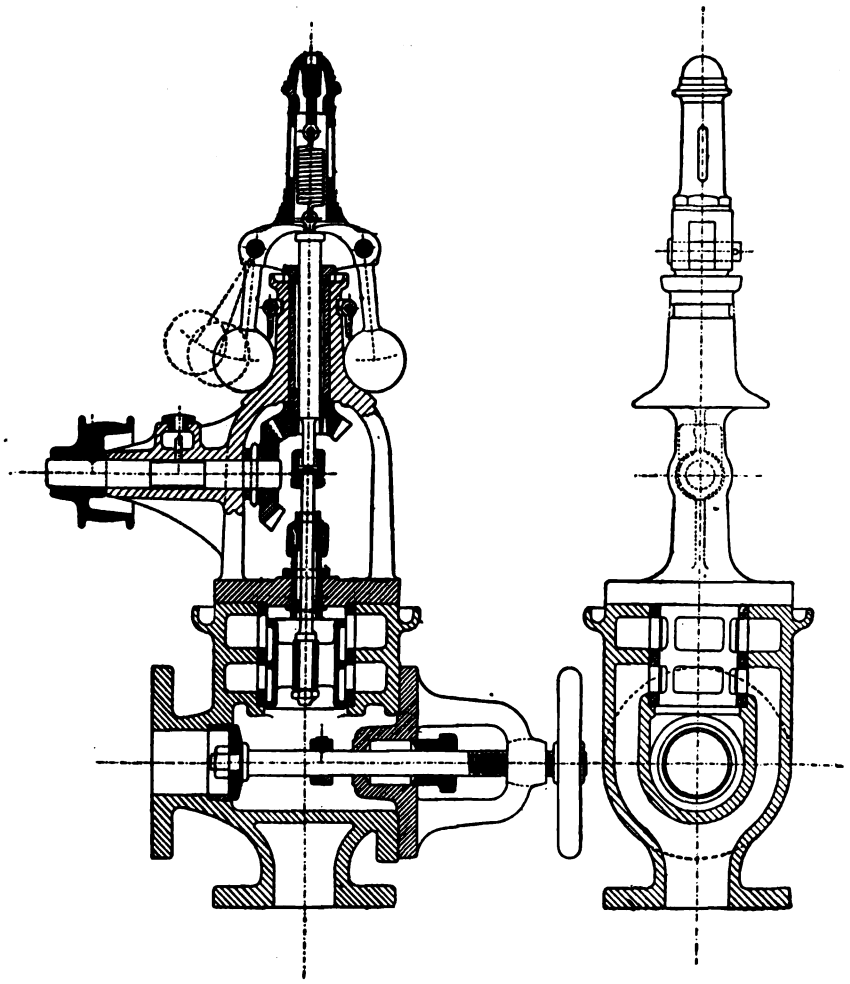


Fig. 12.

adjusting the point of cut-off. The former system is by far the simplest, but the latter has the advantage of greater steam economy, because throttling or wire-drawing the steam results in a considerable loss of power. Generally speaking, expansive regulation is preferable, more especially in large engines working under a variable load, but in cases where the load is nearly constant, a throttle valve engine may work with practically the same economy as an expansion engine under similar conditions, provided the slide valve cut-off is fixed, so that with the maximum load on the engine the pressure obtained in the cylinder falls little short of the boiler pressure.

No hard and fast rule can be laid down regarding the relative advantages of the two methods of regulation, and each case must be considered separately with a due regard to all surrounding conditions, but it must be remembered that both in first cost and in maintenance the throttle valve is by far the cheaper, and although many would have us believe the contrary, there are conditions under which a throttle valve is preferable to any expansion gear. With regard to uniformity of speed, there is nothing to choose between the two systems, as this depends entirely upon the sensitiveness and power of the governor and upon the resistance of the valve or gear.

In the early days of the steam engine, the pivoted disc throttle valve was employed, but this has now been superseded by various cylindrical equilibrium valves, which offer a far smaller resistance, and, therefore, allow of a greater uniformity of speed than the disc valve. The governor and throttle valve is generally combined to form a self-contained fitting, and the manufacture of these has become a specialty, the engine builder being thus relieved of the difficulty of suitably combining governor and valve. Fig. 12 shows a combination of this description, and represents the Soho governor as made by Messrs. Tangyes, Limited, of Birmingham. Similarly, Fig. 13 shows the Buss governor as made by Messrs. Schäffer & Budenberg, of Manchester. These governors, being fixed upon the valve, a long drive is required to work the governor, and strap driving is generally resorted to instead of positive wheel driving.

Although not as reliable as wheels, strap-driving has the advantage that any change of speed is not suddenly transmitted to the governor. Nevertheless, the strap should be fairly stiff, so as not to be materially affected in length when a change of speed takes place, and, above all, it must be perfectly even. Various ingenious appliances have been invented for automatically closing the throttle valve and bringing the engine to a stop in case the strap should give way, but some engineers employ multiple rope driving by which the chance of any such occurrence is practically put out of the question. Some makers employ an ordinary mushroom valve as throttle valve, but this construction is decidedly objectionable, because it offers too great a resistance, and also because it cannot close completely, and is, therefore, not always sure to check the engine when the load is taken off completely.

(To be continued.)

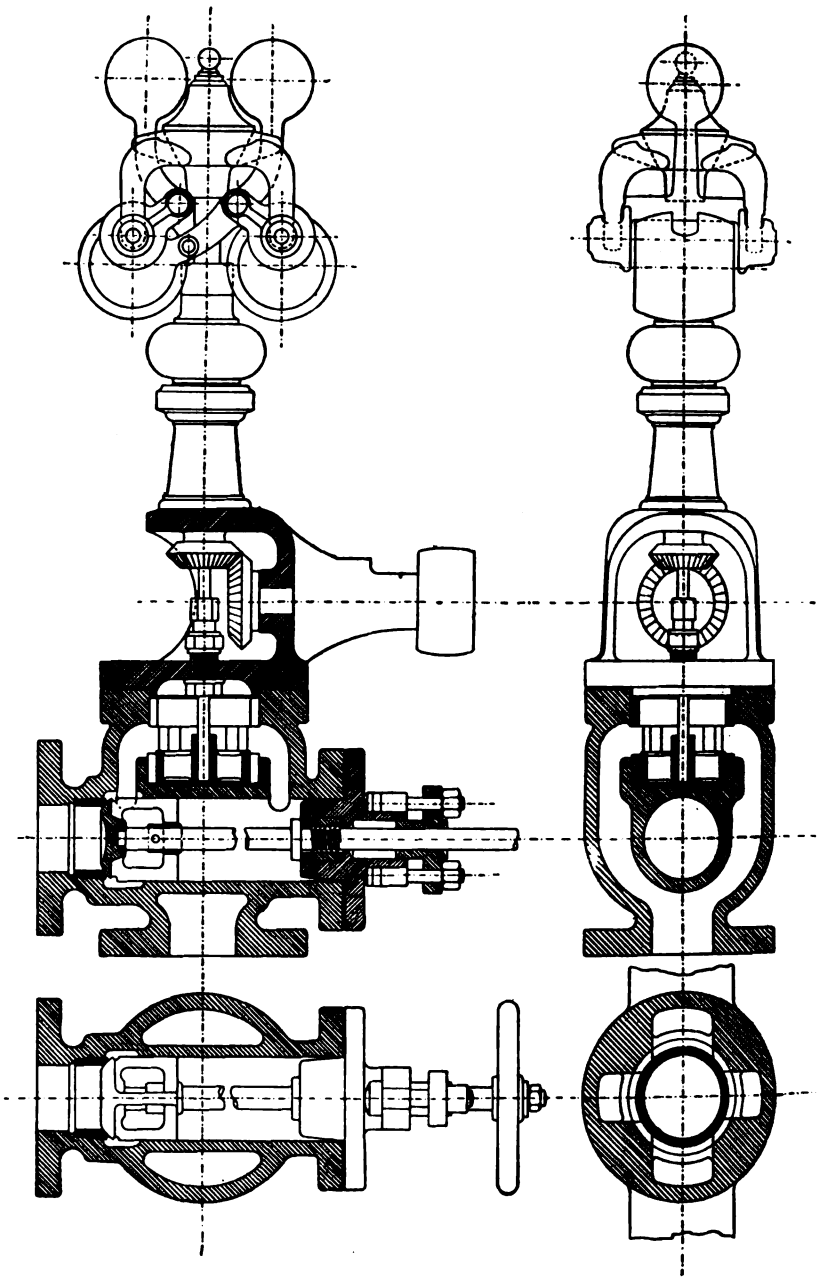


Fig. 13.

THE ROYAL NAVAL EXHIBITION.

The opinion we ventured to state in our last week's issue—viz., that on the opening day the Royal Naval Exhibition would be practically complete—has been fairly verified. In only one similar venture has there been at the formal opening greater signs of completeness, and it is evident that the promoters have at least worked so as to deserve success. This is apparent in more ways than one, and not the least important, to the visitor who desires to live and learn, is the care with which what may be styled petty exhibitors of the heterogenous class have been excluded. Further, in no case has the fact been lost sight of that it is a *Naval* Exhibition, taking the word in its broadest sense, as including the mercantile marine as well as the Navy proper.

In our present article we purpose taking a general survey of the Exhibition, indicating the character of the exhibits, and making passing allusions to some, in the various "galleries" into which the main buildings are divided.

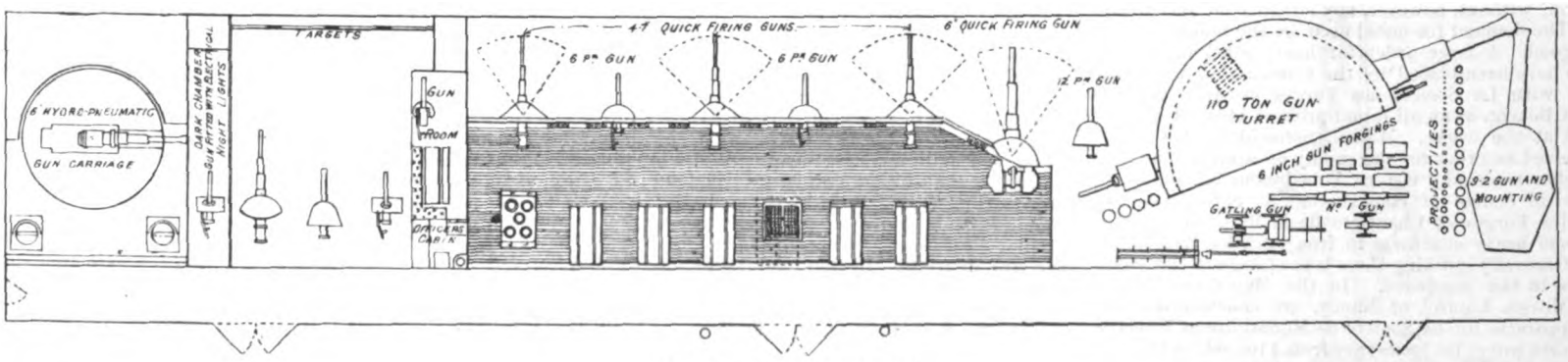
On entering, turning slightly to the left, the Franklin Gallery is first to attract notice (see General Plan, *Industries*, Vol. X., page 218). A large number of the objects exhibited here consist of relics of the ill-fated Arctic Expedition in which Sir John Franklin and so many others lost their lives; thus, of more than passing interest are the models of the steamship "Fox" and of H.M.S. "Terror." The Blake, Nelson, and Benbow Galleries are next, and here the numerous specimens of art and other exhibits, while of general interest, call for no special mention. Passing on to the Howe Gallery, we see specimens of the various necessities required for victualling and clothing our sailors. Several private firms have also miscellaneous exhibits in this gallery, including Messrs. Shand, Mason, & Co., of London, who, amongst a variety of fire-extinguishing appliances, show their patent equilibrium steam fire engine as supplied for H.M. vessels "Hercules" and "Sultan." Messrs. Merryweather & Sons, of Greenwich, are also similarly represented, and to this firm has been entrusted the supervision of the fire brigade of the Exhibition. The Cook Gallery is next in order, and contains a vast variety of purely navigation exhibits, many of historic interest. In this category are the collection of chronometers, including the watch or timekeeper which gained for its inventor, Mr. John Harrison, in 1762, the reward of £20,000. The development of the mariner's compass can also be similarly traced, as also that of the quadrant, and the log. While many of these exhibits have been obtained from the Admiralty, those of private firms add to the value of the collection. The exhibitors of boat-lowering and disengaging apparatus are so numerous that it would be invidious to make special mention of individual exhibitors. Messrs. Watkins & Co., Blackwall, in their collection have several models of racing and cruising yachts, and a torpedo boat built for the Greek Government. Messrs. T. G. Tagg & Son exhibit a combined lifeboat and deck-seat, and Mr. R. J. Turk a centre-board dinghy fitted with self-reefing gear sails.

The Seppings Gallery is now reached, and in it there are many valuable objects of interest to marine engineers and shipbuilders. Here, very fittingly—for Sir Robert Seppings was an eminent naval architect and Surveyor of the Navy in the reign of George IV.—the great bulk of the exhibits illustrative of the construction of the hulls and machinery of seagoing vessels have been placed,

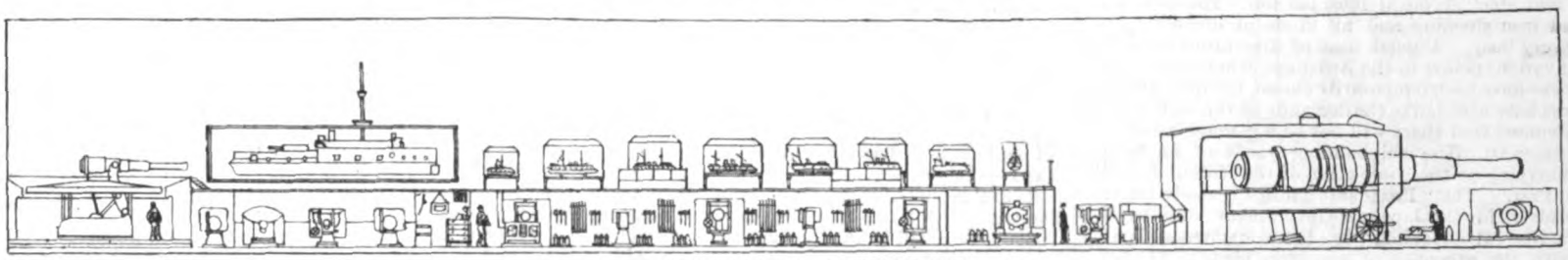
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THE ROYAL NAVAL EXHIBITION.

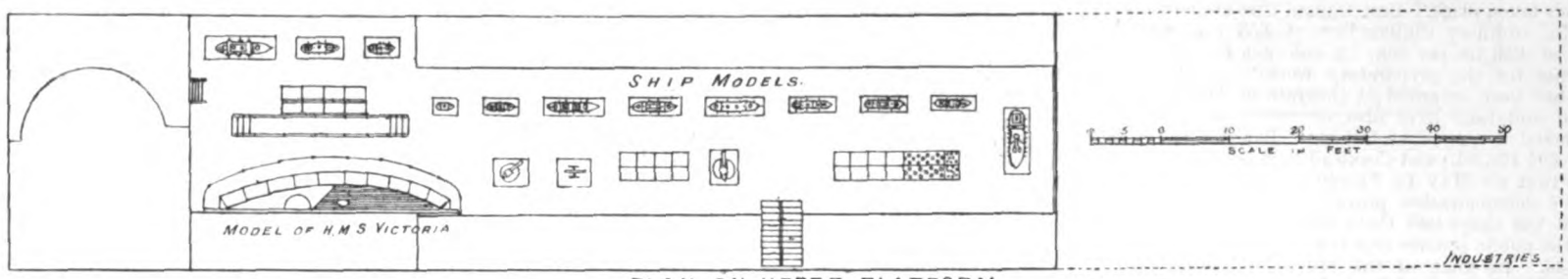
The Elswick Gallery.



PLAN ON BATTERY



SECTIONAL ELEVATION



PLAN ON UPPER PLATFORM

excepting special collections in separate buildings erected by several of the leading shipbuilders and steamship companies. Taking the latter into account, there is no doubt that at the Royal Naval Exhibition the science and art of naval architecture, and its sister science, marine engineering, is better represented than even at the Liverpool Exhibition of Navigation in the year 1886, although many historic vessels are not to the front which would have been had Lloyd's Register of British and Foreign Shipping been represented. Contributions from the Bureau Veritas, another society which did much to add to the completeness of the Liverpool Exhibition, would have also imparted an international character to what is, however, on the whole, a fair representation of the recent development of shipping. If in the mercantile department there are "missing links," it is at all events true that, so far as the Royal Navy and warlike vessels generally are concerned, there has never been a more complete representation at any exhibition.

Marine engineering exhibits are seen first in entering the Seppings by way of the Cook Gallery. Deferring for the present any attempt to describe these exhibits, we cannot but mention here the splendid display of Messrs. Maudslay, Son, & Field, London, of models of marine engines at work, as fitted by them in vessels of the Royal Navy, in a period ranging from the year 1823 to 1874, as also for their other exhibits, which include an air compressing machine for working torpedo gear to be fitted in H.M.S. "Royal Arthur." Messrs. John Penn & Sons, Greenwich, have also a first-class collection of miniature (working) marine engines, besides photographs of the triple-expansion engines now being fitted by the firm in H.M. ships "Sappho" and "Scylla." Probably we may be able to illustrate and fully describe these engines, which are designed to exert 9,000 i.h.p. Messrs. W. H. Allen & Co., Lambeth, exhibit an 18in. pumping engine, which they have specially constructed for H.M.S. "Royal Oak," which is capable of lifting 60,000lb. of water per minute from a depth of 25ft. Messrs. Fleming & Ferguson, Paisley, have a number of exhibits illustrative of their specialties, including their quadruple-expansion engines. Messrs. R. & W. Hawthorn, Leslie, & Co., Limited, Newcastle-on-Tyne, have contributed the working model of the triple-expansion engines for the Italian armourclad "Sardegna," which was specially constructed for the Newcastle-on-Tyne Exhibition. It is probably the most interesting exhibit of the kind, as it represents, on one-eighth of the full size, two sets of engines capable of developing 12,500 i.h.p., and which can be disconnected at will. The "Sardegna" is a twin-screw steamer, the engines represented by the model being merely those to drive the starboard propeller, and they are seen to advantage owing to the special electric lights fitted inside the case covering the exhibit. Other firms might take a lesson from this feature, for, while the general lighting arrangements leave little to be desired, in several instances, owing to shadows cast from screens, &c., objects of interest are undeservedly thrown in the shade.

Palmer's Shipbuilding and Iron Company here contribute their share to marine engineering exhibits, but, owing to their position, the miniature representation of the triple-expansion engines—on a scale of 3in. to the foot—of the s.s. "Flamborough" will, we are afraid, escape general notice. This is partially hidden from view by the collection of ship models exhibited by the company, of which we must defer our notice, as well as any further reference at the present to the remaining exhibits in the Seppings Gallery.

The most important of the separate buildings erected at the cost of the exhibitors is the Elswick Gallery of Sir W. G. Armstrong, Mitchell, & Co., Limited, which we illustrate above. A large portion of this building, which is 230ft. in length and 45ft. in breadth, is occupied with a representation of the 'tween-deck battery of a modern war vessel, with its ordnance in position, ready for action. Above this battery the space on the upper deck is utilised as a model room, in which a number of very completely full models of vessels built by the company are exhibited, besides a half-model, one-twelth the full size, of H.M.S. "Victoria." By having a mirror at the back, the visitor, standing on the raised gangway placed for the convenience of visitors, apparently sees a complete vessel. The whole work reflects great credit on the company's model maker, Mr. W. H. Mattison. At one end of the battery are completely fitted up officers' and midshipmen's cabins. Both these rooms are provided with Mason's recently improved pivoted sidelights. Beyond these rooms, a section is devoted to quick-firing guns, a moveable target being provided, at which the rapidity of firing combined with accuracy of aim can be tested. At the far end, a 6in. gun on a hydro-pneumatic carriage is seen. This type of gun-mounting is being very extensively adopted for coast defence, and in an early number we hope to describe the gun and carriage as actually exhibited, and to continue our description of the other exhibits from Elswick.

The St. Vincent Gallery adjoins Sir Wm. G. Armstrong, Mitchell, & Co.'s building, and is occupied by exhibits of ordnance. Here the contrasts between "culverings," "sakers," "falcons," "minions," "fauconets," "petarares," and a 67-ton breechloading gun, torpedoes, and other recently designed weapons of war are very manifest.

Leaving over for another time the account of the exhibits in the Camperdown Gallery, which are contributed by many leading iron and steel manufacturers, we would remind our readers that, located between the "Camperdown" and the water basin, are the kiosks of the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow; Messrs. J. & G. Thomson & Co., Dalmuir, Glasgow; and the Royal Mail Steamship Company, Limited. In the latter, in addition to miniature representations of naval architecture, there is an elegantly fitted full-size model of a first-class cabin as fitted in the company's steamers. Between the Trafalgar Panorama and the "Victory" is the kiosk of the Thames Iron and Shipbuilding Company, Limited, in which considerable pains has been taken to obtain an effective as well as original arrangement of a variety of exhibits representative of the company's operations. Here also is a completely fitted-up stern cabin for a modern war vessel, while the main portion of the kiosk is taken up by a trophy in which are models of the company's dry docks and works, as well as of bridges, &c.

The Peninsular and Oriental Steam Navigation Company's kiosk, owing to not having any very distinctive outside display, is apt to be overlooked, but will well repay a visit. Even unfinished there is much of interest, including a model of the Suez Canal, large maps, well-finished models of several of the fleet, full-sized state rooms for first-class passengers, &c.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 5th May, 1891.

The Iron Market.—The Paris iron market still continues firm, without, however, any advance on last week's prices. The demand for metal used in the building trade is fairly good. A large order for heavy steel rails is reported to have been placed by the Chemin de Fer du Midi Company with La Société des Forges et Aciéries de la Marine at Boucan at an all round price of 140s. 6d. per ton delivered at the works. Messrs. Schneider, of Creusot, have received an order for the supply of armour plates for the Russian ironclad "Georgy Pobedononetz," of 10,000 tons, now in course of construction at Sebastopol. La Société des Forges et Chantiers de la Méditerranée have taken some heavy contracts in iron work for Mexico and Japan. Generally speaking there is no change in the aspect of affairs in the provinces. In the Meurthe-et-Moselle district Messrs. Cabirol, of Nancy, are constructing four Cooper apparatus for La Société de Montataire at Frouard. In the North prices for joists vary from 116s. 6d. to 120s. 6d. per ton according to the importance of the order; 3 millimetre No. 2 sheets are in fair demand at from 140s. 6d. to 145s., and steel sheets at 160s. per ton. The makers of galvanised iron sheeting and all kinds of domestic iron ware are very busy. A good deal of discontent is said to prevail at various points in the Ardennes, where one or two of the works have been temporarily closed, but in most cases the masters have acceded to the demands of the men, and it may be assumed that there will not be a general strike.

Shipbuilding.—The shipbuilding yards of La Seyne, Var, are hurrying on the completion of the Chilian ironclad "Capitan Prat." The "Presidente Pinto" is ready for sea. Of two cruisers for the Japanese Government built by the same firm, the "Itsukushima" has her armament on board, which, with the exception of one large piece of 34 centimetres furnished by Les Forges et Chantiers du Havre, has been supplied by Sir W. J. Armstrong.

Copper, Tin, and Lead.—A further fall in the price of copper has taken place. Best Chilian bars are now quoted at £56 5s., ordinary Chilian bars at £53 10s., and best selected at £58 5s. per ton. A contract for 800 kgr. of sheet brass for the preparatory workshops at Bourges Arsenal has been awarded at the rate of £64 4s. 6d. per ton. Tin and lead have also decreased in value. The former metal is quoted as follows:—Banca, £96 12s. 6d.; Billiton, £94 12s. 6d.; and Cornwall, £98 per ton.

The First of May in France.—The proposed working men's demonstration proved a fiasco at Paris, where nearly all the shops had their full complement of men, leaving the public squares to a few so-called Socialists and Anarchists. In some of the provincial towns, such as Chaleville, Tourcoing, and Roubaix, the men struck work generally, but apparently in an unorganised manner, and the whole affair seems to have been of a revolutionary political nature rather than a serious endeavour to arrive at a legally curtailed working day.

BERLIN, 4th May, 1891.

The Coal Industry.—The tenders sent in a few days ago for the supply of coal to the railways in the Berlin district gives some indication of the prices of coal in comparison with the prices in the English coal market. For a quantity of 120,000 tons of coal and patent fuel, the tenders included 120,000 tons of coal from the Ruhr district, 197,000 tons of Silesian coal, 30,000 tons of patent fuel, and 105,000 tons of West Hartley pit coal. Mr. W. Peschka, of Nüremberg, tendered for the whole quantity at £6 15s. per double waggon at the pit. Upper Silesian coal was offered by dealers at 8s. to 8s. 4d. per ton at the pit. The demand for English coal was supplied at 16s. 9d. to 19s. 2d. per ton delivered at Stettin, Stralsund, or Swinemünde, to the amount of 181,300 tons of rough coal. Twice the amount of coal required was tendered for from the Ruhr district at £5 9s. per waggon at the pit; 562,500 tons were offered from Silesia at from 6s. 5d. to 11s. per ton at the pit. The United "Gluckhilf" mine offered 120,000 tons at 11s. per ton; the Pleschen mines at Waldenburg offered to supply 37,500 tons at 10s. 2d. per ton; Messrs. C. Kulmitz, 55,000 tons at 10s. 2d.; and the Silesian coal mines at Gottesberg, 18,000 tons at 10s. 290,000 tons of English coal were offered at the prices already mentioned. An offer from the Ruhr district for the whole quantity was made at £8 18s. per double waggon at the pit. There were also offers to the amount of 35,000 tons at 16s. 6d. to 17s.; 20,000 tons of Silesian coke were offered by the "Glückhilf" mine at Hermsdorf at 16s. delivered at the pit. English coke was quoted at £1 5s. 6d. to £1 9s. delivered at Stettin, Swinemünde, or Stralsund. The 5,200 tons of forge coal required was tendered for to eight times the quantity at 8s. to 10s. 9d. per ton for Silesian and 15s. 5d. to 18s. 2d. for English coal. With reference to the supply of coal to German shipowners, an important amount has been secured by the Westphalian mines, whilst the North German Lloyd Company at Bremen holds back. This company some time ago bought 70,000 tons of English coal at 19s. delivered at Norderham. It is reported by some persons that coal of the same quality might have been obtained in Westphalia at 16s. 6d. to 17s., but it is somewhat doubtful whether the quality would have been so good. The Imperial Navy has obtained a supply of best Westphalian lump coal for the current year at 13s. per ton at the pit, and also its supply for the year 1892-93 at 13s. 6d. per ton. It has also obtained a supply of coal for use in the naval workshops at 10s. 6d. at the pit.

VIENNA, 4th May, 1891.

The Iron Market.—There is no important change in the iron market, which continues quiet owing to the reserved attitude of buyers. The Northern Railway Company has placed an important order for axles and wheels. Manufacturers felt some anxiety with regard to the demonstrations on the 1st of May, and in the smaller towns demanded military assistance. At Budapest the State Railways, the shipbuilding establishment, Mr. Lang, and Messrs. Ganz & Co. all resolved to dismiss every man who should leave his work on that day without urgent reason. Similar measures have been resolved upon in other coal and iron districts. In these industries labourers are especially discontented with their lot.—The Egidy Iron Works have resolved to pay a dividend of 4 per cent., as compared with 3½ per cent. in the previous year.

The Coal Market.—The coal market is very active, notwithstanding the advanced season and the small demand for household sorts. There is a large export from North-West Bohemia, and large quantities have been despatched from Aussig, Brux, and Dux into the strike districts. The Lloyd Company may possibly become the property of the Government, and foreign contractors would then be hard pressed by native firms. The negotiations of the Lloyd Company with the State will therefore be interesting to English coal contractors.

Commercial Treaty between Austria and Germany.—This treaty, which has been discussed during the past five months, was signed here yesterday afternoon. The treaty will last for twelve years, and the most-favoured nation clause will be in operation with reference to trade between the two countries. The treaty will also affect other countries in their tariff arrangements with Germany and Austria, as the latter countries have agreed to carry on their negotiations in common. The new treaty is the first which has been concluded between Germany and Austria since the year 1878. In consequence of the new treaty the Austrian customs duty on iron will be decreased from 1s. 6½d. to 1s. 2d.

Electrical Engineering.—It is rumoured that the town of Frankfort has made private arrangements with Messrs. Ganz & Co. for a system of electric lighting. A declaration as to the truth of this report is looked for from this firm, in order that the uncertainty of their numerous competitors may be set at rest. The town of Arad, in Hungary, which has 43,000 inhabitants, has asked for tenders for the electric lighting of the public streets, squares, and gardens. The principal competitors are Messrs. Ganz & Co., of Budapest, and Messrs. B. Egger & Co., of Vienna.

The Monchsberg Electrical Railway.—The electrical railway which ascends the Monchsberg, near Salzburg, had carried 66,712 passengers and more than 1,000 tons of goods up to the end of last year. The net profits amounted to £40,871. It has been decided to enlarge the central station at Salzburg.

Electric Light in Bulgaria.—The Austrian General-Consulate at Sofia, Bulgaria, has been notified by the Municipality to state that tenders for an electric light installation will be received. The time for receiving such proposals expires on the 13th of July, 1891.

Implement Competition.—A competition for threshing machines will be held in Bucharest, at the Ministry of Agriculture, from August 10th to August 15th, and another for sowing machines from September 10th to September 15th. The competition will be held before a special jury, and the Minister of Agriculture will award prizes for the best machines.

BRUSSELS, 5th May, 1891.

The Iron and Steel Market.—There is no improvement in the iron and steel market. The price of the finished product does not rise in proportion to the increased cost of raw material. Business will continue sluggish so long as the price of coal is maintained. The outlook is not promising, as industrial works are not showing the activity which is customary at this season of the year. Joists are quoted at £5 3s., and sheet iron at £6 6s. The import and export of iron and steel have considerably decreased. There is a decrease in the import of steel of 22,000 tons, as compared with the import during the first three months of this year, a decrease of 1,000 tons in iron sheets, of 1,000 tons in rolled iron, of 7,000 tons in pig iron, and of 4,000 tons in railway rolling stock. Contracts for the supply of third-class carriages for the Belgian State Railways have been awarded again. The International Company has obtained contracts to the amount of £5,120; the Malines Company, £5,080; Messrs. Nicaise & Delceeve, £6,000; and M. Verhaegen, £5,090. Goods waggons have been tendered for as follows:—The Metallurgical Company, to the amount of £3,300; the Deyle-Baculan Company, £3,304; the Franco-Belgian Company, £3,312. The Malines Company has obtained a contract for 120 waggons for the Gothard Railway, and the Deyle Company is well employed in the construction of bridges for Asia Minor and of waggons for railways in Holland. This company has just started a system of drying by means of a "thermosyphon," which has been favourably considered by specialists. For the Belgian State Railways the contract for waggon doors has been given to La Société des Forges of Bousval.

The Coal Market.—Prices are well maintained in the coal market. The coalowners allege the existence of strikes as a sufficient reason for making no concessions. The smallness of the stocks at the coal mines forces customers to renew their supplies, notwithstanding the high prices. Prices remain steady with small variations. Small sorts of coke are quoted at 9s. 4d., best coke at 14s., close burning sorts at 5s. 10d. to 6s. 8d. Coal for blast furnaces varies from 9s. 2d. to 10s., and fuel for metal furnaces is quoted at 11s. 3d. Representations are being made with a view to the reduction of the charges for transport. The imports and exports of fuel during the first three months of the year are shown in the following tables:—

Imports.

	Coal.	Coke.
Germany	144,816 tons	21,500 tons
England	110,936 „	13,048 „
France	44,171 „	240 „
Netherlands	6,742 „	1,571 „
Other countries	4,499 „	—

There is thus a diminution in the import of coal, but the import of coke has been trebled.

Exports.

	Coal.	Coke.
Germany	33,269 tons	12,456 tons
England	7,666 „	—
France	918,985 „	187,186 „
Luxemburg	54,588 „	35,350 „
Netherlands	39,516 „	—
Other countries	33,202 „	8,938 „

The export of coal shows a small increase, whilst the export of coke has been diminished by about 30 per cent.

Microscopic Exhibition at Antwerp.—An international exhibition of microscopical instruments will be held in Antwerp in the months of August and September next, in commemoration of the invention of the microscope 300 years ago. Applications for space should be made by intending exhibitors to Dr. Henri Van Heurck, Jardin Botanique, Antwerp. The exhibition promises to be of an interesting character.

DÜSSELDORF, 5th May, 1891.

The Iron Market.—The general condition of the iron market is much affected by the strike amongst the miners, which, however, is now nearly at an end. The coal market is on the whole firm, the demand for home manufacture is small, and there is no improvement in pig iron. The bar iron market has improved, and there is also a greater demand for coarse and fine sheets. It is intended to erect a common place of sale for both these articles. It has also been proposed by the ironmasters in the Siegen district to institute a union for the sale of the iron. Those works which are employed in making railway material are provided with orders for the next few months. Machine works and iron foundries are fairly well employed. The following statistics of the stores at the blast furnaces are given:—

	March 31, 1891.	Feb. 28, 1891.
Puddled and spiegel iron	38,356 tons	39,274 tons
Ordinary puddled iron	4,605 „	5,901 „
Bessemer iron	11,888 „	9,467 „
Thomas iron	23,200 „	27,840 „

Exhibition.—The Electrical Exhibition at Frankfort-on-the-Maine will be opened on the 15th inst.

The Steamship "Bismarck."—The twin-screw steamship "Bismarck," built by the Vulcan Ship Wharfs at Stettin for the Transatlantic service, and which is now being completed at Swinemünde, is the largest vessel of the German navy. When fully loaded its displacement is 12,900 tons. The steamer has two triple-expansion engines of 7,000 h.p. each. The speed is estimated to be about 19 miles per hour.

AMSTERDAM, 4th May, 1891.

Labour Questions.—The 1st of May demonstration of certain portions of working men in Holland have given some trouble to the authorities, who had made certain preparations to meet it. The day passed off in a very quiet manner. In Amsterdam, The Hague, and in other towns, fairly attended mass meetings took place to insist upon the "right" of the labourer to work eight hours a day, and no more. Some violent speeches were delivered, but no disturbance occurred.

The Blitong Tin Company.—The extraordinary meeting of shareholders of the Blitong Tin Company, held at The Hague, has sanctioned the draft of a contract between the company and the Dutch Government for a settlement of the questions in dispute, and for an extension of the concession till the year 1927. The chief points of the new agreement have been given in a previous letter (see *Industries*, Vol. X., page 367). Like the Government, the shareholders have declared in a separate resolution that the agreement contained the utmost limit of their concessions.

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THE AMSTERDAM QUININE FACTORY COMPANY.—In 1890 this company manufactured 21,894lb. of quinine. The net profit, however, was too small to allow a dividend to be declared.

NEW INDUSTRIAL COMPANY.—The Dutch Government has sanctioned the articles of association of the American Petroleum Company, established at Rotterdam, with a capital of £416,666, for the purpose of combining the businesses of the Standard Oil Company at New York with those of its agents at Antwerp and Rotterdam. The latter place is intended to become the chief petroleum centre of the American trade.

DUTCH SOUTH AFRICAN RAILWAY COMPANY.—Messrs. Labouchere, Oyens, & Co., of Amsterdam, have opened the subscription for shares of the value of £500,000 in the Dutch South African Railway Company, forming the third and fourth series of the entire capital of the company, which amounts to £916,666. All these shares bear the unconditional guarantee of the Transvaal Government for 6 per cent. interest. The works on the line from the Portuguese frontier to Pretoria are now rapidly approaching their completion. The price of some of the shares is 115 per cent.

STOCKHOLM, 2ND MAY, 1891.

THE SWEDISH IRON INDUSTRY.—At the quarterly meeting of the Society of Swedish Ironmasters, held at Stockholm on the 28th ult., it was stated that the exports during the first quarter of the present year were as follow:—

	1890.	1891.
Pig and ballast iron ...	5,031 tons	3,416 tons
Ingots	1,666 ,,	568 ,,
Blooms	1,978 ,,	1,661 ,,
Other rolled or hammered bars	26,417 ,,	25,190 ,,
Ends of bars.....	199 ,,	259 ,,
Wire iron	313 ,,	53 ,,
Plate iron	1,386 ,,	853 ,,
Nails	474 ,,	548 ,,
	37,464 tons	32,548 tons

showing a decline, as compared with last year, of nearly 5,000 tons for the first three months of the present year. In the banks there were warrants for the following quantities, on April 1st:—Pig iron, 25,932 tons; bar iron, 9,434 tons; other iron, 16,585 tons; total, 51,951 tons; which is about 7,000 tons more than on April 1st last year. There are in Sweden 191 blast furnaces, 527 furnaces, 33 Bessemer converters, and 32 Martin furnaces, of which the following number were in use during the first quarter of the years 1890 and 1891:—

	1890.	1891.
Blast furnaces	131	138
Furnaces	392	374
Bessemer converters ...	24	23
Martin furnaces	23	28

with a respective production of—

	1890. Tons.	1891. Tons.	Increase. Tons.	Decrease. Tons.
Pig iron	118,839	127,983	9,144	—
Blooms	55,639	54,258	—	1,381
Bessemer ingots	21,423	23,318	1,895	—
Martin ingots ...	14,597	18,163	3,566	—

With an increase of about 9,000 tons in the production of pig iron there is an increase of about 5,500 tons in the manufacture of steel. During the first quarter of the present year the foreign iron markets have on the whole been dull, and the Swedish ironmasters have also been obliged to lower their quotations. For pig iron there is no large demand, but hammered Lancashire has been in better request, and most of the works concerned in this manufacture are well employed. The following quotations, per ton of 1,016 kgr., without discount, were agreed upon:—

	F.o.b Gothenburg. £ s. d.	F.o.b. Stockholm. £ s. d.
Ordinary hammered iron	8 2 6	8 0 0
,, rolled iron.....	7 12 6	7 10 0
Rolled finer iron	8 2 6	8 0 0

THE ZONE TARIFF.—The zone tariff, which has now been worked with satisfactory results for many months by some of the private railway companies, is gaining ground in Sweden. The Second Chamber has made representations to the Government that the question should be investigated in order to effect a reduction in the passenger fares, so as to facilitate the intercourse between the different parts of the country.

CHRISTIANIA, 2ND MAY, 1891.

CONTEMPLATED DRY DOCK.—The construction of a dry dock at Oorevaagen is being favourably considered at Christiansand. The expenditure is calculated at about £16,666.

DR. NANSEN'S ARCTIC EXPEDITION.—The question of where the vessel for Dr. Nansen's Arctic expedition should be built has now been decided, Mr. Collin Archer, of Lourvik, having secured the contract.

THE LOFOTEN FISHING.—This year's fishing at Lofoten amounts to about 21 million fish. The yield of medicinal oil is the largest on record, that of roe somewhat small. The following table gives the respective quantities for the last five years in hectolitres:—

	Roe.	Medicinal Oil.	Liver.
1891 ...	19,600	18,200	22,700
1890 ...	24,000	16,700	58,500
1889 ...	19,800	12,900	23,500
1888 ...	39,000	16,100	38,000
1887 ...	29,850	9,500	38,200

The prices for roe varied much, but were, on the whole, low.

MADRID, 4TH MAY, 1891.

THE MANHÉS PROCESS FOR COPPER.—This process for obtaining copper has been successfully started at the mines of Jerez-Lanteira in the province of Granada. The remaining sulphur and other minerals are eliminated from the crude matte at a single operation. Assays made at Jerez-Lanteira show from 99·5 to 99·75 of pure copper. The process was soon in regular working order, and after a few days the chief engineer was able to leave its management in the hands of his subordinates. The Manhés process, which is employed in the treatment of sulphuret of copper is especially applicable to such cases as that of Jerez-Lanteira, where fuel is very costly, the air being blown into the Manhés converter by hydraulic power at a distance from the works. No fuel is required except for the first smelting of the ores to make the matte. The Fives-Lille Company has carried out the general installation, which is to be applied also to the working of rock drills.

THE BARCELONA AND MARSEILLES TELEGRAPH CABLE.—This cable, which was laid down seventeen years ago has worked without interruption up to the 10th ult. The damage then done was soon mended by the Eastern Telegraph Company, and the cable was again in working order on the 13th ult.

SALE OF THE PEDROSO IRON MINES.—For some weeks past it has been rumoured that an English company was about to purchase the extensive iron mines and old-fashioned iron works belonging to the Pedroso Company. This company was obliged to suspend payment about three years ago, as it was unable to pay interest on its debentures. The price paid for the property is said to be £260,000, besides a commission of £40,000. This is considered a very high price. The company possesses land worth about £30,000, iron works valued at about £25,000, and the mines must therefore be estimated to be worth £200,000. Perhaps the buyers are better acquainted than the natives with the quantity of ore contained in the mines.

ROME, 4TH MAY, 1891.

ITALIAN METALLURGICAL AND CHEMICAL WORKS.—The following table shows the production of metallurgical and chemical works in Italy in the year 1889:—

Products.	Number of Works.	Production. Quantity. Tons.	Value in Units. Lire.	Total Value. Lire.	Number of Men Employed.
Pig iron	11	13,473	157·58	2,123,096	227
Iron and Steel	323	181,623 157,899	277·33 223·78	50,343,398 35,185,837	14,518
Gold.....	3	212	2,640·15	569,848	89
Lead	1	18	340·00	6,176,100	700
Silver		33	150·00	5,025,750	
Copper and its alloys..	9	6,904	1,773·75	12,246,000	1,638
Antimony ...	1	1,969	—	280,066	44
Mercury	3	378	5·90	2,274,450	43
Salts.....	77	430,639	—	2,919,092	5,037
Aluminite & sulphate of alumina ...	8	4,047	—	456,840	125
Refined sulphur	17	53,816	93·00	4,958,586	269
Patent fuel ...	22	520,450	—	16,515,900	618
Total.....	475	1,369,961		139,074,963	23,308

SHIPBUILDING.—Two fine steel cruisers, the "Etruria" and the "Umbria," have been launched from the yard of Messrs. Orlando Brothers, at Leghorn. They are provided with armoured bridges, and are each of the capacity of about 2,300 tons. Their length is 80 metres, beam 12 metres, and depth 8·6 metres. The engines, which have been constructed at the works of Messrs. Orlando, are on the triple-expansion system, and develop 6,500 h.p. A speed of 19 knots per hour will be attained. The designs of these vessels have been made by the Italian naval authorities, and the engines have been designed by Messrs. Orlando. The engines are intended to develop the maximum of power with the least possible weight, and are said to combine all the latest improvements in naval engineering.

NEW YORK, 25TH APRIL, 1891.

PNEUMATIC GUN CARRIAGE.—A pneumatic disappearing gun carriage for a 10in. breechloading gun, which was built at Boston, under a contract with the Board of Ordnance of the Army, has arrived at the Government Proving Grounds, Sandy Hook, and will be in place, ready for a series of practical tests, about May 10th. The 10in. steel breechloading gun, built by the War Department, which was successfully tested at Sandy Hook, and which broke the French carriage, made by the Creusot Works, upon which it was mounted, a year ago, is to be mounted on the disappearing carriage in a pit below the surface of the ground.

LARGE CASTING.—One of the largest castings ever made in Worcester, Mass., was poured at the Star Foundry recently. It was a fly wheel, weighing over 20 tons, and was 20ft. in diameter, with a 42in. face. It will be finished in Fitchburg, there being no lathe large enough in Worcester.

ELECTRICITY IN A GLASS FACTORY.—The Pittsburg Plate Glass Company, of Ford City, Pa., is adopting the use of electric motors in its large plant in that city. The company has a glass polishing table which is said to be quite novel, and economical in comparison with similar machines. These tables are over 30ft. in diameter, and are revolved by gearing which has heretofore been operated by steam. The Thomson-Houston Motor Company has now installed a 100 h.p. motor to operate these polishing tables.

LATHES FOR BORING GUNS.—The United States Government has given an order for eight lathes to be used for trimming and boring guns. They will cost over £80,000, and an idea of their size may be formed from the fact that one of them will weigh 250 tons.

MEASURING INSTRUMENTS.—Messrs. Darling, Brown, & Sharpe, of Providence, R.I., are issuing an artistic reproduction of the diploma they received at the Paris Exhibition of 1889 in respect of their exhibit of accurate measuring instruments.

PHILADELPHIA, 24TH APRIL, 1891.

THE STRIKE IN THE COKE REGIONS.—The trouble at Connelsville and the surrounding coke regions still continues. During the past week considerable rioting has been going on. The labour leaders have been informed by the Frick Company that 500 experienced miners from the Punxsutawney coalfields have been engaged to work in the various mines of the company. The Frick Company has also engaged the services of a number of Pinkerton detectives, 500 of whom are already on the grounds, and will guard the mines at which the men are at work. A regular battle occurred between the sheriffs and some Hungarians while the former were making evictions. The arrival of a company of the National Guards put a stop to the fight, but not until after there had been some bloodshed. The owners of bituminous coal mines in Indiana have decided to resist the eight-hour day movement announced for May 1st, and refuse to pay for mining before the coal is screened. They have also decided that the wage schedule for the year beginning May 1st shall be on the basis prior to this year—that is, 2½d. less for the summer months than for the winter, and that the rate shall be 7½d. per ton less than for block coal.

NAVAL.—Two nickel-steel plates, which are to be used as armour, have been received at the Navy Yard in Washington, whence they will be taken to the proving ground at Indian Head, Maryland, in order to be practically tested. These are the first American plates made, and much interest is manifested in the test. The plates are 8ft. long, 6ft. wide, and 3in. thick. The official report of the trial trip of the gunboat "Bennington" has been received at the Navy Department. It showed that the main engines developed 3,323 h.p., which, with the auxiliaries, made the total 3,436 h.p. With the steam pressure at 166lb., the starboard engines made 150·82 revolutions, and the port engines 151. Under authority conferred by Congress, the Secretary of the Navy is making arrangements to reopen the League Island and Boston Navy Yards for construction and repair works. Tenders for furnishing the yards with tools have been opened, but the contract has not yet been awarded.

RESUMPTION OF WORK.—A general resumption of work has taken place at the Edgar Thompson Steel Works of Messrs. Carnegie, Phipps, & Co. The works have been closed for about two weeks, and the resumption will give employment to about 2,000 men, but will, it is stated, last only a short time. The Brooke Iron Company's mines at French Creek, about thirty miles from this city, which have been idle for two years, are about to resume work. The Temple Iron Company, of Temple, which has been prospecting for ore on an adjoining track, struck a rich deposit at a depth of 150ft. Along the East Penn Road, several other mines which have been idle during the winter have resumed work.

THE PROPOSED INTERNATIONAL RAILWAY.—The Pacific Mail steamship "Newport," which sailed for Central America, carried a party of engineers to study the feasibility of the proposed international railway, designed to connect North, Central, and South America. The party comprises Mr. W. F. Shunk, chief director of the enterprise, Mr. J. Inurie Miller and assistants, Mr. Joseph Parker and Mr. J. D. Forster, of Harrisburg, and five members of the United States Navy. The expedition will last two years, and each member has contracted to remain one year. Its object is not to make surveys, but rather to make observations of and to study the system of railroads now in use in the Republic, the local lines, and their uses and possibilities. Maps and plans will be prepared in such a way as to show the possibility of a railway system extending the entire length of South America.

NEW INDUSTRY AT AMBLER.—The town of Ambler, in this State, will soon have another large manufacturing industry. It will be known as the Halsey Manufacturing Company, the leading members of the firm being Philadelphians. The product will consist of steel drills and kindred implements. The capital is to be £10,000, and about 100 mechanics will be employed at first.

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THE INSTITUTION OF MECHANICAL ENGINEERS.

The ordinary general meeting of this Institution was held on the 30th ult. and the 1st inst., at the Institution of Civil Engineers, Great George Street, Westminster, Mr. Joseph Tomlinson, President, being in the chair. After the transaction of the usual formal business, the Secretary read the report of the

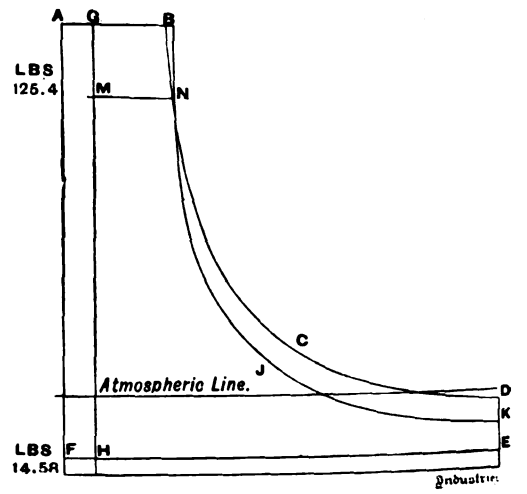
Research Committee on Marine Engine Trials: Report upon Trials of the S.S. "Iona."

The result of these trials will be found in some respects more complete than any of those previously made by the committee. The steamer tested, built in 1889, is 275·1ft. long, 37·3ft. beam, and 19ft. depth, with a gross registered tonnage of 2,094 tons. Her mean draught during the trial was 20ft. 7½in., corresponding to a displacement of 4,430 tons. The trial lasted sixteen hours, ending at 10.30 a.m. on July 14th, 1890, the weather being fine throughout. The speed of the engines was not altered nor was the valve gear touched during the trial, and in addition to all the observations taken on former occasions, indicator diagrams were taken at intervals from the circulating and air pumps, from the first and second receivers, and from both ends of the condenser. The temperatures of the circulating and discharge water were noted, and the jacket-water, steam pipe drain-water, and supplementary feed-water were each measured. The engines have cylinders of 21·88in., 34·02in., and 56·95in., each with 39in. stroke. The high-pressure cylinder only is jacketed, and this during the trial was drained into a measuring tank. The clearances of the cylinders are given as 12·41, 10·11, and 7·64 per cent. of the volumes swept through by their respective pistons. The high and low pressure cylinders have ordinary double-ported slide valves, the intermediate a Trick slide valve, the gear being the ordinary link motion. The pumps are all driven from cross-head of low-pressure cylinder. The surface condenser contains 1,360 square feet of tube service. The four-bladed cast-iron propeller is 14ft. 6in. diameter, with a mean pitch of 14ft. 6in. Steam, at a mean pressure of 165lb., was supplied by two single-ended double-furnaced steel boilers, of 13ft. 3in. mean diameter, and 10ft. long, worked under forced draught. Each grate was 3ft. 6in. broad, and had fire-bars 3ft. long, thus giving a total grate of 42 square feet. The total heating surface is 3,160 square feet, 2,590 square feet being tube surface. The Tyne coal used was weighed, and the consumption plotted out in one of the diagrams accompanying the paper, the first portion of which is given on page 448. From the thirty-two sets of diagrams taken the following mean effective pressures were found to exist in the high, intermediate, and low pressure cylinders respectively — viz., 46·65lb., 20·44lb., and 7·16lb.—and these correspond with the following horse-powers:—205·6, 221·2, and 218·6, or a total of 645·4 mean indicated horse-power, with an average throughout the trial of 61·1 revolutions per minute. The mean boiler pressure was 165lb. above the atmosphere, and the mean barometric pressure 14·58lb. (29·67in. of mercury), the mean vacuum being equal to 28·25in. of mercury. The actual boiler efficiency was 69·2 per cent. of the thermal value of the fuel. The absolute engine efficiency, or ratio of the heat turned into work to the heat given to the feed-water, was 17·1 per cent., the combined efficiency being equivalent to 11·8 per cent. The coal burnt was at the rate of 1·46lb. per indicated horse-power per hour. A mean speed of 8·6 knots was maintained throughout the trial.

Professor Kennedy, who opened the discussion, hoped that the interest of the paper would more than than compensate those who attended for its apparent dryness, and suggested that the paper was a difficult one to follow. He regretted that the failure of the apparatus designed for measuring the amount of priming had prevented their investigations of this part of the trial being carried to a successful termination. Referring to certain of the diagrams accompanying the paper, he explained that these were shown shaded in error. In concluding his introductory remarks, he stated that in these trials the Committee had endeavoured to give in this paper information asked for in connection with the previous papers. He congratulated Mr. Brown, the chief engineer of the ship, on the data obtained at the subsequent trial independently carried out by him, and he was glad that the results obtained by that gentleman so closely approximated to those of the Committee.

The President then called upon Mr. J. R. Fothergill, the superintending engineer to the owners, who, after asking to be allowed to speak later on, was ultimately persuaded to give his experiences of the ship. Mr. Fothergill stated that he could not very well criticise the paper, as his position somewhat militated against his doing so. He explained that a deflector plate which should have been shown in Fig. 1 was omitted. The object of this plate was to deflect the gases and give as complete combustion as possible in the combustion chamber. The lowness of pressure in the ash-pit he attributed to cleanness of fires and no formation of clinker; hence the air passed freely through, and the pressure kept low. Notwithstanding this, there was an exceptional quantity of air, and he considered the good combustion obtained was due to this. He thought that the tables of results obtained bore out the fact that these trials were not undertaken to furnish any fancy figures, but to obtain data as to work done under ordinary average working conditions

Mr. Mudd (the manager of the firm who built the engines), after complimenting the chief engineer of the "Iona" for his energetic labours, and also Mr. J. R. Fothergill for his admirable superintendence, stated that he was thoroughly satisfied with the trials: (1) Because the coal consumption agreed closely with the best records they had been able to obtain from time to time from sea-going engineers; (2) because the water consumption was somewhat less than he anticipated. The engines were of the triple-expansion type, and the boilers of ordinary construction, fitted with Mr. Fothergill's system of forced draught. One of the principal features of these engines was the arrangement of the cylinders. The high-pressure cylinder was placed in the middle, and had three metals or walls around it. Counting from the inside the first metal is the working barrel. Between the first and the second metal a space forms a steam jacket at full boiler pressure. This is the only jacket about the engines, and is the one referred to throughout the report. The space between the second and the outer wall is partly the receiver between the first and second cylinders, but mainly it is the receiver between the second and third cylinders. The jacket, therefore, gives off heat inwards to the first cylinder, and outwards to the receivers. Doubtless this double action of the jacket accounts for the large condensation therein shown in the report—namely, 4·3 per cent. of the whole feed. When the engines were at work in the ordinary way without the measuring tanks, two objects were accomplished at once by very simple means—viz., the securing of a well-drained jacket, and a highly heated feed, by simply carrying the drain pipe from the jacket into the feed suction pipe, which takes the water from the hot-well to the feed pumps. In this way the feed can be heated to 160° or 180° Fahr. without the pumps refusing duty. Mr. Mudd said that the position of the jacket, especially in relation to the receivers; the efficient drainage of the jacket; and the use of a high feed temperature in conjunction with a low condenser temperature, all tended to economy. On the official trial, at least one of these things was necessarily interfered with—viz., the feed temperature—because the act of measuring in tanks, that took a quarter of an hour to fill, brought down the temperature to an average of 106° Fahr., as seen by the report. There might yet be some persons who would doubt whether this would have any effect on the consumption, and therefore it is very fortunate that the engineer was able to make a trial of the consumption in the same manner as that adopted by Professor Kennedy, omitting the water measurements, which trial showed in a most satisfactory and convincing manner that, had the feed temperature been 160° instead of 106°, the consumption would have been in the region of 1·38lb. per horse-power per hour instead of 1·46lb. A correction for this would increase the boiler efficiency from 69·2 per cent. to 73·4 per cent., increase the total efficiency from 11·8 per cent. to 12·55 per cent., and leave the engine efficiency where it was—viz., at 17·1 per cent. Referring to the question of the supplementary feed supply, and which amounted to as much as 6·1 per cent. of the total feed, it was noticed that the feed pump glands were not quite in order; but the leakage did not appear anything alarming, although the fact of turning on suddenly a big tank full of water, causing the pumps to run almost full-pump, had a tendency to make the leakage worse. There was also some leakage at the large 4in. cock at the bottom of the measuring tanks. Although no one thought these leakages serious, it is astonishing what a large quantity of water can pass in sixteen hours in what appears to be a very small leak; and here again a careful test made by the engineer on this very ship, but in this case made *previously* to the official trial, and covering as long a period as nine days, is accessible, and shows what one would naturally expect—viz., that 6·1 per cent. was very greatly in excess of the ordinary supplementary supply necessary. As good fortune again would have it, the horse-power during that trial was about the same, and certainly not *less* than on the official trial, so that he was safe in taking the same total feed for a basis. Assuming that at the time of this trial of the engineer there was absolutely no leakage at feed pumps, it would still appear that as much as 6,622lb. of water must have been measured on the official trial without ever reaching the boilers. This reduces the water consumption from 13·35lb. per horse per hour to about 12·69lb. It also reduces the efficiency of the boiler again to 69·8 per cent., increases the efficiency of the engine from 17·1 per cent. to 18 per cent., and leaves the total efficiency where it was by the last correction—viz., 12·55 per cent. Attention has of late years been very forcibly and very properly called to the condensation taking place in cylinders; and in the report it is stated that at 125·4lb. above the atmosphere there was present, by the indicator diagrams, 63·4 per cent. of the feed as steam and 36·6 per cent. as water; at 19·4lb. pressure, 74·9 per cent. of steam and 25·1 per cent. of water; at 8·6lb. pressure, 59·1 per cent. of steam and 40·9 per cent. of water; these calculations being made on a total water consumption of 2·35lb. per revolution. Commenting on this, he wished to state—Firstly, the correction for water measured but not put into the boiler, and alluded to previously, alters the total water per revolution to 2·23lb., and the percentages of steam and water to the following, viz.—At 125·4lb., 66·8 per cent. of steam and 33·4 per cent. of water; at 19·4lb., 79 per cent. of steam and 21 per cent. of water; and at 8·6lb., 62·4 per cent. of steam and 37·6 per cent. of water. Secondly, that the condensation should be apportioned as much as possible wherever we have known quantities, and thus reduce the unknown sources of loss to a minimum. For instance, it was shown that 6·15lb. of water went through the jacket per minute; and that ·88lb. were collected at the steam pipe per minute, neither of these quantities ever going into the working cylinder at all. Making further reduction under these heads to try to arrive at the actual condensation *within* the cylinders, he got a total water consumption entering the cylinders of 2·115lb. per revolution, and the percentages of steam and water fall to the following:—At 125·4lb., 70·5 per cent. of steam and 29·5 per cent. of water; at 19·4lb., 83·2 per cent. of steam and 16·8 per cent. of water; and at 8·6lb., 65·7 per cent. of steam and 34·3 per cent. of water. Mr. Mudd had no reason to suspect, he said, that any less quantities of water than the latter were in existence in the cylinder at these various points, but he was anxious that it should not be all attributed to "initial condensation." He thought that Professor Kennedy or some other person might do a valuable work in attempting to further subdivide and apportion to known causes as much as possible of this water. For instance, looking for a moment at what goes on with regard to the cushioning steam—viz., that steam, which, while existing as steam in the cylinder, is not measured or taken into account at all, and rightly so, because the cushion steam is properly regarded theoretically as a fixed and constantly existing quantity that is simply expanded and compressed like stretching and relaxing an elastic band—we have to deal with the fact that we cannot take work out of steam by expanding it and put it back again by compressing it *without loss*: indeed, there must be a loss in the act of expanding, and a further loss in the act of compressing. Therefore a portion of the cushion steam has to be made up by fresh steam at every stroke



to balance the condensation due to these necessary losses in the expansion and compression of the "cushion." If the precise efficiency of the cushion steam could be determined, the water in the cylinder could be subdivided, apportioning to this inevitable source of loss its proper share. On the same grounds he had hoped much from the ingenious attempt that was made on this trial to determine the priming water; and if the apparatus had not given out, we should doubtless have been in a position to charge to that cause also *its* proper share of the water found in the cylinder. Mr. Mudd here made a sketch of a diagram, which is given above, showing the ratio of the realised work to the theoretical work, and taken in two or three different ways. All the horizontal measurements of the engine diagrams are set off from a vertical line G H, thus obliterating the effect on the appearance of the diagrams of the compression. This causes them to overlap, and the area

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of the overlapping parts is equivalent to the shaded areas. The distance between the two vertical lines represents the volume of the compression steam at the time of admission to horse-power cylinder, and which, in this instance, is equal to the clearance volume. The upper and lower limits of the diagram are the upper and lower pressures registered in the cylinders by the indicator: and lower down there is a zero line shown. The volume M N represents the 1·49lb. of steam stated in the report to be present in the cylinder at 125·4lb. above the atmosphere. The point N, therefore, has been taken as the origin of the two curves, and the curves are both what are known as "ten-ninth" curves—that is, the pressure varies as the reciprocal of the ninth root of the tenth power of the volume. The outer curve B C D represents the expansion of the whole steam in the cylinder, including the cushion steam, and the realised work represents 75 per cent. of the whole work-area A B C D E F. Leaving off the area A G H F, the work realised is 83·6 per cent. of the remainder G B C D E H. This latter percentage is of little value however, because, if the cushion steam be left out of the comparison at all, it should be left out up to a curve dropped from G, with the quantity of steam A G. The more interesting way to look at it, he said, was the following:—M N is the working steam found in the cylinder at 125·4lb. pressure. The lower curve N J K represents the expansion of a quantity of steam M N, as though it were expanded in one cylinder to a volume H E, equal to the volume swept through by the low-pressure piston. An interesting fact was that the realised work was 103·5 per cent. of the whole area G B N J K E H, and if it is left off from both the theoretic and the actual diagrams the piece above M N, which ought to be done, the diagrams give 105·2 per cent. of the theoretic area. That apparently means that some portion of the water found in the cylinder at the pressure 125·4lb. was subsequently evaporated and performed work. He would not go into the question as to how far the jacket lent its aid in effecting this, nor venture to discuss to what extent it is economical or the reverse to allow the engine thus to act as a boiler, but he thought this turns on the source from whence the water came, whether it came from a necessary or an unnecessary source. If it were priming water or excessive initial condensation or the like, it would be very undesirable to see the diagrams bulging out from the evaporation of water that should have been prevented from being there; but if it were the necessary condensation due to the performance of work, or the inevitable condensation due to the cushion steam or the like, then he was of opinion there is economy in getting what work we can out of the water that *must*, from these insurmountable causes, be present in the cylinder. He expected some one would make the usual remark, that if the steam that was put in the jacket had been put in the cylinder instead, more work would have been realised. In this case there was a good answer to that. If the jacket steam had been put in the cylinder so as to have lengthened the line M N, it could not have lengthened that line in any greater proportion to the whole jacket water than the proportion that M N itself bears to the whole feed-water, and when that addition was made to M N, and a new curve thrown down, it would be found that the realised work represented almost precisely 100 per cent. of the new theoretic area. A high degree of economy can only be attained by bringing to one's aid a great number of details all making to one end instead of counteracting each other. The steam must be thoroughly "bottled up" in the cylinder when it is wanted there, as a slight leakage past the valves or pistons is disastrous to economy. He had adopted as a regular principle the common slide valve in preference to the piston valve, not having found it possible to keep the latter quite as tight over long periods as the flat slide. Another condition of economy is that the steam must be supplied to the engine fairly dry; and if dry steam be supplied the greatest care possible is necessary in the design and arrangement of the valves and piston packing rings, or a trouble of a mechanical order will arise.

(To be continued.)

SHIPBUILDING NOTES.

On the 25th ult. there was launched from the yard of the Sunderland Shipbuilding Company, Limited, the steel screw steamer "Wallarah," built to the order of Mr. William Lund, of London. The vessel is of the following dimensions:—Length between perpendiculars, 360ft.; breadth of beam, 43ft.; depth, 29ft. She is classed 100 A1 at Lloyd's, on the three-deck grade. Triple-expansion engines will be fitted by Messrs. Wigham Richardson & Co., of Newcastle. The vessel has been specially designed for the owner's line running between London and Australia.

On the 28th ult. Messrs. W. Doxford & Sons, Limited, launched from their yard at Pallion the fine cargo steamer "Clan Macintyre," built to the order of the Clan Line Steamers, Limited, managed by Messrs. Cayzer, Irvine, & Co., of that city. The vessel is steel throughout, built to Lloyd's 100 A1 class, and her dimensions are:—Length, 312ft. 6in.; breadth, 39ft. 6in.; depth, 24ft. 8in. The engines, which are on the triple-expansion system, were built by Messrs. Doxford, the cylinders being 23in., 37in., 62in., by 42in. stroke, steam being supplied by two large boilers with Howden's forced draught. This vessel is of similar construction to the "Clan Macneil" and "Clan Macleod," just completed by the same builders.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, May 8th, at 9 p.m. Lecture on "Liquids and Gases," by Professor W. Ramsey, F.R.S.; Saturday, May 9th, at 3 p.m., Lecture I., on "The Artificial Production of Cold," by Mr. H. G. Harris, M.Inst.C.E.

INSTITUTION OF CIVIL ENGINEERS.—Friday, May 8th, at 7.30 p.m. Students' meeting. Paper to be read: "Malta Dockyard Caisson," by Mr. J. W. Brown.

PHYSICAL SOCIETY.—Saturday, May 9th. Meeting at Cambridge.

NEXT WEEK.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Monday, May 11th, at 7.30 p.m. Resumed discussion on the following papers: "The Unsinkability of Cargo-carrying Vessels," by Mr. W. Hök; "Water Gauge Fittings for Steam Boilers," by Mr. H. Gray; "The Basis of Ships' Scantlings," by Mr. J. Petree.

INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 12th, at 8 p.m. Ordinary meeting. Discussion on the paper on "Railway Train Lighting," by Mr. W. Langdon.

SOCIETY OF ARCHITECTS.—Tuesday, May 12th, at 7.30 p.m. Paper to be read: "Timber Piling in Foundations and other Works," by Mr. H. Adams, M.Inst.C.E.

OLD STUDENTS' ASSOCIATION OF THE CITY AND GUILDS OF LONDON INSTITUTE.—Wednesday, May 13th, at 8 p.m. Paper to be read: "Some Researches in Electro-Magnetic Induction," by Mr. E. B. Vignoles.

SOCIETY OF ARTS.—Wednesday, May 13th, at 8 p.m. Paper to be read: "Fast and Fugitive Dyes," by Professor J. J. Hummel. Thursday, May 14th, at 4.30 p.m. Paper to be read: Description of the Growing Uses of Tussur Silk in the European Textile Manufactures," by Mr. T. Wardle.

INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, May 14th, at 8 p.m. Discussion on the following papers: "On Some Effects of Alternating Current Flow in Conductors having Capacity and Self-Induction," by Dr. J. A. Fleming; "Some Points Connected with Mains for Electric Lighting," by Mr. W. H. Preece, F.R.S.

ROYAL INSTITUTION.—Thursday, May 14th, at 3 p.m. Lecture on "Recent Spectroscopic Investigations," by Professor Dewar, F.R.S.

PRICES CURRENT, 6TH MAY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	5 15 0	6 5 0	f.o.t. wks.
" Angles	5 10 0	6 0 0	"
" Plates	5 12 6	6 2 6	"
Staffordshire Bars	6 10 0	7 0 0	London.
" Angles	6 12 6	7 2 6	"
Crown Sheets	7 0 0	7 10 0	"
" Hoops	7 0 0	7 10 0	"
"Siemens-Martin" Steel Boiler Plates		7 5 0	"
" Ship and Girder		6 10 0	"

METALS.

		£ s. d.		£ s. d.	
Spelter:	Ordinary	£24 0 0	to	24 5 0	
Copper:	British Cakes and Ingots	56 0 0	"	56 10 0	
"	Chili Bars, G.O.B.'s	51 17 6	"	52 2 6	
"	Other sorts, G.M.B.'s (equal to Chili Bars)	51 17 6	"	52 2 6	
"	Manufactured (strong)	64 0 0			
Lead:	Common Pig	13 7 6	"	13 10 0	
"	English Sheet	14 2 6	"	14 5 0	
Tin:	Straits	91 7 6	"	91 15 0	
"	Australian	92 0 0	"	92 10 0	
"	English Ingots	95 10 0		.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: A better feeling is observable in copper, with improved demand. During the week a fair amount of business has taken place in Chili bars at steadily advancing rates. To-day's quotations are £51 17s. 6d. to £52 2s. 6d. cash. Manufactured £64, "strong," with more inquiry.

TIN has continued to improve during the past week, and values of foreign are about £1 per ton higher than on the 29th ult.

LEAD has advanced slightly during the last few days.

SPELTER is in better demand, and seems likely to be dearer owing to the labour troubles on the Continent, stocks being small.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£ s. d.		£ s. d.	
Acid:	Carbolic Crystals lb.	0 0 5¼	to	0 0 6¼	
"	" Liquid gal.	0 1 0	—	.....	
"	Citric lb.	0 1 8½	—	.....	
"	Oxalic "	0 0 3½	—	.....	
"	Sulphuric ton	1 15 0	—	.....	
"	Tartaric lb.	0 1 3½	—	.....	
Alum:	Lump (powder 10/- ex.) ton	5 12 6	—	.....	
Ammonia:	Carbonate lb.	0 0 3½	—	.....	
"	Muriate (Grey) ton	23 10 0	—	.....	
"	" (White) "	26 10 0	—	.....	
"	Sulphate "	11 2 6	—	11 5 0	
"	Liquor lb.	0 0 3	—	.....	
Antimony	ton	75 0 0	—	.....	
Bleaching Powder	"	6 12 6	—	.....	
Bisulphide of Carbon	"	13 0 0	—	.....	
Borax	"	29 0 0	—	.....	
Benzole (90 %)	gal.	0 4 4	—	.....	
" (50/90 %)	"	0 3 2	—	.....	
Copper Sulphate	ton	15 10 0	—	.....	
Copperas	"	2 0 0	—	.....	
Kieserit	"	.....	—	.....	
Lead:	Nitrate "	21 10 0	—	.....	
"	White Sugar "	26 0 0	—	.....	
"	Brown "	19 10 0	—	.....	
Potash:	Bichromate lb.	0 0 3¾	—	.....	
"	Caustic ton	22 0 0	—	.....	
"	Carbonate "	20 10 0	—	.....	
"	Chlorate lb.	0 0 5½	—	.....	
"	Prussiate (Yellow) "	0 0 10½	—	.....	
"	Sulphate (Basis 90 %) ton	4 0 0	—	.....	
Precipitate:	Red lb.	0 3 6	—	.....	
"	White "	0 3 6	—	.....	
Salts:	Epsom {Bags ton	3 0 0	—	.....	
	{Casks "	3 15 0	—	.....	
"	Glauber "	1 10 0	—	.....	
Sulphur:	Sublimed Flowers "	10 10 0	—	.....	
	Recovered "	7 0 0	—	.....	
Soda:	Ash deg.	0 0 1¾	—	.....	
"	Caustic (White 70%) ton	10 17 6	—	.....	
"	" {" 60%) "	9 12 6	—	.....	
"	" {Cream 60%) "	9 5 0	—	.....	
"	Crystals "	3 7 6	—	.....	
"	Bicarbonate "	7 0 0	—	.....	
"	Hyposulphite "	6 10 0	—	.....	
Solvent Naphtha	gal.	0 1 7	—	.....	
Tartar, Cream of	cwt.	5 7 6	—	.....	
Zinc Sulphate	ton	7 10 0	—	.....	

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: There is no change in the position of alkalies. Soda ash continues active. Bleaching powder has a steady inquiry, and caustic soda is rather slow. Crude carbolic is very dull, although the production is considerably reduced, but there is little demand for crystals. Sulphate of copper continues to fall. Acetates of lime are rather pressed for sale. Acetate of soda is more plentiful.

OILS.

		£ s. d.
Cocoanut:	Cochin per tun	35 10 0
"	Ceylon "	29 10 0
Cottonseed	"	22 10 0
Cod	"	24 0 0
Lard	"	36 0 0
Linseed	"	22 0 0
Olive, Spanish	"	45 0 0
Palm, Lagos	"	26 0 0
Rapeseed:	English "	31 10 0
Seal:	Pale "	26 0 0
"	Brown "	.....
Sperm	"	50 0 0
Whale	"	22 0 0
Turpentine	per cwt.	1 10 0
Coal	per gal.	.....
Petroleum	(Refined) "	0 0 5¾
	Spirit	0 0 7¾

WE have received from Messrs. Barry, Henry, & Co., engineers, Aberdeen, a copy of their new catalogue. In the catalogue, which is very neatly got up, complete particulars are given of gear, spur, and helical wheels, belt and rope pulleys, shafting, couplings, pedetals, edge runners, water wheels, &c.

WILLING'S BRITISH AND IRISH PRESS GUIDE FOR 1891.—This is the eighteenth year of publication of this very useful book, which gives a comprehensive index to all the newspapers and journals published in the United Kingdom, with particulars of each one, as regards the time and place of publication, price, &c. The book also contains a list of the principal colonial and foreign journals published.

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HOME INDUSTRIES.

LONDON, 7th May, 1891.

THE MONEY MARKET.—Money has been plentiful during the week, and call loans have been fairly easily obtainable. The discount market maintains a firm tendency, there being still some demand for gold for the Continent. The stock markets have been irregular, with a decided inclination to droop. The postponement of the impending Russian Conversion Loan has upset the Paris market, whence the uneasiness thereby produced has spread to London. At the same time New York is troubled by continued shipments of gold, and the boom which seemed so promising has rather come to grief for the time being. The postponement of the Russian Loan has been attributed to serious friction between the Russian Government and its financial representatives abroad, and all Russian securities have consequently declined heavily. All foreign securities gave way in sympathy, and brought down home stocks with them. Americans have been moving irregularly, and, though the undertone is firm, the immediate prospect is a little uncertain. Miscellaneous securities have presented no striking feature. Silver stocks, after a brief rally, have lost ground again with the metal. Mining shares have not been in much favour, with the exception of Indian gold shares.

GREAT NORTHERN TELEGRAPH COMPANY.—The traffic returns of this company show that the receipts during the month of April were £23,600. The receipts from January 1st to April 30th, 1891, were £88,000, whilst for the corresponding months of 1890 and 1889 they were £81,800 and £84,000 respectively.

THE BOILER REGISTRATION AND INSPECTION BILL.—We observe that the supporters of this Bill, being not overnumerous, have found it necessary to make considerable modifications in it, which will necessitate its being reprinted prior to a further attempt being made to get a second reading on the 17th prox. It would seem that their efforts to enlist the support of the Trades Councils have been entirely unsuccessful, as far as regards Glasgow. As the *Trade Unionist* observes:—"It would be interesting to know on what grounds the Bill can possibly be recommended. What would be thought of a Factory Bill which empowered the manufacturer to select his own factory inspector? Yet this precious Bill of Sir W. Houldsworth, under the pretence of carrying out inspection, makes the steam user, to all intents and purposes, his own inspector."

INSTITUTE OF MARINE ENGINEERS.—A meeting of the Institute of Marine Engineers was held on the 28th ult., Mr. J. H. Thomson, Vice-President, being in the chair. After a digest of Mr. D. McMillan's paper on "Pressures in Compound Engines" had been read, a discussion took place. Mr. Gray and Professor Elliot (of the South Wales University) explained the theoretical considerations in designing engines. Professor Elliot stated that he had found a gain of 20 per cent. in compounding an engine and raising the pressure. Meetings are to be held on the 12th and 26th inst. Papers will be read on these dates. The dinner of the Institute will take place at the Holborn Restaurant on the 20th inst., when the inaugural address will be given by the President, Mr. P. Denny.

THE JUNIOR ENGINEERING SOCIETY.—On the 2nd inst. a large party of members of this Society visited the Tower Bridge works, where they were received by Mr. E. W. Cruttwell, the resident engineer. The steel columns have been erected at the piers and abutments, and the other parts so far pushed forwards that the suspension chains supporting the shore spans will shortly be proceeded with. The fixed girders on the piers, between which the girders of the opening span rotate, have been placed in position. In the north pier the accumulators are being fixed. The masonry, with which the steelwork of the pier and abutment towers is to be surrounded, is stored on the ground, and the setting of it will soon be commenced.

DECIMAL ASSOCIATION.—A joint deputation from the Associated Chambers of Commerce and the Decimal Association will be received by Mr. Goschen and Sir Michael Hicks-Beach on the 8th inst., at 1 p.m., to urge the Government to take the necessary steps for rendering compulsory the adoption of the metric system of weights and measures, now generally adopted in other countries, as the first stage in the introduction of a complete decimal system. The Decimal Association will be represented by the following gentlemen, and a petition, praying for the appointment of a Royal Commission or Select Committee, will be presented to the Chancellor of the Exchequer:—The Right Honourable Sir John Lubbock, Mr. O. V. Morgan, M.P., Mr. Frederick Hendricks, Professor Foxwell, Colonel R. J. Ward, Mr. Stephen Court, Sir Guildford Molesworth, K.C.I.E., Mr. Tom Mann, President of the Dockers' Union, Mr. Frank Debenham, Professor Gladstone, F.R.S., Sir Philip Magnus, Mr. A. D. Provand, M.P., Mr. S. Montagu, M.P., Mr. J. E. Dowson, Mr. F. F. Begg, Mr. A. Siemens, Mr. W. T. Rowlett, Mr. R. A. Hadfield, Mr. W. B. Myers, Mr. H. J. Falk, Mr. J. Rankin, M.P., and Mr W. A. Smith.

BUSINESS ANNOUNCEMENT.—The business of wire rope manufacturing, which has hitherto been carried on by Mr. William Wilkins, at the Wire Rope Works, 39, High Street, Wapping, London, has been transferred to Mr. Gastrill Wilkins and Mr. S. H. Hudston (eleven years with the firm of Messrs. Richard Johnson & Nephew, wire manufacturers). The style of the new firm will be Messrs. Wilkins & Co.

MANCHESTER, 7th May, 1891.

THE THIRLMERE WORKS.—The works connected with the aqueduct for the conveyance of water from Thirlmere to Manchester are making great progress. Only about 600 yards of tunneling requires finishing out of a total length of 14¼ miles; about 9 miles of cut and cover, and 19 miles of pipe-laying also require completion. In all a total length of 67 miles out of 95 is completed. The ironwork is being steadily delivered along the route. The large service reservoir at Prestwich is also nearly completed. It is pentagonal in shape, and has a capacity of 22,000,000 gallons. The inlet is 9ft. in diameter; the beds are of puddled clay covered with concrete and bricks set in pitch, and the banks are stone-pitched.

THE TEXTILE WORKERS AND THE TRADE UNIONS CONGRESS.—At a meeting of delegates from all the chief manufacturing districts in Lancashire, Cheshire, Derbyshire, and Yorkshire, held on the 2nd inst., which was very fully attended, a long discussion took place whether the textile trades should be represented at the Trade Unions Congress. It was finally agreed to recommend all the associations to send delegates, and by a further resolution the raising of the age of half-timers was opposed.

ARSENIC IN COTTON GOODS.—The Consul at Christiana having recently reported that British cotton prints had acquired a bad reputation owing to an excess of arsenic in the pigments employed, the Manchester Chamber of Commerce remitted the subject to the Chemical Sectional Committee for examination. This committee reported that after testing the cloths they found arsenic in dangerous proportions. The use of arsenical compounds was not absolutely necessary, and the same effect could be got in another manner. It was decided to communicate with the Government in order to ascertain what action, if any, should be taken in the matter.

GAS COOKING RANGES.—The Gas Engineering Company of Manchester are placing upon the market a gas cooking range which comprises among its features an automatic flue-damper motion, by which the size of the flue is regulated in exact accordance with the gas consumed. When the doors of the oven are opened the light is automatically reduced, the act of closing them again turning on the full supply. An extra oven heated by the waste heat is also fitted, in addition to the one ordinarily supplied. The cost does not exceed that of the ordinary type of gas stove.

ENGINEERING DISPUTE.—Following upon the settlement of the hours question in Manchester, a dispute is going on in Oldham consequent upon a demand from the men for an advance of 2s. per week. In one or two cases the advance has been conceded, but in most establishments it is being resisted.

ELECTRIC LIGHTING.—A second instalment of what is probably the largest shop installation in the provinces is now under way at Paulden's Drapery Stores, Stretford Road, being found necessary on account of the recent structural enlargements. The original plant consists of a 200 h.p. compound engine driving two 400-light Edison-Hopkinson, four 10-arc Weston, and one 2-arc Gramme dynamos. About three hundred 50 c.p. incandescent and fifty arcs are in place. The new plant comprises a second engine of 130 h.p., three 10-arc Weston machines, and one Edison-Hopkinson dynamo for 1,000 amperes and 100 volts. Three hundred more 50 c.p. incandescents and twenty-two arc lamps are being wired.

THE LINEN AND JUTE TRADES.—Although the home trade has improved, the demand is chiefly confined to fancy goods. The heavy branches, on the whole, are neglected, with the exception, perhaps, of linens. Buyers have placed orders more freely, owing probably to the firmness in Scotch, Irish, and Continental centres of production. The North of England linen manufacturers are fairly well employed. Leeds employs less than 3,000 operatives in its flax mills, but for crashes and other goods of that class local mills have a steady output. The fabrics are stout, and wear well, genuine material being used for both warp and weft. The price, however, is rather high in comparison with the cheaper and, of course, lighter Scotch makes. The shipping trade has improved somewhat, and there is a better demand from Canada, several large buyers being at present in the city. New York and Chicago firms are also operating, and there is no diminution in purchases on account of the high tariff as far as linens are concerned. Fancy Belgian jute tapestry furniture hangings continue to find a ready market in the home trade.

PRINTS AND GINGHAMS.—The sale of prints will, in the near future, suffer considerably from the competition of the coloured woven cotton dress materials known as ginghams. The latter, in fact, are already being shown much more extensively in the local warehouses, as fashion, which has been against them for twenty years or more, has now turned in their favour. The tendency is not very marked, but it is sufficiently distinct to justify the anticipations here made. In the United States ginghams have made much more rapid progress in public favour during the past few seasons.

A NEW CLOTH AND BAG STAMPING MACHINE.—Messrs. Lancaster & Co., of 35, Market Street, are introducing a new machine for stamping names and trade marks on cloth or bags. The machine has been specially designed to suit the requirements of bleachers, finishers, packers, &c. The machine is provided with a self-inking roller, and it is claimed that from 1,200 to 1,500 pieces of cloth can be stamped per hour. The machine can be driven by a small motor.

GLASGOW, 7th May, 1891.

COAL SHIPMENTS.—The coal shipments from Scottish ports, which had been expanding rapidly during the few past weeks, now show some falling off in the rate of expansion. The increase last week was only 800 tons. Glasgow ports, however, show the large increase of 7,000 tons, against a decrease for several successive weeks. The falling off in the increase is said to be due partly to scarcity of tonnage, especially in the west. The falling off is no doubt also due to some extent to the reluctance of buyers to pay the present high prices.

PROPOSED NEW BRIDGE.—At a meeting of the inhabitants of the district north and south of Loch Etive at Connel Ferry, about four miles from Oban, it was decided to initiate a movement for the erection of a bridge at Connel Ferry. The bridge would pass over the curious Falls of Lora, where the incoming tidal waters pass over a gravel bed into Loch Etive, producing the phenomenon of a fall in one direction during the flowing of the tide and in the other during the ebbing. The estimated cost of the bridge is about £20,000. The population of the district is sparse, but the increase of facilities for communication would undoubtedly aid its development.

GOLD EXTRACTION.—Advices from New Zealand report that the Crown Mines Company, a Glasgow enterprise, have made a successful trial of the Cassel process. A crushing of 263 tons of ore yielded 90¼ per cent. of the assayed gold, and 70¼ per cent. of the silver. The value of the product was £6 4s. 6d. per ton of ore, as against £2 per ton by the old battery method. The cost of the extraction is set down by the Crown Mines Company as follows:—Drying, 1s. 6d. per ton; grinding, 5s. per ton; cost of Cassel process, 13s. 6d.—total, 20s. per ton.

OIL COMPANIES.—Messrs. Donald & Co.'s monthly circular on the oil companies states that the Pumpherston Company is expected to pay 10 per cent. dividend, and Young's Paraffin Oil Company 8 per cent. The two dividends declared during April were the Broxburn, 15 per cent., and the Clippens, *nil*. The Broxburn Company has in addition written off a large sum for depreciation—a wise step in a prosperous year. Broxburns have advanced 7s. 6d. during the month, while nearly all the other companies' shares have fallen sharply—Linlithgows, 23s. 6d.; Clippens, 22s. 6d.; West Lothians, 20s.; Burntislands, 10s.; Pumpherstons, 7s. 6d.; Holmes, 6s. 3 l. per share.

MINERALS.—The five blast furnaces at Calder belonging to Messrs. Wm. Dixon & Co., Limited, are now being relighted. Two furnaces were put in blast on the 4th inst., another is being prepared, and the remaining two are expected to follow ere long. New ammonia plant is being re-erected at Carnbrae, one of the works of Messrs. Merry & Cunninghame. The five furnaces at these works will be relighted on the completion of the ammonia plant.

SHIPBUILDING.—Notices have been posted at all the leading shipbuilding and engineering establishments in the Clyde district that piece work wages are to be reduced by 7½ per cent.

GLASGOW CORPORATION.—The Glasgow Boundaries Bill, which settles the long-vexed question of the extent of the municipal area, passed the House of Lords on the 4th inst. —The Corporation appointed a committee to consider the question of electric lighting in the compulsory area under the provisional order granted to the Corporation in accordance with the Electric Lighting Acts. The Town Council will consider the recommendation of their committee within a few days. Sir William Thomson is understood to have advised the Corporation to adopt a low-tension in preference to a high-tension system.

THE LATE MR. ROBERT KINGHORN.—Mr. Robert Kinghorn, J.P., whose death occurred at the end of last week, was for many years connected with the firm of Messrs. Robert Napier & Sons, and was latterly general manager of the London and Glasgow Engineering and Shipbuilding Company, Limited. Mr. Kinghorn, during the half century of his association with shipbuilding on the Clyde, took an active part in promoting the rapid development which was characteristic of the period.

(From our own Correspondents.)

LIVERPOOL, 6th May, 1891.

TIMBER TRADE.—There has been a moderate import during the past month, with a fair consumption. The stocks generally are heavy, and there is a want of buoyancy in the market, with little improvement in prices. The stock of yellow pine is very heavy, and the consumption small, several lots having been sold at very low prices. The stock of red pine is ample for present demands. The stock of oak is very heavy, but the deliveries have been fairly satisfactory. The consumption of elm has been fair, and the stocks are light. There has been a small consumption of ash, and the stocks are heavy. Birch has not been imported, and the stocks are moderate. The arrivals of mahogany consist of 455 logs and curls of St. Domingo, 400 logs and curls Honduras, 209 logs Tabasco, 1,317 Mexican, 119 African, and 16 Panama. There was strong competition at the three sales, good prices being obtained. There is a fair demand for cedar at steady prices.

SHEFFIELD, 6th May, 1891.

THE IRON AND STEEL MARKET.—A fair amount of work is being turned out from the rolling mills and forges. The Association Mills are employed on hire work of special

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descriptions. A large amount of cycle material is also being made. The file steel trade is not very brisk. Railway material is only in moderate request, Some orders for rails have been received at £4 17s. 6d. Tyres and axles are still quoted at about £12 per ton. The armour plate mills are kept fully employed on heavy plates for the Government, and Messrs. Vickers on the light Russian all-steel plates. Orders for marine work are scarce, and there is little new work in progress. There are a few solid triple-shafts for a Continental Government, but these will soon be completed. Engineers are not well employed, and pattern makers are working short time. The file and cutlery trades are also very quiet. The building trades are brisk all round, and workmen are asking for an advance of ½d. per hour, which will bring their wages up to 6d.

COAL AND COKE.—All descriptions of coal are firm in price. Best coal is at 11s. 6d. in the Barnsley district at the pit's mouth. The demand for London continues good, and with the opening of ports in the Black Sea there has been an increase in the export from this district. Coke is rather easier. The best quality is selling at about 23s. per ton.

LOCAL COMPANIES.—The Staveley Coal and Iron Co., Ld., are about to issue warrants for the payment of a second interim dividend of £3 per share on the A and C shares (£60) and 10s. on the B and D shares (£10). The Parkgate Company are also paying a dividend of 4 per cent.

SHEFFIELD SOCIETY OF ENGINEERS.—A lecture will be given at a meeting of this Society, on the 7th inst., on "English *v.* American Engineering Practice," by Professor J. Goodman, M.Inst.M.E., of the Yorkshire College, Leeds.

A TECHNICAL SCHOOL FOR HALIFAX.—The Halifax Corporation are taking steps to found a technical school. It has been decided to devote the whole of the sum accruing from the Exchequer surplus of last year to the purpose, and several leading local firms have given handsome donations, while the Clothworkers' Company have headed the list with a subscription of £2,000. A total sum of £20,000 is asked for to enable the object to be accomplished.

NEW WATER SUPPLY FOR MORLEY.—The construction of the water works for Morley, from the designs of Mr. Chas. Gott, C.E., of Bradford, is now in hand. A reservoir is being constructed at Withens Clough, with a water area of 63 acres and a storage capacity of 300,000,000 gallons, which is equal to 200 days' consumption of the full supply, in addition to the quantity required for compensation purposes.

NORTH STAFFORDSHIRE, 6TH MAY, 1891.

THE IRON TRADE.—The advance in the price of Scotch warrants is a matter of surprise, and is looked upon as the result of speculative buying, and justified neither by the demand nor the price of finished material. Negotiations have been in progress between blast furnace proprietors and their employés in this district with a view to a reduction in wages, and a final meeting is to be held on the 8th inst., when an arrangement will be made, probably, for a reduction of 10 per cent.

THE COAL TRADE.—Collieries producing house coal still find a large demand. Prices of manufacturing fuel are weaker in consequence of the heavy falling off in demand.

THE POTTERY TRADE.—The arbitration agreed upon for the settlement of the wages dispute will take place during the present month.

LEICESTER, 6TH MAY, 1891.

COAL MINING.—This industry remains remarkably active in this district. Most of the pits are fully employed, and orders are not slow in coming to hand. Prices are very firm in all the better qualities of coal, and no reduction is anticipated before June.

WOOL SPINNING AND YARN TRADES.—Since our last report there has been a small improvement in the business of the local wool market. A fair quantity is changing hands at recent prices, at which quotations the market is very firm. Colonial wools are in good demand, and prices are slightly higher. As a rule, the supply of English wool is small, and there will be no large transactions before the new clip comes in to the market. Spinners are busier than for some time, and in some instances are able to obtain a small advance in prices, but the low rates prevailing for some time past are not easily moved. Lambswool yarns are most in demand. In cashmeres and cotton the trade is not up to the average.

HOSIERY TRADE.—There is only a slow improvement here, the backward spring seriously affecting the placing of season orders.

MIDLAND RAILWAY.—This company are engaged in building a new passenger station here at a cost of over £200,000. There is great activity prevailing on the works, which will be of a heavy character.

SWANSEA, 6TH MAY, 1891.

TINPLATES.—Notwithstanding the decision to bring all the works to a standstill for a month, additions to plant are being carried out in several instances. Another mill has been started at the Pentyrch Works, where for more than a year two mills have been unable to meet the demand. A new engine to drive two more mills and the cold rolls was put into operation last week. At Barry Port a new tinplate works, to consist of four mills, is about to be erected on land which has been secured near Derwydd, belonging to the Earl of Ashburnham, who will be a large shareholder in the new enterprise. Building operations are expected to commence about the end of May. In regard to the stop-month, it is stated that in a few instances the masters have signified their intention of assisting the men by paying them a portion of their wages as if they were working.

CARDIFF, 6TH MAY, 1891.

IRON AND STEEL.—There is a slightly better tone in the hematite pig iron trade, but the business done has been small. Steel rails find a poor market at £4 10s. to £4 15s. per ton, heavy sections. Steel tinplate bars are in moderate request. Iron ore is in better demand, and prices have advanced. Rubio ore is quoted at 13s. 6d. to 14s. c.i.f. Cardiff and Newport, and 14s. 6d. Pathcawl, with 50 per cent. iron as basis.

STEAM COAL AND COKE.—The advance in colliers' wages of 2½ per cent. has come as a surprise even to those who were intimately connected with the trade, and should justify the sliding scale as a correct means for adjustment of disputes between masters and men. The market continues very firm, and shipments during the past week have reached nearly 300,000 tons, which is about the highest amount recorded. Prices remain at for 1st quality steam coal, 14s. 6d. to 14s. 9d.; 2nd, 13s. 9d. to 14s. 3d.; 3rd, 13s. to 13s. 6d.; 4th, 12s. 6d. to 12s. 9d.; first house coal, 14s. to 14s. 9d., and second ditto, 12s. 9d. to 13s. 3d. Coke, furnace, 17s. 6d. to 19s.; foundry, 20s. 6d. to 21s. 6d.; best foundry, 23s. to 25s.

BARROW-IN-FURNESS, 6TH MAY, 1891.

HEMATITE.—A better trade is being done in hematite, and sales this week, both of warrants and makers' parcels, show an improvement. The demand for Bessemer iron has especially increased. Warrant iron has been changing hands at 49s. net cash, and makers are asking 49s. 6d. to 51s. 6d. for mixed Bessemer numbers net f.o.b. During the week the Lowther Hematite Company at Workington has blown out another furnace, and has now only one of their three furnaces in blast. Throughout the district only 39 furnaces are in blast, and 12 of these are at Barrow, while 38 furnaces are standing idle. The stocks of warrant iron this week have been decreased to the extent of over 6,000 tons, and the stocks still held represent 161,000 tons. It is hoped that makers will restrict their output so as further to decrease these stocks.

STEEL.—There is a better trade doing in Bessemer qualities of steel, and some large orders have been recently received. Heavy rails are quoted at £4 12s. 6d., light rails at £5 15s., and colliery sections at £6 10s. per ton. Prices are steady at £6 5s. for ship plates, £6 for angles and other sections, and £6 15s. for steel boiler plates.

SHIPBUILDING AND ENGINEERING.—The need of new orders in the shipbuilding trade at Barrow is fully demonstrated by the fact that the five steamers in hand, and now in course of construction at Barrow, will only afford work for three months. As some of the departments have already completed the work in hand the stagnation is beginning to assert itself. It is expected, however, that new orders of some importance will soon be obtained. The new second-class cruiser "Melampus," built and engined by the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, is now almost completed, and will sail from Barrow in the course of the next week to undergo her speed trials at Portsmouth. The Barrow Company have shown great energy in executing the order they have from the Admiralty to build three of this class of vessels, which were ordered to be built under the Naval Defence Act. Their first vessel, the "Latona," has recently made her maiden run to Gibraltar with great success, a speed of 15 knots having been maintained. The "Latona" is the only ship of her class yet delivered by private builders entrusted with similar orders. Their third vessel, "Naiad" is now having her machinery put on board.

MIDDLESBROUGH, 6TH MAY, 1891.

PIG IRON.—There was a good attendance on 'Change yesterday, and a better feeling prevailed, owing to the large decrease in stocks and the good shipments. Business, however, was quiet, buyers holding back in expectation of prices dropping again. Towards the end of last week Cleveland warrants dropped to 38s. 6d. buyers, and 38s. 9d. sellers, but rose yesterday to 39s. 2d. cash buyers, and 39s. 3d. cash sellers. When the market opened 38s. 9d. was taken in several instances for prompt f.o.b. deliveries of No. 3 G.M.B., but the price soon advanced to 39s. Grey forge is very plentiful, for, though a large quantity is being sent to Scotland, less is being consumed locally. Though 37s. per ton has been taken, 37s. 3d. is the usual price, and even more has been paid for special brands. There is little demand for local hematite, and the price asked is from 51s. to 52s. per ton for mixed numbers.

MANUFACTURED IRON AND STEEL.—There is no change in the prices of manufactured iron and steel, though producers are badly supplied with contracts. Prices are:—Steel ship plates, £6 2s. 6d.; iron ship plates, £5 12s. 6d.; steel angles, £5 17s. 6d.; iron angles, £5 10s.; iron bars, £5 12s. 3d., all f.o.t. at works, and subject to the usual 2½ per cent.

COKE.—Good blast furnace coke has been sold at 13s. and 13s. 3d. delivered.

IRONMASTERS' RETURNS.—The return for the month of April of the Cleveland Ironmasters' Association was issued yesterday, and shows there were 91 furnaces blowing, as against 94 in March, a decrease of three. The make of pig iron for the month was 222,067 tons, compared with 226,544 tons in March, a decrease of 4,477 tons. The stocks of pig iron held are 271,199 tons, as against 289,986 tons in March, a decrease of 18,787 tons. The principal decrease was in makers' stocks, of 13,063 tons, and in Connal's stores, of 4,395 tons. The shipments were 32,405 tons foreign, against 27,522 in March and 59,886 in April last year; while coastwise they were 47,378, against 38,876 in March and 16,420 in April, 1890. The total shipments for April were 79,783 tons, compared with 66,435 tons in March, an increase of 13,348 tons.

SHIPMENTS.—The shipments for this month are still satisfactory, and were 11,340 tons up to the 4th inst.

WORK.—The directors of the Tees Side Iron and Engine Works Company have decided to blow out the two remaining furnaces which they have in blast, as trade has not improved to their satisfaction. This will reduce the output of the district about 11,000 tons.

NEWCASTLE, 6TH MAY, 1891.

THE COAL TRADE.—The local coal trade shows increased activity, and, though the collieries are generally working full time, the output is scarcely equal to the demand. The opening out of North Sea navigation has doubtless contributed to this result, but the labour disturbance in Belgium is also an important factor in the case. The shipments of coal and coke at Tyne Dock during the week ending the 2nd inst. amounted to 112,849 tons, being an increase, as compared with the shipments in the corresponding week last year, of 1,398 tons.

SHIPBUILDING.—The Jarrow and Howden yards of Messrs. Palmer & Co. are now very active, and most of the workmen who have been recently discharged from other local yards through lack of work have found employment at these establishments. Excepting in the instances referred to, slackness becomes more marked each week at the various shipbuilding centres on the river. As builders will be compelled to lower quotations in order to stimulate business, it is probable that a reduction of wages will soon be asked for. It is stated that such a demand has already been made on the Clyde.

ROPE WORKS.—Rope manufacturers are well supplied with contracts, both for mining accessories and for shipping, and at almost every establishment in the district overtime is being worked. Messrs. Haggie Brothers, wire rope manufacturers, are putting down special machinery in extensive new premises that have been erected near to their present works. The firm are also putting down machinery in a new fitting shop, which is to be principally used for the manufacture and repair of wire rope-making plant.

GAS ENGINES.—Messrs. Fielding & Platt, of Gloucester, have, through their new agency at 36, Mosley Street, Newcastle, just supplied one of their "Fielding" gas engines to a firm at Hartlepool. Inquiries are being received in daily increasing numbers.

LEATHER WORKS.—At many of the leather works business has improved of late, and stocks are being diminished. Messrs. E. & J. Richardson, of the Elswick Leather Works, find a large demand for their specialties in machine belts, bands, hose-pipe, and valves.

ELECTRIC LIGHTING.—The Earl of Durham has decided to thoroughly reorganise the electric lighting arrangements at Lambton Castle. An entirely new electric generating plant, comprising two Cornish boilers, each of 25 n.h.p., and two of Parsons' steam turbines and dynamos of the new improved type, with automatic expansion, each capable of supplying 32 kilowatts, is to be erected by Mr. A. A. Campbell Swinton.

DUNDEE, 6TH MAY, 1891.

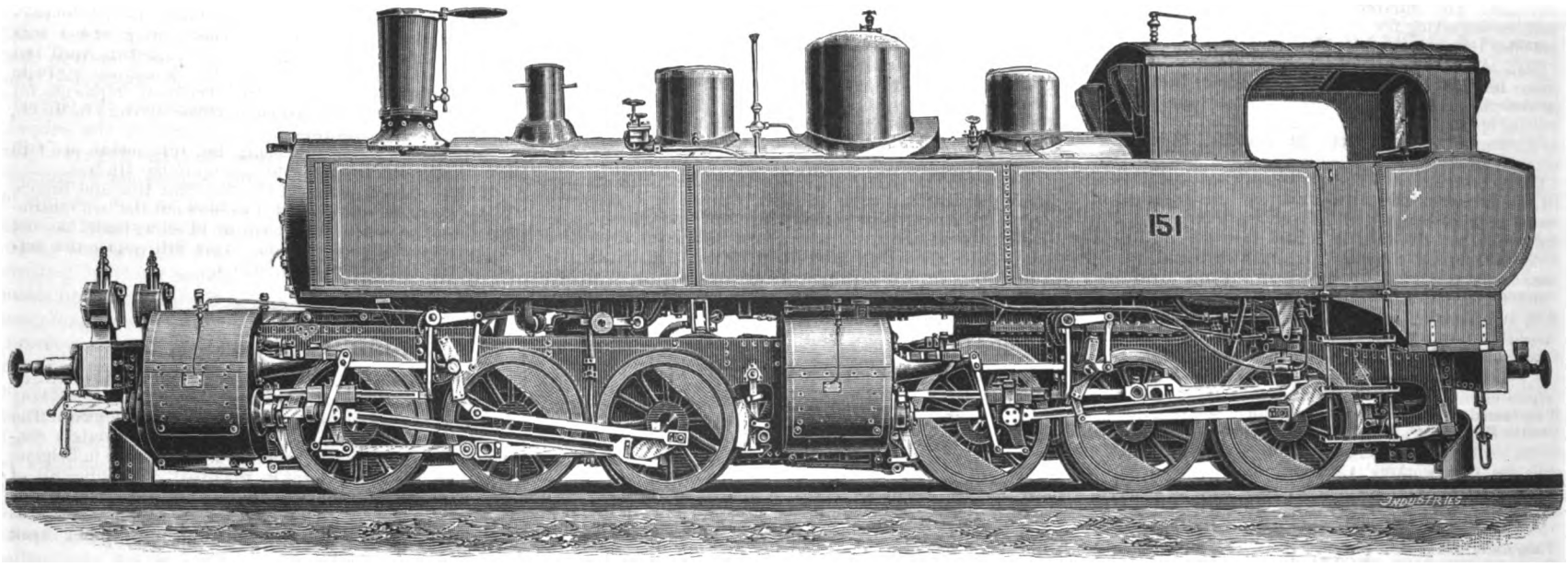
JUTE AND FLAX TRADES.—Both branches of the local industry are steady, with a firm market. Jute is strong in all positions, and prices firm. Yarns are selling well, and prices favour sellers. Hessians are steady, but the New York market is rather weaker. Burlaps, 40in. 10¼oz., are quoted at 4 5/16c. per yard, and light weights at 4 3/8c. The flax market is very strong, but transactions are confined to the satisfaction of actual wants. Prices of flax yarns are well maintained, but business is limited, as buyers do not follow the higher prices asked. Manufactories of linens are well employed. Some controversy has been caused by a statement in the Factory Inspector's report, just issued, to the effect that the rate of wages paid in the jute industry is lower than in any other textile industry. It is stated that some firms pay 12s. per week for spinners and 17s. per week for weavers who attend double looms. Weavers are said to earn in some cases from 20s. to 24s. per week.

SEAL FISHING.—The total catch of the Dundee sealing fleet for the season was 88,400 seals, and the value of the oil and skins £40,000.

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DUPLEX-COMPOUND LOCOMOTIVE FOR THE ST. GOTHARD RAILWAY.

CONSTRUCTED BY MR. J. A. MAFFEI, ENGINEER, MUNICH.



GENERAL VIEW.

DUPLEX-COMPOUND LOCOMOTIVE FOR THE ST. GOTHARD RAILWAY.

THE illustration given above represents a new duplex-compound locomotive engine, constructed by Mr. J. A. Maffei, engineer, Munich, for the mountain traffic of the St. Gothard Railway. This engine is now doing regular service between Airolo and Bellinzola, and, we believe, to the entire satisfaction of the owners. It will be seen from the illustration that this is a twelve-wheeled tender engine. The axles are fixed to a system of two frames, connected in the middle by a strong joint so that they can form any convenient angle, and thereby adapt the engine for travelling on quick curves. The boiler is fixed to the rear frame and is free to slide upon two heavy support plates on the front frame. The engine is constructed on the compound system, and has four steam cylinders, two of which are high-pressure cylinders, and are fixed to the rear frame, and the other two, low-pressure cylinders, are fixed to the front frame. The steam, after doing its allotted work in the high-pressure cylinders, passes then by means of a movable receiver tube to the two low-pressure cylinders and escapes through another movable pipe to the chimney. The following are the leading particulars of this powerful engine:—

Steam pressure	150lb. per sq. in.
Diameter of high-pressure cylinder	400 millimetres
„ low-pressure „	580 „
Stroke of piston	640 „
Traction power	9,000 kilos
Heating surface of fire-box	9·3 square metres
„ „ boiler tubes	145·7 „
Total heating surface	155 „
Grate area	2·2 „
Diameter of driving wheels	1·23 metres
Distance between buffers	13·776 „
Length between outer wheels	8·13 „
Weight with full equipment	85 tons
Weight without equipment	73 „
Empty weight, approximate	67 „
Water supply	7 „
Coal supply	4·3 „

AMERICAN MAIL SERVICE.

A PARLIAMENTARY Paper has been issued showing the number of days, hours, and minutes occupied by the passages, both outward and inward, during the year 1890, of each of the steamships carrying Her Majesty's mails, between Queenstown and New York, and also between Southampton and New York. The return specifies the names of the steamers and indicates by asterisks those not carrying mails under contract. We imagine that the object of Mr. Leng in asking for this return was to ascertain what effect, if any, the subsidy paid to certain steamers had on the speed; in fact, to ascertain whether, in these days of improved Atlantic service and keen competition, it was any longer necessary to continue the payment of the subsidy. In the returns of the outward sailings, none of the steamers marked with an asterisk carried mails under contract with Her Majesty's Government. In these cases there are no records of the time actually occupied by the sea passage; but the length of passage given in the return shows the time occupied between the delivery of the mails to the vessel at the port of departure and their receipt at the Post Office at New York. There is a considerable variation in the time occupied by both classes of steamers, and there can be no doubt that in many cases the subsidised steamers have the advantage, although some of the newer vessels which are not subsidised run them very close. None of the inward steamers carried mails under contract, and in each case the length of passage given in the return shows the time occupied between the delivery of the mails to the packet at New York and their receipt at the Post Office at the port of arrival, so that in these cases it is possible to arrive at a more correct comparison than in the outward voyages. The paper gives a collection of figures regarding the "Atlantic race" which cannot fail to be interesting to many of our readers, and therefore we have directed their attention to it.

THE SOCIETY OF ENGINEERS.

AT a meeting of this Society, held on the 4th inst., Mr. J. W. Wilson, Jun., Vice-President, being in the chair, a paper was read by Mr. C. C. Carpenter, on "Modern Coal Gas Manufacture." The author commenced by saying that upwards of ten million tons of coal were carbonised annually for gas-making purposes in the United Kingdom. The subject of carbonising was dealt with, reference being made to the shape of retorts best adapted for the purpose, as well as the most suitable settings of them and their construction, the relative advantages of "moulded" and "brick" or "tile" retorts being also considered. The various modes of retort heating by direct or gas furnaces were next explained, reference being made to a system of multiple heated settings introduced by the author in 1886. Charging machinery and inclined retorts was next touched upon, as well as other details of retort-house working. Beale's exhausters for pumping foul gas were illustrated and discussed. The washing and scrubbing plant for the removal of soluble impurities was explained, and the necessity of protecting it from atmospheric changes was pointed out.

Purification by means of lime and oxide was next considered, special reference being made to what are known as "sulphur compounds." The author traced the history of this impurity and described the methods of its removal, stating also how the process depended for its efficacy upon the presence of a percentage of oxygen. The measuring and storing of the purified gas were then explained, as also the development of the large type of modern gasholder, with cantilever framing, originated and perfected by Mr. George Livesey. The paper concluded with a reference to an ingenious invention for dispensing with the ordinary guide framing by means of a spiral roller path formed in the wall of the tank itself.

THE UNITED STATES NAVY.

In a speech recently delivered by President Harrison at San Francisco, he referred to the United States Navy in the following terms:—

"I believe that we have come to a new epoch as a nation. There are opening portals before us inviting us to enter, opening portals to trade and influence and prestige such as we have never had before. We will pursue the path of peace. We do not need a great navy as some other people do; but we do need sufficient first-class ships simply to make sure that the peace of this hemisphere be preserved, simply that we may not leave great distant marts and harbours of commerce and our few citizens who may be domiciled there to feel lonesome for sight of our flag. We are making fine progress with the construction of the navy. The best English constructors have testified to the completeness and perfection of some of our latest ships. In San Francisco the energy, enterprise, and courage of some of your citizens have constructed a plant capable of building the best modern ships. We want merchant ships, and I believe we have come to a time when we should choose whether we will continue to be non-participants in the commerce of the world or now vigorously claim our share in the world's commerce. The Postal Bill marks the beginning of methods to regain that commerce. My belief is that under the operation of that law we shall be able to stimulate shipbuilding, to secure some new lines of American steamships, and increase the ports of call for those now established. It will be my effort to do what may be done under the powers vested in me to open and increase our trade with Central and South America. I am a thorough believer in the construction of the Nicaragua Canal, and I think that influences and operations are now started that will complete that stately enterprise."

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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FRIDAY, 8TH MAY, 1891.

MARINE ENGINE TRIALS.

THE Report on Marine Engine Trials presented to the Institution of Mechanical Engineers at its recent meeting by the Research Committee, although in some respects more complete than any of their previous reports, was not of such a nature as to add much to our existing knowledge regarding the problems of marine engineering. The Report was a very good example of the applications of the methods which have been found so useful in the case of land engines to those used in steam vessels. These methods, however, are scarcely within the domain of what is usually considered research, as they have become the common property of engineers. Their application to marine engines has, however, been as yet sufficiently rare to justify the Committee in confining their work to what may be called a standard example of finding the efficiency of marine engines and boilers which will serve as a guide to those who wish to follow in their steps. Without wishing to depreciate the work done by the Committee in the past, we venture to express a hope that in the future it will be able to take up the field of research proper, and not only tell us all about the special engines which were the subjects of the experiments, but also extend our knowledge of the general conditions which tend to efficiency. As we pointed out when noticing the previous Report of the Committee (see *Industries*, Vol. IX., page 453), while the past experiments reflect great credit on those who conducted them, they only open up a few of the more important subjects connected with marine engines, and really settle none. Similar experiments must be repeated under varying conditions, so that the effect of boiler pressure, cut-off, steam jackets, speed of piston, and many other factors in steam-power efficiency may be determined. We pointed out, moreover, that one part of the subject, from which almost all experimenters seem to shrink, is the determination of the efficiency of the mechanism of marine and other engines. On this subject we know practically nothing. We are quite aware that all the matters we have mentioned involve much labour and a large expenditure of time and money, but if the work is to be done it ought to be carried out under the superintendence of the Institution of Mechanical Engineers. The economy of marine engines is, however, a work of such national importance that we think the Council of the Institution would be justified in appealing for financial assistance in carrying it out, either from the Imperial Treasury or from the steamship owners of the country. If we consider what an immense amount of money would have been saved if, say, thirty years ago a series of well-designed experiments had been conducted, which would have led to the present practice as regards pressure, expansion, and design, we see that the matter of economy of steam engines becomes a national question in view of the present drain upon our coalfields. The money which is spent on one ironclad, if judiciously employed in experiments on the conditions of efficiency of marine engines, would probably prove a most remunerative investment. We hope, therefore, that the Council of the Institution of Mechanical Engineers will take steps to impress upon the Government or the country the importance of the subject.

As we have already remarked, the Report of the Committee is chiefly useful as a standard example of the methods to be adopted in the testing of marine engines. The value of the report is much enhanced by the diagrams and illustrations given. Such illustrations show at a glance the chief features in the trials, as, for example, the total coal and water consumption, the temperatures of the chimney gases and feed-water, and the total indicated horse-power. Details are also given of the boiler pressure above the atmosphere, the revolutions per minute, and the mean effective pressures in the three cylinders, as well as indicator diagrams from each cylinder. Such a report will be most useful to all students of mechanical engineering, and, no doubt, will find its way into many drawing offices, both of colleges and of works, as a model on which similar reports should be made out. There was nothing special about either the design or construction of the "Iona," although it was a fine example of a modern well-decked cargo schooner with economical engines, of the triple-expansion type, with three cranks working a single screw. The vessel is 275ft. in length, 37ft. in breadth, and 19ft. in depth, and her registered tonnage is—gross, 2,094 tons; under deck, 1,610 tons, and net, 1,348 tons; and she is classed at Lloyd's 100 A1 (special survey). The trial was conducted with great care, and lasted for sixteen hours. The speed of the engine was not altered during the trial, nor was the valve gear touched or altered during the whole time. In addition to all the observations which had been taken on former trials, indicator diagrams were taken at intervals from the circulating and air pumps, from the first and second receivers, and from both ends of the condenser. The temperatures of the circulating water and the discharge water were also noted; and the jacket-water, steam pipe drain-water, and supplementary feed-water were each separately measured. We only mention these in a general way for the purpose of showing the care with which the experiments were carried out, for we must refer to the Report itself for details. This we reprint on page 448, and in it will be found descriptions of the engines and boilers, and of the methods of conducting the experiments, of collecting the furnace gases, and making the necessary measurements of the quantities required. We cannot enter into these, but can only note a few of the results. With regard to boiler efficiencies, the mean rate of combustion in the furnaces was 22·41lb. of coal per square foot of actual grate surface per hour, or 0·30lb. per square foot of total heating surface per hour. The evaporation from and at 212° Fahr. was 10·63lb. of water per lb. of coal, and the equivalent amount of heat utilised per lb. of coal 10,265 thermal units, or 69·2 per cent. of the thermal value of the fuel, and this latter figure represents the actual boiler efficiency. The weight of air theoretically necessary for the complete combustion of 1lb. of coal is 11·41lb. The air actually used was 2·15 times the amount theoretically required. The weight of water evaporated from and at 212° Fahr. per square foot of total heating surface was 3·17lb. per hour. The total coal burnt—namely, 942lb. per hour—corresponds to 1·46lb. per indicated horse-power per hour. The total indicated horse-power being 645·4, and the total feed-water used per hour being 8,616lb., the feed-water used per indicated horse-power per hour was 13·35lb. The

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actual heat received by the feed-water per minute was 161,100 thermal units, or 249·6 thermal units per indicated horse-power per minute, which is 69·2 per cent. of the whole heat of combustion. The absolute engine efficiency, or ratio of the heat turned into work, to the heat given to the feed-water was 17·1 per cent. The combined efficiency of the boilers and engines, or ratio of the heat turned into work, to the total heat of combustion of the fuel was equivalent to 11·8 per cent.

These results are very satisfactory as regards the special engines under consideration, but we hope that the Research Committee of the Institution of Mechanical Engineers will enlarge the scope of their investigations. We trust that their future reports will not only give details of performances of special engines, but also help to extend our knowledge of the conditions of efficiency of marine engines in the manner which we have indicated.

THE NEW BATTLE-SHIP "RENOWN."*

The launching of the first-class battle-ship "Renown" was successfully carried out at Pembroke Dockyard yesterday, the 7th inst., the christening ceremony being performed by Her Royal Highness the Duchess of Connaught. The "Renown" is the second of a class of eight battle-ships built and building under the Naval Defence Act of 1889, which were specially designed to take part in general fleet actions in European waters. The leading dimensions of the "Renown" are:—Length, between perpendiculars, 380ft.; breadth, extreme, 75ft.; mean draught of water, 27ft. 6in.; and displacement at this draught, 14,150 tons, which surpasses that of any other ship in the navies of the world. Previous to the launching of the "Royal Sovereign"—a sister vessel—which took place at Portsmouth in February last, the largest warships in the British Navy were the "Nile" and "Trafalgar," each of 12,500 tons, and these were largely exceeded in displacement by the "Italia," of 13,900 tons, and the "Lepanto," of 13,550 tons, belonging to the Italian Navy.

The "Renown" is built throughout of mild steel, the stem and stern post, together with the shaft brackets, being of cast steel. Steel-faced armour, having a maximum thickness of 18in., extends along the sides for 250ft. amidships, the lower edge of the belt being 5ft. 6in. below the normal water-line. The belt is terminated at the fore and after ends by transverse armoured bulkheads, over which is built a 3in. protective steel deck extending to the ends of the vessel and terminating forward at the point of the ram. Above the belt the broadside is protected by 5in. armour, the central battery being enclosed by screen bulkheads of the same thickness. The barbettes, which are formed of armour 17in. thick, rise from the protective deck at the fore and after ends of the main belt. The principal armour throughout is backed by teak, varying in thickness from 18in. to 20in., behind which is an inner skin of steel 2in. thick. The engines are being constructed by Messrs. Humphreys, Tennant, & Co., London, and are of the vertical triple-expansion type, capable of developing a maximum horse-power of 13,000 with forced draught, and 9,000 horse-power under natural draught, the estimated speeds being 16 and 17½ knots respectively at the normal displacement. The regular coal supply is 900 tons, which will enable the ship to cover a distance of 5,000 knots at a reduced speed of 10 knots, and about 1,600 knots at her maximum speed. The main armament of the "Renown" will consist of four 67-ton breechloading guns mounted in pairs *en barbette*. The secondary armament includes ten 6in. 100-pounder quick-firing guns, four being mounted on the main deck and six in sponsons on the upper deck, sixteen 6-pounder and nine 3-pounder quick-firing guns, in addition to a large number of machine guns.

The largest guns at present mounted in any British warship are the 110-ton guns mounted in the "Benbow" class, and the difference between these weapons and those to be carried by the "Renown" is very marked. The projectile fired from either of the "Benbow's" heavy guns weighs 1,800lb., and is capable of penetrating 35in. of unbacked wrought iron at a distance of 1,000 yards. The projectile fired from the 67-ton guns of the "Renown" will have a much less penetrating power, being only equal to 27in. of wrought iron, with a full charge of 520lb. of prismatic brown powder, the missile weighing 1,250lb., or about one-half less than the weight of the shot used with the 110-ton gun. It will thus be seen that the ordnance of the "Benbow" can penetrate armour that would defy the attack of the guns of the "Renown." It should be said, however, that the heavy artillery of the latter vessel is capable of penetrating any armour at present afloat, and is carried at a much greater height above the designed load water-line than in any existing battle-ship, either in the British or foreign navies. The armour being of less weight, too, enables the new ship, and others of her class, to carry an auxiliary armament of unprecedented weight and power.

The "Renown" will be lighted throughout by electricity, the installation comprising some 600 lights, and will be provided with four 25,000 candle-power search lights, each of which will be worked by a separate dynamo. The "Renown" has been built from the designs of Mr. W. H. White, C.B., Director of Naval Construction, and will be fitted out for the use of an admiral, and when commissioned her complement of officers and men will number 700.

Table I. gives the leading particulars of the "Renown," summarised for comparison with the "Trafalgar" and the larger foreign battle-ships.

* We learn, on going to press, that the name of this vessel has been altered to the "Empress of India."

COMPARISON OF BRITISH AND FOREIGN BATTLE-SHIPS.

TABLE I.

Name of ship	Renown.	Trafalgar.	Italia.	Admiral Duperre.	Sinope.	Coast Line Battle-ships 1, 2, 3.
Nationality	British	British	Italian	French	Russian	American
Date of design	1889	1885	1877	1876	1883	1890
Length between perpendiculars	380ft.	345ft.	400ft. 6ft.	311ft.	300ft.	348ft.
Breadth	75ft.	73ft.	72ft. 9in.	66ft. 11in.	69ft.	69ft. 3in.
Draught, mean	27ft. 6in.	27ft. 6in.	31ft. 3in.*	26ft. 9in.*	26ft.*	24ft.
Displacement, tons ..	14,150	12,500	13,900	11,100	10,800	10,298
I.h.p., maximum	13,000	12,000	18,000	8,000	13,000	9,000
Official speed, knots ...	17·5	16·5	18·0	14·2	16·8	16·2
Coal capacity at designed draught	900	900	1,600	—	890	400
Coal endurance at a speed of 10 knots ...	5,000	5,000	—	—	—	3,600
Armament, main	4 67-ton B.L.	4 67-ton B.L.	4 100-ton B.L.	4 47-ton B.L.	6 50-ton B.L.	4 13in. B.L.
Weight of projectile, heaviest, lbs.	1,250	1,250	2,002	926	732	—
Maximum thickness of armour, inches	18	20	—	21·5	16	18

* Extreme draught.

CONTINENTAL LABOUR.

May Day has come to be a kind of labour festival on the Continent, when agitators and their followers meet together and demonstrate in a noisy, and sometimes in a violent, manner. The dread with which the Continental Governments, alike Imperial and Republican, regard these demonstrations is scarcely realisable in this country, where we are habituated to such methods of letting off the steam, which, pent up, might lead to explosion. The existence of discontent among Continental labourers is not without important influence upon our own country, since to some extent, at any rate, our merchants are met in foreign markets by wares made by poorly-paid Continental labour, while our own industries are invaded by foreigners seeking in this country a larger rate of remuneration than they can obtain in their own. Thus, although it is no doubt distressing to read of perpetual bickerings and occasional conflicts between Continental employers and their workmen, there is no doubt that Continental labour has to make many strides before it reaches a platform of anything like so great equality for making a contract for employment as the British workman attained long ago. From several points of view it is important to us that Continental labour should be fairly remunerated. Even from the purely commercial standpoint, it is quite clear that a nation whose working class is living at a depressed standard of comfort is a less advantageous customer to us than a nation the bulk of whose people live at a high standard and consume largely. For the very reason that the cost of production of commodities does not altogether govern the prices of these in the market, the prices of some of our products are depressed by the products of cheap labour abroad. Therefore, from the point of view of competitive commerce, it is to our interest that wages abroad should be as high, and the standard of comfort as elevated, as are those of our own working class.

While movements primarily of a purely economic character are often manipulated in such a way as to convert them into subversive political movements, it is open to doubt whether the repression of public demonstrations and such other safety valves is a wise policy on the part of Continental Governments. The incident at Fourmies, described as a "massacre," in which, at all events, several unarmed men, women, and children were shot down by the French troops, is, if the facts be as stated, indefensible from any point of view. No doubt the officers on the spot, rather than the Government, were to blame, and no doubt also the exercise of large discretionary powers must be left to the officers commanding troops detailed to maintain order; but the risks on all hands are too great for a Government to afford many military blunders of this kind.

Sooner or later, the advantages of public meetings, demonstrations, and the like, as highly necessary outlets for the discontent of large populations, must be recognised abroad. When these methods are no longer so discredited that they are apt to be attended only by those with a certain tendency to violence, and when even the most conservative among the working class attend them, and so leaven the lump, they will cease to be regarded by the fear with which, not always unreasonably, they are now regarded abroad.

IMPROVED COMMUNICATION WITH THE EAST.

In our last issue we referred to the quick passage made by the new steamer the "Empress of India" between Yokohama and Vancouver. On the arrival of the steamer at Vancouver the passengers were transferred to the Canadian-Pacific express train for Montreal. The run from Vancouver to Montreal, a distance of 2,900 miles, was made in three days seventeen hours, whereas the time usually occupied is six and a half to seven days. The average speed for the entire distance was 34 miles an hour. Owing to this splendid performance, the time occupied in the journey from Yokohama to Montreal is brought down to two weeks, and it is expected to bring London within three weeks' journey from Yokohama. The performance of the Canadian-Pacific train is really an excellent achievement on the part of the railway company, which will in future run a similar train to carry the mails from Great Britain to China and Japan, and *vice versâ*. These mails will thus be conveyed in a much shorter space of time than by any other route.

THE "CITY OF PARIS."

The "City of Paris," which sustained severe damage to her machinery last year, has been, during the past four or five months, in the hands of her builders, Messrs. J. & G. Thomson, of Clydebank. New engines have been fitted to replace those damaged, a new shaft has been made, and Howden's system of forced draught has been introduced. The vessel has, besides, been thoroughly overhauled, and the passenger accommodation redecorated. Notwithstanding delay in obtaining the necessary supply of steel, the builders have succeeded in completing

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the extensive alterations in an extremely short time. As is well known, the engines are 10,000 i.h.p. The shafting has been supplied by Messrs. Vickers & Co., Sheffield, and several important improvements have been introduced. An appliance, devised by Messrs. Brown Brothers, of Edinburgh, the well-known hydraulic engineers, has been introduced in order to effect the automatic stopping of the engine should the normal number of revolutions be exceeded. A gauge has also been fitted for the purpose of enabling any undue wearing of the shaft to be promptly detected. At the trial on the measured mile, preliminary to a Channel cruise, the mean speed attained was 21·048 knots. The mile was covered with the tide twice in succession in 2 minutes 48½ seconds, and against the tide twice in succession in 2 minutes 55 seconds. In the Channel trial, a distance of 500 miles was covered at an average speed of 19½ knots.

The vessel commences her sailings from Liverpool to New York on the 13th inst.

Letters to the Editor.

THE SINKING OF THE "BLANCO ENCALADA."

To the Editor of "Industries."

Sir,—The political questions raised by your correspondent, Mr. Alfred E. Mavor, are, of course, beyond the scope of the discussions carried on in a technical journal, and, therefore, I will not touch upon them, but such a matter as the sinking of an ironclad by torpedoes should receive the attention of all who are interested in the design and construction of ships. The behaviour of ironclads in a battle is almost an unknown quantity, for, beyond the small experience in the Austro-Italian and the Russo-Turkish wars, naval constructors and officers have almost nothing to go upon. Mr. Mavor remarks that torpedo warfare has probably been more extensively and more fatally practised on the West Coast of South America than anywhere else, and that the Chilians and Peruvians have both proved themselves to possess, at least in attack, all the vigilance, resource, and ingenuity upon which these are dependent. The present example, I am afraid, seems to show that the officers of the "Blanco Encalada" were wanting in vigilance. Whether it will afford any other lessons it is still premature to say until we have got more particulars. No one, of course, doubts that it is possible for an ironclad to be sunk by torpedoes if the former is at rest, and not defended with vigour.

We are told that the ironclad was moored to the quay in Caldera Bay, when it was surprised by torpedo boats, and only on the seventh attack did the latter succeed in destroying the vessel. The sinking of the ironclad under these circumstances is not at all surprising, but what I would like to know about torpedoes is how far they are a match for quick-firing guns carried by a vessel under steam. Mr. Mavor thinks that if the vessel had been at sea, and could have chosen a duelling ground with two cruisers, we should have had news of a different tenour. That, however, is scarcely the question raised by the incident. It is not how far one ironclad can defend itself against other ironclads, but what part ironclads are to take in the naval warfare of the future—in fact, the whole policy of building ironclads is involved in the matter. Perhaps Mr. Mavor, who seems to have had some South American experience, or some of your other readers, will favour us with opinions on the subject.

Yours, &c.,
Torpedo.

London, 4th May, 1891.

ENGINEERS IN THE ROYAL NAVY.

To the Editor of "Industries."

Sir,—I do not think that much good will come from continuing a correspondence with your Portsmouth correspondent "A. E.," as he seems determined to misunderstand both your own article and my letter. So far as I understand your article you did not propose that the main supply of engineers for the Navy should come from the engine-room artificers, you simply suggested that an avenue ought to be opened up whereby *at least the best of them* might be able to obtain the position of engineer officers. With regard to the officers, you said that "when we consider how little mathematical knowledge is required by sea-going engineers, we think a test might be devised which would secure the best men for the work to be done," and you added that "you did not think that this is likely to be the case if a knowledge of pure mathematics, or even physics, is to be preferred to good workshop practice."

I have no hesitation in saying that there are hundreds of young men who now serve their apprenticeships in engineering workshops who would make excellent engineer officers, and who are excluded by the requirements regarding theoretical knowledge. If the service were open to such men, many of them would be willing to serve a year or two at sea for the purpose of gaining some experience, and their conduct during that year would be the best test of their fitness for the service. If that experience was recognised as qualifying for the first examination of the Board of Trade, the probationers could then decide whether they prefer to remain in the Navy or go to the mercantile marine, or possibly return to some land employment. Those who decided for the Navy should be required to pass a comparatively simple examination, while those who passed a higher one might be offered some advantages as regarded their start in the service. Teachers have been too much in the habit of looking upon their classrooms as the centre of the universe, and mathematicians of considering their special training as the one thing needful. The President of the British Association, in his address last year, attempted to warn his hearers on this subject. He said, "However much we may be convinced of the supreme value of scientific methods of observation and of reasoning, both as mental training of the individual, and in the elucidation of truth and advancement of knowledge generally, it is impossible to be blind to the fact that we who are engaged with the investigation of those subjects which are commonly accepted as belonging to the domain of physical science are unfortunately not always, by virtue of being so occupied, possessed of that most precious gift 'a right judgment in all things.'"

In this, indeed, he was correct, and my only reason for troubling you was for the purpose of indicating a method by which the Navy might obtain a good supply of good practical engineers, who have a right judgment in—if not all—at least a good many things, and who also had sufficient theoretical knowledge for the due performance of their duties. As, however, every service should have men of varied characters, I think it desirable that those who showed special aptitude for mathematics and science generally should receive every encouragement to develop them, in so far as that is advantageous to the work of the service.

Yours, &c.,
Glasgow, 5th May, 1891. M.I.N.A.

TRIAL OF H.M.S. "VULCAN."

To the Editor of "Industries."

Sir,—In your account of the trial of H.M.S. "Vulcan" you refer to the three Willans central-valve engines for electric lighting, which this ship carries, and mention the claim made that these engines and dynamos develop an electrical horse-power for 29lb. of water per hour—and you add the words, "which is a remarkably good result."

Will you allow us to say that an important qualification is omitted in these figures? 29lb. is the consumption *at the steam pressure named in the specification*—viz., 100lb. per square inch; and when exhausting into the atmosphere. With similar engines and dynamos there is no difficulty in obtaining an electrical horse-power upon less than 25lb. of water per hour, if the steam pressure is 140lb. or upwards; and if the exhaust be into a good vacuum, instead of into the atmosphere, the consumption falls to about 19lb. The pressure actually available in the boilers of the "Vulcan" is, as you state, 150lb.; and we believe arrangements are made for discharging the exhaust from the electric light engines into a condenser. The Admiralty, however, naturally specifies what it assumes to be the least favourable conditions the engines may have to work under; and the statement of consumption of course follows the specification in this respect. It may be added that the dynamos are of Messrs. Siemens Bros.' make, and are of a pattern with which we rarely fail to obtain a total efficiency of 82 per cent. from the engine and dynamo combined.

A similar set will, in a few days, be running in the Central Lighting Station at the Naval Exhibition, in the same building with the three large central-valve engines of 300 indicated horse-power each by which the Exhibition and grounds are lighted.

Yours, &c.,
Willans & Robinson, Limited.
(C. S. Essex, Secretary.)
Picton House, Thames Ditton, Surrey,
5th May, 1891.

THE NICARAGUA CANAL.

To the Editor of "Industries."

Sir,—The interesting and important articles which are appearing in *Industries* on "The Nicaragua Canal" come at a very opportune time, when the Government of the United States is making special efforts to expand the trade of that country, and practically to monopolise the whole of the foreign commerce of South America. Our manufacturers and merchants must keep their eyes open, not only with regard to the daily or weekly variations of the markets, but they must look ahead and try to ascertain how far engineering or other conditions are likely to affect both its amount and direction. The other day President Harrison expressed the opinion that the United States were now great enough and rich enough to reach forward to grander conceptions than have entered the minds of their statesmen in the past. Personally, he said that he was not content that the nations of Europe should absorb nearly the entire commerce of the Republics of South America. This commerce was naturally theirs by neighbourhood, nearness of access, and the sympathy that binds the hemisphere which is without a king. He mentioned with approval the treaties which had been made with Brazil, and stated that he was not disclosing any Executive secret when he said that the arrangement with Brazil was not likely to abide long in lonesomeness, that other countries are likely to follow, and that, as a result, the products of the United States will find free or favoured access at many of the ports of the South or Central American States. To carry American goods to these ports they would need American steamships, and to encourage the production of these Congress had made very liberal provision. He much wanted the time to come when the citizens of the United States living in temporary exile in foreign ports should now and then see fine modern men-of-war flying the United States flag, with the best modern guns on their decks, and brave American crews in their forecastles. He wished also that in those ports so long unfamiliar with the American flag there should again be found their steamships and sailing vessels flying that flag and carrying their products. He added that in order to accomplish this they ought to make individual efforts for the early completion of the Nicaragua Canal, for he was strongly of opinion the Pacific Coast should no longer be reached by sea only by the passage round Cape Horn.

Your articles have given an interesting historical sketch of the proceedings connected with the Canal, and also of the attitude of the United States Government at various times towards it. President Cleveland repudiated the proposed treaty with Nicaragua, which had been drawn up under his predecessor, and, while wishing to encourage the scheme, he thought it should be done without involving any political engagements, and entirely as a piece of private enterprise. President Harrison's opinions on this point have not been definitely stated, but the subject is attracting very considerable attention in the United States press at the present time, as it is felt that no other measure of public policy now submitted is of such wide-reaching importance, and Government aid is strongly advocated. At another time I may, with your permission, briefly indicate some of the commercial effects of the Canal, if it were completed, not only on the United States, but also on Europe, and especially on this country. The study of questions of this kind tends to give our merchants greater breadth of view, and enable them to follow some of the most important movements in commerce.

Yours, &c.,
C.E.

Liverpool, 2nd May, 1891.

THE USE AND ABUSE OF MATHEMATICS.

To the Editor of "Industries."

Sir,—After reading the letters you have already published upon this subject, my belief has been strengthened that the value of an opinion depends to a very large extent upon who gives it, and hence that the value of your contributions to your general readers would be increased, could your contributors convey more information as to the nature of their own engineering experience and work. If this was done, I venture to think you would find the abuse of mathematics as a part of an engineer's training would come only from those who possess no personal knowledge of that subject, and hence regard it very much as "sour grapes," while those who had attained to some mathematical powers would be unanimous as to its use. Of course, it will be understood that I speak here, not of that ethereal mathematics which delights to speculate in four dimensions, or examine the greatest possible height to which a tree can grow, but of that mathematical knowledge which can be brought to bear upon actual engineering work. It can give exact results instead of approximate ones, and can displace the rough-and-ready rule of adding certain numbers together and dividing by two to make quite sure, by a method at once sound and educational. Moreover it can anticipate results without costly experiment, or decide with speed and certainty a result otherwise only obtainable by a laborious and costly system of trial and guess-work. In connection with this, is it not a fact that Sir W. Thomson first demonstrated mathematically the possibility of the first Atlantic cable, before practical men would undertake its construction?

I know of only one thing more remarkable than the confidence of the non-mathematician in his own method of "near enough," and his satirical contempt of exact investigations; and that is, the eagerness with which he will afterwards secretly endeavour to master the mathematical method for himself, and his after merciless criticism of those who do not share his newly acquired knowledge. The memory of my own want of sympathy in my very practical days with the "pedantic college man" in his distinctions between "mass" and "weight," "empirical" and "true" formulæ, is still fresh upon me, as is also the satirical opposition I have not infrequently met with since I have recognised that certain words or phrases should possess one meaning only, and have besides parted with my "Molosworth." Then, I could quite cheer the definition of an empirical formula as being founded upon knowledge, and a theoretical formula upon the want of it; whereas now, having proved something of the use of mathematics for myself, I am able rather to exactly reverse this statement. And I think you will find this to be a very general experience.

The more I see and know of engineers and their profession the more I become a believer in the importance and use of mathematics, and the more I regret that, instead of giving seven years to my practical training, I did not devote a large part of that time to a comprehensive study of applied mathematics. Am I not also right in finding a strong support for this belief in the fact that the leading positions in the engineering world are now being given to men who are distinguished among their fellows, not for their practical ability, but as possessing a sound theoretical and mathematical training? The names of several of these have already been given in the course of this discussion, and who can have failed to notice the increasing demand among large firms for "theoretical advisers"? Professor Kennedy now ranks as a chief among consulting engineers, and he has upon his staff at least one man who was among the first twenty in a recent mathematical tripos at Cambridge.

It was my good fortune to gain my drawing office experience in the works of an engineering firm of world-wide reputation, which kept a staff of about twenty draughtsmen. No one could say they ever abused mathematics, or *used* it. I never remember seeing a book of logarithms in use, which meant, I suppose, that the power of logarithms was unknown, while little problems such as required the finding of the third side of a triangle, knowing the others and their included angle, could only be solved by actual drawing. Another instance I still marvel at, where a draughtsman in another well-known and respected firm came to me for assistance in finding the actual length of the curved part of a cast piece, shaped to a sector of a circle, the radius and included angle being known. I say nothing against the ability of these men to capably design machinery under given conditions and with given examples of similar construction, but no one will assert they would not be better for some knowledge of workable mathematics, and at least we may expect the next generation, hailing from our technical colleges, will possess more power.

Mathematics, then, must be used before it can be abused, and I am not sure that professional critics are not too ready to discover abuse, forgetting the importance of its greater use. The tendency of modern technical training is to increase the latter, and many examples are now to be found of capable mathematicians willing to break through the antiquated notions of how the various parts of mathematics should be approached, the result of which generally was that they were never approached at all, and to bring down within the scope of the ordinary mathematical student its most useful properties. If they show clearly the limits of its application to practical problems, and keep distinct the right analogy between conditions that arise in actual construction and their theoretical counterparts, and generally impart a sound knowledge of how to use theory in practice, we need not be fearful of the result. Mathematics is absurd when a laborious and advanced calculation is used to solve a problem which can be answered even beyond practical needs by some simple method of approximation, or when long formulæ are placed in the hands of those who do not understand them, or forced upon unwilling and unsuitable students, but engineers at present most of all abuse it by not using it.

Yours, &c.,
Engineering Demonstrator.

London, 2nd May, 1891.

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THE ROYAL SOCIETY CONVERSAZIONE.

The first conversazione of the present session was held on Wednesday evening, the 6th inst. The exhibits were not probably so numerous as on previous occasions, but the very latest forms of scientific apparatus were shown, and demonstrations of the latest features of scientific research were watched with interest.

Mr. Crookes exhibited some very beautiful and striking experiments with electricity in high vacua, especially in the production of phosphorescence. Among a variety of other electrical exhibits we may mention the various self-recording instruments of MM. Richard Frères, an electrical safety valve by Mr. Killingworth Hedges, various adaptations of selenium by Mr. Shelford Bidwell, and some forms of Clark cells by Professor A. Schuster. The Tomlinson regulator for electric light mains was exhibited by Messrs. J. E. H. Gordon & Co. Professor Oliver Lodge exhibited some new electrical apparatus.

Among the non-electrical exhibits there were several of practical value and scientific interest. Mr. A. P. Trotter exhibited a curve ranger which is a portable instrument intended to facilitate setting out large curves for railway and other work. Professor Roberts-Austen exhibited his method of recording pyrometric measurements at temperatures between 600° and 1,200° Centigrade.

The great show of the evening, however, was the very beautiful and instructive series of meteorological photographs (clouds, hoar frost, &c.), thrown on the screen by means of the electric lantern, by Mr. Arthur W. Clayden. The photographs of clouds were taken by reflection from a mirror of black glass placed in front of the camera, so that the plane of its surface makes the polarising angle with the axis of the lens. Every variety of cloud was thus brought into clear prominence on the screen. The exquisitely beautiful photographs of hoar frost showed how the crystals attach themselves to the projecting portions of objects, such as the margins of leaves, the loose fibres of a string, and the thorns of a briar, and also their tendency to grow towards the direction from which the air has been moving.

We hope to refer more at length to the exhibits in our next issue.

THE IRON AND STEEL INSTITUTE.

The annual meeting of the Iron and Steel Institute was opened on the 6th inst., at the Institution of Civil Engineers, Sir James Kitson, President, being in the chair. In moving the adoption of the report, he referred to the memorable occurrences of the last two years—first the visit to Paris, and then that to America. The difference between American blast furnace practice and their own was very marked, but though the Americans produced more pig iron, yet they did it under certain disadvantages in spite of the lower price of coal and coke. The Institute during the last year had been prosperous, and a larger number of members had joined them than they ever had before; in fact, the increase during last year was equal to the number that the Institute had started with during its first year of existence. They had suffered several regrettable losses, notably by the deaths of Lord Granville, Mr. Mushet, and Mr. Benjamin Walker. It is proposed to hold the autumn meeting in Birmingham.

After the usual formal proceedings, Sir James Kitson vacated the chair in favour of Sir Frederick Abel, the incoming President, who proceeded to deliver his Presidential Address. Referring to the important position gradually assumed by the chemist and analyst, he mentioned the great impetus given to their subjects by the investigations undertaken after the Crimean War into ores and metal for ordnance purposes. Ever since the analyst has been indefatigable in his endeavours to improve the manufacture of iron and steel, and the latest development of the question is the appointment of a Committee to consider the general question of analysis, and to make standards for future reference. Microscopic examination in connection with etched surfaces has been extensively worked at, and results have been attained which agree, as pointed out by Professor Roberts-Austen, with Osmond's researches. This method is now largely employed in Germany, and is still under the consideration of many scientists. As early as 1865 he had used etching in connection with an investigation of the application of steel to solid shot. In the first specimens, violent rupture of the shells often occurred, due to the internal strains set up on cooling, and even now this often takes place. The importance of *rest* in bringing about a diminution, if not the entire disappearance, of internal strains in masses of metal, is illustrated by the behaviour of chrome-steel projectiles, which—at any rate in the earlier days of their manufacture—it was found necessary to store for several months before their transport to a distance could be ventured upon. Since steel was first adopted for the internal tubes or chases of guns, some few casualties have occurred which can only be ascribed to the same cause. Oil hardening and subsequent tempering do much to relieve these strains, and the tempering is effectual if cracks did not exist previous to that operation.

The President then referred to the use of silicon and the careful blending and remelting of pig iron for producing sound and uniform castings. The elimination of phosphorus in the open hearth furnaces and in other processes was dealt with, as an example showing the complexity of the chemical problems which present themselves. As bearing on the further development of the basic process, the Darby recarburising process and American blast furnace practice were cited. The chemical composition of steel for ordnance, at the present time, is not prescribed by the Government, as the modifying effects of varying proportions in which several impurities co-exist in the metal is not understood. Nitrogen in iron and steel received some notice, and Osmond's researches on the constitution of steel then occupied some time. The similarity in the behaviour of other metals containing small traces of impurities had, he said, steadily expanded the functions of the Institute, so that in time it might be transformed into the "Metallurgical Institute of Great Britain."

A large part of the address was given up to a summary of the recent knowledge of the effect of aluminium, silicon, manganese, and nickel on iron and steel, reference being made to the researches and papers of Riley, Hadfield, Keep, and others. In connection with nickel-steel and the supply of nickel, it was suggested that the recent discovery of a gaseous compound of nickel and carbonic oxide might form the basis for a metallurgical process of extraction.

After the conclusion of his address, the President presented Lord Armstrong with the Bessemer Medal, in recognition of the great services rendered by him to the manufacture of iron and steel, and especially of ordnance, and of his valuable researches on tempering and other matters.

The first and only paper read at this day's meeting was by Dr. W. Anderson, on

Tests for Steel Used in the Manufacture of Artillery.

He stated that specifications of gun steel exclude all definitions of chemical composition. Even chromium, aluminium, or nickel are not forbidden, but care is taken to ascertain their effects. The composition of steel for small arms is, however, restricted within certain limits, on account of hardening and uniformity. The effect of cooling either in cast or forged objects is to set up strains in them, and these are more pronounced when the cooling is rapid, as in the case of oil hardening. Tempering, however, reduces these strains and their effects, unless, indeed, cracks have been produced. The changes are by no means regular, as allotropic and chemical changes are affected by both temperature and pressure. It is necessary to test specimens under treatment similar to that which the whole mass undergoes, and for this purpose the specification now in force in Her Majesty's service lays down that the specimens, which are to be cut from the components of the guns in a carefully specified manner, are to be 1in. diameter by 4½in. long; they are to be heated to 1,425° Fahr., or a bright red, and quenched in oil of 65° Fahr. temperature, and left in the oil till cold. They are then to be turned down for a length of 2in. to a diameter of 0·533in., and tested by tearing asunder. Bending tests on specimens 4½in. long, and 0·75in. wide, and 0·375in. thick, cut to these dimensions after being oil hardened, are also prescribed.

Struck by the importance of the researches of Osmond, Roberts-Austen, and others, the author had proposed to the Institution of Mechanical Engineers that they should undertake a research into the behaviour of large masses of steel. The methods adopted he could not give, but it will very likely be possible to determine the quality and conditions from mere shavings turned off the mass. They prove that steel is ill treated within a range of 300° Fahr. Modifications in the specifications are to be introduced, which will provide for special methods of working the steel. The elastic limit is not defined in Her Majesty's service as it is in the specifications of all foreign Governments.

In the discussion which ensued, Professor Roberts-Austen described the means of measuring elevated temperatures when performing experiments on the behaviour of steel, especially when experimenting on allotropic modifications.

Mr. Hadfield pointed out the value of these means when working steel, as estimation of temperature by the eye was entirely a personal factor. He did not believe in oil tempering, if it were only on account of the cracks produced.

Mr. Carbutt thought that some of the surplus funds of the Institute might be applied to experimenting instead of allowing them to accumulate.

Other speakers briefly followed with remarks on oil tempering and on the recent investigations into the nature of steel and its alloys.

Mr. Watson Smith wished to know if vibration had any effect on the temper.

Mr. Snelus defended the value of chemical analysis, and wished especially to call attention to the danger of segregation of such elements as phosphorus in large masses of steel. He quoted experiments with zinc-iron alloys to show to what extent this might go. If 0·1 per cent. of phosphorus prevented them from making good cutlery steel from Cumberland hematite, there ought also to be danger in large masses. The interior of small test pieces would be more strained under the tests than the masses themselves.

In reply to the discussion, Dr. Anderson stated that oil hardening had not been given up, but that annealing was used, and the best methods to attain the best results were always employed if possible. He had hoped to have given them the new specifications, but, up to the present, they had not been published. As an example of the strains produced, oil hardened hoops opened or closed when cut, but remained neutral if they were first annealed. In guns there was no vibration to speak of, and so no effect would be produced. If they could tell the composition from the shavings, he thought they would overcome Mr. Snelus' objection on the score of unexpected segregation.

(*To be continued.*)

AN ELECTRIC PINNACE.

During last week we had an opportunity of inspecting an electric pinnace which is being tried on the Thames. This boat, which has been built by Messrs. Woodhouse & Rawson, United, Limited, for the Government, is intended for carrying troops between Chatham and Sheerness Dockyards. The "Electric," as she is called, is 48ft. 6in. long over all, by 8ft. 9in. beam, with an average draught of 2ft. 3in., and is intended to carry 40 fully equipped soldiers. Her speed on the measured mile is 8 knots per hour, and to meet cases of emergency she is fitted with two masts, two balance lug sails and a stay sail. The electric motor is capable of developing 5 h.p. The accumulators, which are stowed away under the seats, are capable of supplying current for a run of 10 hours' duration. During the short trial which we witnessed the boat appeared to fulfil all that was claimed for it. The ease and rapidity with which it was steered were specially noticeable. The cost of propulsion is estimated not to exceed that of steam vessels with similar carrying capacity.

Books Received.

Reports and Statistics of the Mining Department of Victoria for the Quarter ending 31st December, 1890.

American Chemical Journal. Vol. XIII. No. 4.

Transactions of the American Society of Civil Engineers. Vol. XXIV. No. 2. February, 1891.

Hints to Power Users. By R. Grimshaw, M.E. New York: Cassell Publishing Company.

Elementary Lessons in Heat, Light, and Sound. By D. E. Jones, B.Sc. London: Macmillan & Co.

RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

REPORT UPON TRIALS OF THE S.S. "IONA."

Since their report of May, 1890, the Research Committee on Marine Engine Trials have had the opportunity of carrying out another trial, which will be found in some respects more complete than any of those they have made previously.

Steamer.—The steamer tested was the "Iona," owned by Messrs. Erskind & Woods, of West Hartlepool, to whom the Committee are greatly indebted for all the facilities they kindly afforded for the trial, and for the obliging arrangements they made for the comfort and convenience of all on board. The "Iona" is a fine example of a modern well-decked cargo schooner with economical engines. She was built in 1889 by Messrs. W. Gray & Co., of West Hartlepool, and engined by the Central Marine Engine Works of the same firm with triple-expansion engines on three cranks working a single screw. She is a vessel of 275·1ft. length, 37·8ft. breadth, and 19ft. depth. Her depth, moulded, is 21ft. 10in., and her coefficient of fineness is 0·765. She has a double bottom of cellular construction 230ft.

* Report prepared by Professor Alexander B. W. Kennedy, F.R.S., Chairman of the Committee, for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 31st ult.

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long, and can carry 448 tons of water ballast. Her registered tonnage is—gross, 2,094 tons; under deck, 1,610 tons; and net, 1,348 tons; and she is classed at Lloyd's 100 A1 (special survey). Her draught in Tyne Docks before the trial started was 20ft. 7in. forward, and 20ft. 9in. aft, or 20ft. 8in. mean; but in salt water she rose ½in., as measured by hydrometer, so that the mean draught during the trial was 20ft. 7½in., corresponding to a displacement of 4,430 tons.

The "Iona" arrived at Middlesbrough from her voyage on 23rd June, 1890, and her engines were afterwards overhauled by their makers. She subsequently went north to the Tyne to take in a cargo of coal, and the trial was made during her outward voyage south. The steamer left Tyne Docks at 12·20 noon on 13th July, 1890, and crossed the bar about 1 o'clock, the weather being fine with a fresh breeze. The fires had been lit since 6 a.m. on the previous day, and, in order to get everything warmed up and the fires in normal condition, the trial itself was not started until 6·30 p.m. on 13th July, by which time the steamer was off Robin Hood Bay. The trial lasted for sixteen hours, ending at 10.30 a.m. on 14th July, when the steamer was off Yarmouth. The weather remained fine throughout, so that there was no difficulty in taking any of the usual observations.

Forced Draught Arrangement in the "Iona"

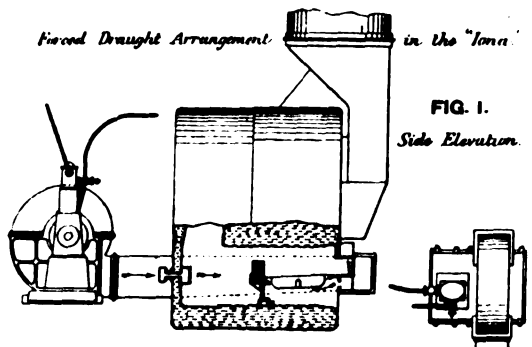


FIG. 1. *Side Elevation.*

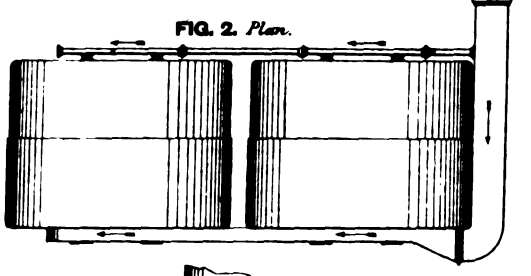


FIG. 2. *Plan.*

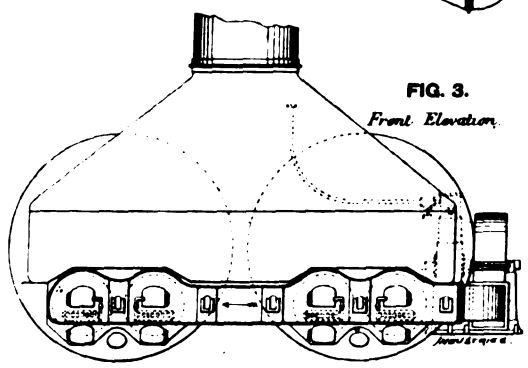


FIG. 3. *Front Elevation.*

The speed of the engines was not altered during the trial, nor was the valve gear touched or altered throughout the whole time. In addition to all the observations which had been taken on former trials, indicator diagrams were taken at intervals from the circulating and air pumps, from the first and second receivers, and from both ends of the condenser. The temperatures of the circulating water and discharge water were also noted, and the jacket-water, steam-pipe drain-water, and supplementary feed-water were each separately measured.

Engines.—The "Iona" is fitted with triple-expansion surface-condensing engines, the cylinders being placed in the order—intermediate, high, low, going from forward to aft. The cranks rotate in the sequence—high, intermediate, low. The diameters of the cylinders are 21·88in., 34·02in., and 56·95in., by gauges. The piston rods are all 5in. diameter. There are no tail rods. The stroke of all three cylinders is 39in. The high-pressure cylinder only is jacketed. Its jacket is supplied with steam from the boiler direct; under ordinary working conditions it is drained directly into the hot-well, but during the trial it was drained through a measuring tank. A drain pipe was taken from the steam pipe, and another from the high-pressure valve chest, and these were connected to another tank, so as to be also separately measured. The intermediate and low-pressure cylinders are not jacketed. The clearance volumes of the cylinders are given by the makers as 12·41, and 10·11, and 7·64 per cent. of the volumes swept through by their respective pistons. The high-pressure and low-pressure cylinders are provided with ordinary double-ported slide-valves, and the intermediate cylinder with a Trick slide valve. None of the slide valves are balanced. The valve gear is the ordinary link motion. There are two feed pumps, one circulating pump, one air pump, and two bilge pumps, all driven by levers from the cross-head of the low-pressure cylinder. The feed pumps are each 3in. diameter, single-acting; the circulating pump is 10in. diameter, double-acting; the air pump is 17in. diameter, single-acting; and the bilge pumps are 3½in. diameter, single-acting. The stroke of all six pumps is 26in. The surface condenser contains 1,360 square feet of tube surface, in 475 tubes of ⅝in. external diameter and 14ft. 7in. length between tube plates. The screw propeller is of cast-iron, having four blades, and is 14ft. 6in. diameter, with a mean pitch of 14ft. 6in. and a surface of 63 square feet.

Boilers.—Steam is supplied by two single-ended steel boilers with Purves' corrugated flues. The boilers are 13ft. 3in. in mean diameter and 10ft. long, with two furnaces each, or four furnaces in all. The total grate area was originally 52·5 square feet, each grate being 8ft. 9in. long, and 3ft. 6in. broad; but the fire-bars have since been shortened by the length of one brick to 3ft., so that at the time of the trial the total grate area was only 42 square feet. The total heating surface of the two boilers is 3,160 square feet, of which 2,590 square feet is tube surface. The total heating surface is therefore 75·2 times, and the tube surface 61·7 times the actual grate area. The ratios of total heating surface and tube surface to the original grate area are 60·2 and 49·3 respectively. There are in all 480 tubes, 3in. external diameter and 6ft. 10⅛in. long between plates. The internal diameter of the funnel is 6ft. 3in., and its total height is 51ft. 9in. above the level of the fire grates. A damper is placed in the funnel at a height of 17ft. 8in. above the level of the fire grates. The total cross-sectional area through the tubes is 18·3 square feet, and the area across the funnel is 30·7 square feet. The net volume of the boilers is 2,680 cubic feet. The boilers are worked under forced draught, on a plan designed by Mr. John R. Fothergill, the arrangement of which is shown in Figs. 1, 2, 3. A fan in the engine-room, driven by an engine which during the trial received steam from the donkey boiler, forces air into a trunk which extends across the front of the boiler. This air passes into the furnaces through gridiron valves placed just below the level of the fire-bars; each of these valves is made to close automatically by the lifting of the latch, whenever the corresponding furnace door is opened, thus preventing flame and gases from being blown out from the furnace into the stoke-hold. A smaller air trunk, branching off from the main trunk and provided with a deflecting valve, passes along the back of the boilers and admits a quantity of air through perforated plates into the combustion chamber, in the form of small streams which mix with the gases after they have passed the furnace bridge and have been deflected to the bottom of the combustion chamber by a plate hung at the back end of the furnace. The fan is 60in. diameter and 20in. broad, and is capable of supplying 14,000 cubic feet of air per minute at a pressure of 3¼in. water-gauge; it is driven direct by a Chandler's single-acting high-speed engine, with cylinder 8in. diameter and 7in. stroke, developing 2·1 indicated horse-power at a speed of 180 revolutions per minute, which was the mean speed during the trial. The fan engine is usually supplied with steam from the first receiver of the main engines; but throughout the trial, as already stated, steam was supplied to it from the donkey boiler. Water gauges connected to the casings and ashpits were read at intervals of half an hour, and the following are their mean readings:—

Position of Gauge.	Pressure.
On air trunk near fan	0·86in. of water.
On air trunk at back of boilers	0·34in. ,,
On ashpits, mean of four gauges	0·17in. ,,

Weights.—The total weight of the engines and boilers and all mountings, including water in condenser, pipes, and boilers, is about 202 tons, exclusive of shafting, tunnel bearings, and propeller. The following are the weights of the various parts of the machinery, boilers, and accessories, as given by the makers:—

Engines alone	64·92 tons
Shafting, tunnel bearings, and propeller	26·59 ,,
Engine-room auxiliaries, including donkeys, pipes, platforms, ladders, and gratings	12·16 ,,
Water in condenser, pipes, and pumps	1·71 ,,
Boilers alone	58·60 ,,
Boiler-room auxiliaries, including forced draught gear, smoke-box, uptake, funnel, furnace gear, mountings, stoke-hold floor, boiler chocks, and ties	28·49 ,,
Water in boilers	35·75 ,,
Total	228·22 tons

(To be continued.)

COCKBURN'S TYPE-WRITER FOR THE BLIND.

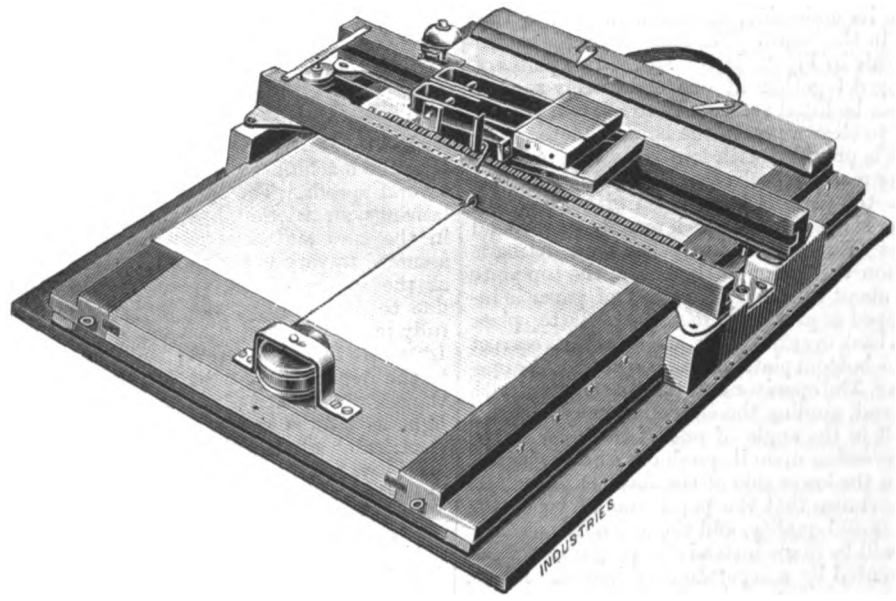


FIG. 1.

COCKBURN'S TYPE-WRITER FOR THE BLIND.

ON glancing at the above heading the question will arise in many minds, "How do the blind write?" It will therefore be of some interest to describe the method in common use for the purpose, and then to give a detailed description of the type-writing machine which is now superseding to a large extent the earlier apparatus.

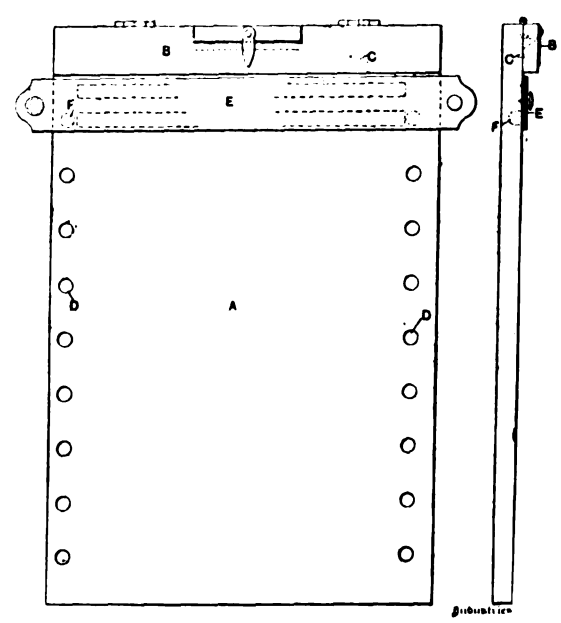


FIG. 2.

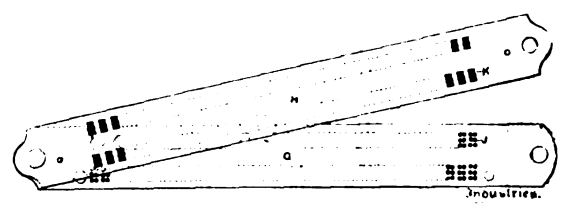


FIG. 3.

The ordinary apparatus is shown in Fig. 2 and consists of a board A provided with a hinged flap B at the top. The paper used by the blind for writing what is known as the "Braille" type is a specially prepared thick paper with a smooth face, and the size of the sheets is about the same as ordinary foolscap. Two pins C are fixed into the board itself under the hinged flap, and two others into the flap at a distance of about ⅜in. nearer

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the top of the board. The sheet of paper is fixed in position by raising the flap, pressing the paper over the two pins on the board, and then closing the flap, so that there are then four holes in the sheet of paper, the use of which will be described later on. The sheet is now fixed firmly in position, and is ready to be written upon. Along each side of the board is a row of holes D equidistant from each other, and a brass fitting E stretches across the board from side to side and is provided with two pins F upon its underside, which can enter into two opposite holes in the board. The brass fitting is shown upon a larger scale in Fig. 3. It consists of two plates of sheet brass, hinged together at one end loosely so that the top plate can be lifted sufficiently to allow a hole at the other end to clear a pin in the bottom plate. The bottom plate G is provided with two rows of groups of holes J, or rather recesses, each recess being hemispherical in shape. The top plate H is provided with a series of holes K of the shape shown, which exactly correspond with the groups of recesses below. The brass fitting is placed in position at the top of the board, the top plate is then turned about its hinge, the sheet of paper is inserted and clamped as previously described; the top plate is then brought back over the paper, and retains its correct position over the bottom plate, and all is ready for the operation of writing. The operator now takes a small awl with a blunt point, and, guiding the end of the awl with his fingers, places it in the angle of one of the holes in the top plate, and, pressing upon it, produces a hemispherical projection upon the lower side of the sheet of paper. It is of great importance that the paper should be of the proper thickness and quality, and the awl not too sharp, or a puncture will be made instead of a projection. Each letter is represented by a separate combination of dots, which, of course, vary in position in a somewhat similar manner to the Morse code used in telegraphy. It will be readily seen that two lines of letters can be written with one setting of the cross-bar, after which it is necessary to move it into the next lower pair of holes upon the writing board. When the whole of one side of the paper has thus been filled, the sheet is turned over, and is now lowered the distance between the holes made by the pins upon the hinged flap and those upon the board itself, so that the rows of small projections now lie between those previously written upon the other side. The great objections to the use of the board, cross-bar, and awl are the extreme tediousness of the process, and also the fact that the use of the awl for any length of time produces cramp in the fingers.

The Cockburn type-writer does away with the use of an awl in the fingers, and substitutes a set of three keys similar to those used in ordinary type-writers. Fig. 1 represents a general view of the machine in working order. It will be seen that the board with the hinged flap is present as in the old apparatus, and the same method of fixing the paper is employed. Instead of the cross-bar composed of two brass plates a carriage is here used, which can slide from top to bottom of the board; a cord is attached to the slide and passes round a drum in which a spring is coiled. There is thus a constant tendency for the slide to move towards the drum. This is prevented by a spring catch, which strikes against pins, the pins acting for the same purpose as the side rows of holes on the simple board. After writing each line the spring is released, and the slide passes down sufficiently far to enable another line to be written. The slide itself carries a bar with recesses or holes as in the simple form. Upon the slide is fixed a traveller, to which is attached a cord, which passes round a drum containing a coiled spring; the traveller has thus a tendency to cross the board. It carries three keys, which act upon punches in such a way that the punches cause the paper to enter the recesses in the cross-bar and produce the projections. Supposing the traveller to be at one edge of the board; then one, two, or three punches will be depressed, as the case may be. A fourth key is then pressed, which projects beyond the other three, and this releases a pawl from the tooth of a rack fixed to the cross-slide, and allows the traveller to advance the distance between the two rows of three recesses. The punches may then be again depressed, and next time the fourth key allows the pawl to pass over a wider space, in order to separate the groups forming letters. A bell is placed on the cross-slide which gives notice when the traveller has reached the end of its course. The traveller is then brought back, the cross-slide lowered, and a new line can be written. At the edge of the board are placed marks which enable the operator to tell at what distance from the top of the paper he is writing, and along the edge of the cross-slide are pins by which he can tell how far across the paper he has written.

The machine is a very ingenious contrivance, and appears to have received the approval of all who have used it. A considerable number of them are now in use. Sample machines are on view at the offices of Messrs. Cockburn, Phillips, & Montgomery, 2, Princes Mansions, Victoria Street, S.W.

FOUCAULT CURRENTS IN DYNAMOS.

By J. Swinburne.

The question of the loss in dynamos by Foucault currents in the armature cores and windings has been brought prominently forward lately. Mr. Kapp and Mr. Housman published accounts of a method of estimating the losses in a recent number of the *Electrician*. Moreover, Mr. Kapp explained the method at the Institution of Civil Engineers, and Mr. Housman at the Institution of Electrical Engineers, and the importance of the subject warrants its being brought forward so prominently. The method of estimating the loss by Foucault currents described by Messrs. Kapp and Housman consists of running the machine as a motor with no load at two or several speeds. The losses are due to friction in the bearings, air friction, hysteresis, and Foucault currents in the core and armature bars. The first three are assumed to vary as the speed, and the Foucault currents as the square of the speed. This method is, however, due to Mr. Mordey, who worked the subject out very fully in his paper on "Alternate Current Working" in 1889. He did not, however, supply the power electrically to the dynamo, but used a transmission dynamometer, though the method of testing dynamos by running them light as motors was well known. Supplying the power electrically admits of its being measured with greater accuracy, but does not allow the Foucault currents in the core to be determined before the armature is wound.

The method has, however, one very serious objection—viz., that the loss by Foucault currents at full load is very much greater than at no load, at least in a large machine, and this makes the method inaccurate. The loss by Foucault currents in the discs is increased considerably by the distortion of the field due to the armature current, and the losses by Foucault currents in the conductors are increased greatly by the same cause. The method may thus under-estimate the losses very considerably—that is to say, the losses may be double those determined in such a way. This is discussed in my paper on "Armature Reactions" in 1890, so I need not go into it farther here.

I tried a number of experiments on the stray power in 1886. Various dynamos were run as loadless motors, but the results were all vitiated by variations of the friction. The machines were, however, comparatively small, and the friction may have been large in proportion to the hysteresis and Foucault currents. I do not mean to imply that I forestalled Mr. Mordey in 1886; I was merely attempting to separate the electrical and mechanical losses. The assumption that the loss by friction varies as the speed is gratuitous, and Messrs. Kapp and Housman are really trying to determine three unknown quantities from two equations. Mr. Mordey can, however, find the friction losses at various loads, and can thus apportion the no load losses accurately. I tried another method of finding the loss by hysteresis and Foucault currents in the core. The armature, before being put in the machine, had one wire disconnected from the commutator, so that the circuit was open. The armature was then treated as a choking coil, and the power measured when an alternating pressure was applied. There was no wattmeter available, so a current dynamometer was employed. The fixed coil was put in series with the armature, and the moving coil, which had only one turn, was put in series with a non-inductive resistance. The dynamometer thus became an accurate but wasteful wattmeter. By using more than one frequency, the Foucault current and hysteresis losses can be separated according to Mr. Mordey's equation.

Alternating currents also supply a most convenient method of testing armature insulations during the progress of manufacture. Before the last connections are made to the commutator, several sections are included between the terminals of an alternating machine. The armature then acts as a transformer, transforming up, and testing its own insulation. This method was introduced at Messrs. Crompton's works about four years ago, and has, I believe, been used ever since. It may be made too severe, and any armature can be broken down by including few enough turns between the terminals of the alternating dynamo.

The loss by Foucault currents in a disc which is uniformly magnetised can be calculated if the specific resistance of the iron is known. Discs are sensibly uniformly magnetised in a transformer, and I have elsewhere* given the formula—

$$P = 2{\cdot}6\, B^2 n^2 t^2 10^{-16} R^{-1},$$

where P is the power wasted per c.c. of iron, B is the induction, n the frequency or revolutions per second of a two-pole dynamo, t the thickness of each disc in centimetres, and R the specific resistance of the iron in ohm centimetres. It will be noticed that the diameters, internal and external, do not appear in the equation, so that the loss per cubic inch does not depend on the size of the machine. To give a concrete example, we may take a two-pole dynamo with a 20in. by 20in. armature with a 14in. hole, and 600 revolutions per minute. If the armature induction is 13,000, the loss by hysteresis comes out 450 watts, while, taking the specific resistance of iron at 10 microhm centimetres, the loss by Foucault currents is 370 watts if the discs are $\frac{1}{20}$in. thick. The induction does not vary in a dynamo in the same way as in a transformer, so this is too low an estimate. It will be nearer the truth to take it at 450 watts also. In a small machine, which is run at 1,200 revolutions or so, the loss by Foucault currents may easily be four times that by hysteresis with the thickness of discs commonly employed by makers. It is here assumed that the discs are insulated from one another. There is no difficulty in separating them well enough to avoid any Foucault currents due to contacts.

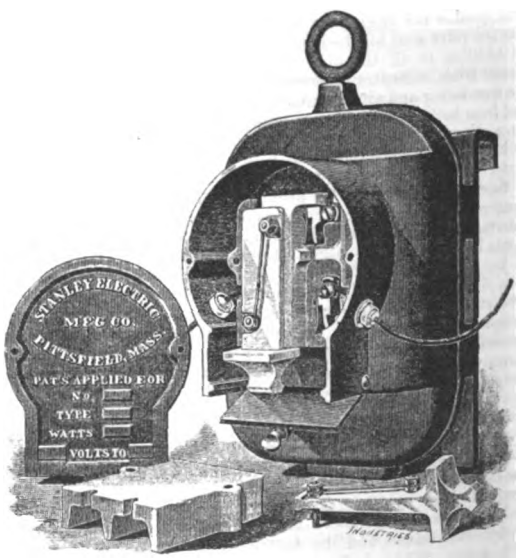
Foucault currents in bars can also be calculated roughly, but only roughly. As large bars are seldom used there is no need to go into the methods of calculating. Twisted conductors get over the difficulty if the various component wires are not in good enough electrical contact to allow the Foucault currents to flow. The only way to determine these losses is to test the machines at full load by some of the modifications of Hopkinson's method. There are also serious losses by Foucault currents in Gramme machines, which may not appear at all at no load.

The losses by Foucault currents in the conductors are often very serious in alternating current machines. As the cross-induction is generally small in such machines, Mr. Mordey's method will give accurate results. The superposition of the main current does not increase the loss. For instance, if there were 100 watts lost in a main by a current already flowing, and a second current is superposed, which by itself would produce a loss of 100 watts, the two together would waste 400 watts, not 200 watts. In a dynamo, however, if the Foucault currents waste 100 watts in the conductors, and the armature loss by C^2R is, say, 200 watts, the total waste is 300, not 583 watts. It is, perhaps, unnecessary to give the explanation of this here.

* B.A. Paper on Transformer Design, 1889.

THE "STANLEY" TRANSFORMER.

The accompanying illustration shows the details of arrangement of the latest type of "Stanley" transformer. As these transformers are manufactured by the Stanley Electric Manufacturing Company, of Pittsfield, Mass., U.S.A., we may surmise that Mr. Stanley has severed his connection with the Westinghouse Company, and that he is putting forward apparatus of his own design independently.



These transformers are arranged without any secondary fuses, while the primary fuses are longer than usual in America. The secondary fuses are put in the circuits elsewhere. The whole practice relating to fuses is different in England and America, and it is time this very important matter was thoroughly ventilated and discussed. The average American transformer has half an inch or so of primary fuse on each terminal, while in this country primary fuses are separate structures in cumbrous porcelain or stoneware cases. These transformers are made in sizes for 10, 20, 30, 40, and 100 lamps.

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SOME EFFECTS OF ALTERNATING CURRENT FLOW.*

The simple cases of circuits with resistance and self-induction and capacity in series are first examined, and the phenomena of electrical resource are fully investigated. Warnings against using step-up transformers for testing cable insulations are given, with the author's reasons. He then discusses the effect of the capacity of the Ferranti mains upon the electromotive force at various parts of the circuits, and describes some experiments made at Deptford. These show that there is no foundation for the statement that the pressure is ever higher at London than at Deptford.

The condenser effect, and in particular the alteration of the change ratio of a transformer which takes place when its secondary circuit is connected to a conductor system having a certain capacity in relation to the inductance of that secondary circuit, is found to operate in many curious ways in the practical use of such combinations. For instance, if a pair of alternators separately excited are working in parallel on an omnibus main leading to a conductor system of no sensible capacity, then we know very well that if the dynamos are synchronised, and contributing equally to the outgoing current, the method adopted to take one dynamo out of circuit would be to lower its exciting current, and when its outgoing current fell to zero to sever its connection with the omnibus main. If, however, the alternators are working through step-up transformers, and into a conductor system consisting of concentric cable, it is found by experience that the exciting current of the dynamo to be taken out must be raised, and not lowered, in order to bring it into a condition in which it can be cut off from the omnibus main without dangerous sparking at the switch; and, conversely, in putting it into parallel the incoming alternator has to be excited to a lower electromotive force than is necessary to maintain the standard P.D. at the terminals of the step-up transformer before putting it into connection with the omnibus main. This is obviously due to the fact that the change ratio of the step-up transformer is altered by the very act of putting it into connection with the conductor system, and hence the excitation of the alternator at the moment of making or breaking connection with the main must be such as will bring the P.D. of the free secondary terminals of the step-up transformer to a value equal to the P.D. of the two points on the conductor having capacity to which they are about to be connected, or from which they have just been severed; and when the connection of the alternator is made, the excitation can be altered to divide the load on the machines properly. This, of course, would not be the case if high-tension alternators of very small inductance were set to work in parallel on such a concentric conductor system. In this case the condenser effect is practically nothing, and the behaviour of the machines on going into or out of parallel would present nothing unusual.

In the cases briefly discussed above, the cables, whether concentric or simple, have been found to act as single condensers substituted for them would act; and in the experiments described no progressive rise of pressure from one end to the other of a cable possessing capacity was found to exist.

It is, however, quite possible for self-induction, resistance, and capacity to be so combined together in one conductor that the action of an impressed periodic electromotive force at one end will create a progressive rise of mean pressure along the cable when the far end is insulated.

* Abstract of a paper read by Dr. J. A. Fleming before the Institution of Electrical Engineers on the 7th inst., and fully entitled "On Some Effects of Alternating Current Flow in Circuits having Capacity and Self-Induction."

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

VII.

(*Continued from page 427.*)

Mottled Soap.—Household blue and grey mottled soaps are commonly made from the oils mentioned above, or from tallow, cocoanut or palmnut oil, and lightest coloured rosin. In each case the process of manufacture is practically the same as described for yellow soap, so far as, and including, the operation of boiling on strength. After settling, the half-spent lye is drawn off as completely as possible, and the soap is then closed or fitted with a solution of sodium silicate. Crystals of sodium carbonate are also often added, and, when the original fats are not of sufficiently good colour, a solution of bleaching powder is sometimes used to whiten the soap. As little, however, of this substance should be used as possible, because its addition to the soap gives rise to the formation of a calcium salt of the fatty acids, which is insoluble in water, and is useless for washing purposes. The soap is then finished by boiling for some time with closed steam, or by fire, to evaporate excess of water, until a sample taken out of the pan and cooled sets with the required firmness, and contains only the desired percentage of water.

The colouring matter, or mottling material, which is usually ultramarine for blue mottled soap, and manganese dioxide or plumbago for grey, is then stirred up with a little hot silicate solution, and added to the mass, with which it is thoroughly incorporated by boiling. If properly made and finished, the soap has now a thick, flaky appearance, and, if ultramarine has been added, has a uniform, dark, bluish-grey colour. It is not advisable to add the colour, especially ultramarine, until the last moment, and the soap should then be ladled out, or otherwise withdrawn from the pan, and placed in the frames with as little delay as possible.

The separation of the colour into small spots and patches, to form the mottling, requires a certain amount of time, during which the soap must be kept in a fluid condition; hence the frames used for mottled soaps must be such as will retain the heat for a considerable time, and only allow the soap to cool slowly.

These frames are of two kinds, wooden and iron. The former consists of a number of wooden sections, lined inside with zinc (see Fig. 13), one of which is placed on a frame bottom or base, and others fitted into sockets, one upon the other, to form a soap frame of almost any desired height. When a sufficient height is attained the separate parts are firmly clamped together by long iron rods, attached to the frame bottom

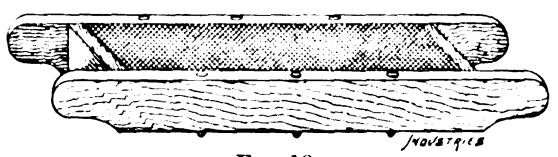


Fig. 13.

and connected with cross-heads placed across the top section at each end, pressure being applied by a screw. These frames, being of wood, allow the heat to dissipate only slowly, and, although somewhat cumbersome, they are excellent for mottled soaps. The iron frames are similar to the ordinary ones, but the bottoms are double or jacketed, and heated by steam, so as to retain the heat of the soap and allow time for the colour to aggregate into patches and so form the mottle. When solid, the soap is cut into slabs and bars in the manner already described.

The above description refers to the manufacture of mottled soaps of the better class, containing 45 per cent. to 50 per cent., or more, of fatty anhydrides; but there are also cheap mottled soaps in the market, which are made in a few hours, instead of days, from cocoanut and palm-kernel oils, on the principle of marine soap. This soap differs from those already mentioned in that it contains the whole of the glycerine formed during the process of saponification, no lye being separated or removed from the pan. It is generally made in a pan provided with open steam coils, and also jacketed for heating by closed steam, or else capable of being heated by fire. The oil is saponified by relatively strong alkali, using open steam for the boiling. Comparatively large quantities of water, silicate of soda, soda ash, and common salt are then added, and the soap finished by boiling with closed steam or by fire in the same way as ordinary mottled soaps. The whole contents of the pan are then run into ordinary iron frames to be mottled. The thick fob of scum or froth, which forms on the surface of the soap in each frame, is skimmed off, and the colour crutched in by hand, after which the frames are covered with sacks and the soap allowed to cool.

The colour should be added while the soap is hot—the hotter the better—if a good strike and bright colour be desired; but as the soap is extremely thin and deficient in body, there is considerable risk of the mottling material sinking entirely to the bottom of the frame if the crutch be withdrawn and the soap left at rest too soon; while, on the other hand, prolonged crutching is certain to prevent the mottling from taking place at all. In the one case, the bulk of the soap turns out perfectly white, all the colour being contained in the bottom two or three slabs; in the other case, it has either one uniform tint of blue or grey, or else the colour is distributed evenly throughout the mass, in the form of minute points or dots. Some experience is therefore necessary in deciding when to leave this class of soap to mottle, the best way being to stop the crutching at a point determined by observations of the temperature and density of the liquid soap. Mottled soap, made in this way, usually contains more than half its weight of water, and from 20 per cent. to 30 per cent. of fatty anhydrides. It is very liable, on exposure to air, to become crusted all over with fine needle-shaped crystals of sodium carbonate, from the large quantity of soda ash contained in it.

The following analysis gives the composition of a sample of this class of soap, from which it will be seen that it contains comparatively little real soap, although the presence of silicate and carbonate of soda, and even of caustic soda, in this soap, which is mainly used for scouring purposes, cannot be considered altogether as a disadvantage:—

Analysis of Low-priced Blue Mottled Soap.

	Per Cent.
*Fatty anhydrides	18·98
Soda, existing as soap	2·79
" " silicate	·09
Silica	·22
Free caustic soda	none
Sodium carbonate	3·92
Sodium chloride	4·79
Ultramarine	·10
Water and glycerine	69·11
	100·00

* Equivalent to 19·57 per cent. fatty acids, derived from cocoanut oil.

(*To be continued.*)

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

The last meeting of this section was held on the 4th inst. The title of the paper by Messrs. Archbutt and Deeley, as first announced, was somewhat modified at the time of reading the paper, the new designation being "The Treatment of Hard Water," and the subject really being the description of a series of experiments made by the authors on the softening of the feed-water for locomotives at the Midland Railway Company's works at Derby. After an historical sketch of the process of water softening, in which it was suggested that the ordinary use of lime for this purpose should be ascribed to Henry rather than Clark, reserving for the latter the credit of introducing the soap test, the qualities of an ideal process were enumerated. Such a process must be effected by the use of the simplest and cheapest chemicals and plant, must cost little in labour, and be suitable for all kinds of water. Though not claiming these advantages in an absolute sense for their process, the authors considered that they had made a perceptible advance towards attaining them.

The experimental plant which they had employed consisted of a tank holding 20,000 gallons, into which the water to be treated was run, and a smaller tank, in which the reagents used were brought into solution or suspension by boiling. The concentrated purifying liquor was allowed to flow into a well in the large tank, at the bottom of which was a steam injector, whose action mingled it with the rest of the contents of the tank. The sludge produced by a previous operation was permitted to remain at the bottom of the large tank during this process, and become stirred up with the new volume of water being treated. Air was also blown in to complete the admixture of the already precipitated lime and magnesium salts with those in the act of precipitation, and it was found that the effect of so doing was to clarify the water at a much more rapid rate than was possible by ordinary subsidence. The reagents used were simply lime, soda ash, and sulphate of alumina, the last named being added only to the extent of about 1 grain per 1,000 gallons. Ferrous sulphate has been lately substituted for the sulphate of alumina with success. Settlement was so rapid that the nearly clear liquid, containing only about 1 grain per gallon of suspended matter (less than the water before treatment), could be drawn off in about an hour, and even this short period could be reduced, if necessary, by the use of a specially constructed pipe. The mixing appliances were cheap, efficient, and manageable; the labour was light, involving little beyond opening and shutting a few valves; and its cost did not exceed one farthing per 1,000 gallons.

No great novelty was claimed for the process, its efficiency depending rather on the careful adoption of the best method of working from a mechanical point of view than on any special chemical conditions. The authors particularly insisted on the advantage of abandoning the use of caustic soda, which was comparatively expensive, and in careless hands gave rise to much mischief. A glaring instance of the waste that frequently resulted from its abuse was afforded by a water which had come under their observation, and which, after softening, contained 29 grains per gallon of sodium carbonate and 4 grains per gallon of caustic soda.

The precipitated lime and magnesia salts in their process were easily removed from time to time. but a portion was always left to aid in clarifying the next batch. The water thus softened had been in use for a battery of four old locomotive boilers which supplied steam for one of the shops at Derby. One difficulty had presented itself: it was found that the valves, feed-pipes, and injectors became coated with a thick soft deposit which gave serious trouble. It was proved to be due to the tendency of the purified water to deposit a further small quantity of solid matter on heating. A remedy was devised, which consisted in carbonating the clear effluent by means of the gases from a coke stove. With this precaution not only was there no deposit, but that already formed was removed. The sulphur in the coke was of no moment, the alkalinity of the water being more than ample to neutralise the trace of sulphuric acid that might find its way in from this source.

The efficiency of the process appears evident from the following analyses:—

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	Before Treatment. Grains per Gall.		After Treatment. Grains per Gall.
Calcium carbonate	9·74	...	2·25
Magnesium carbonate...	2·45	...	2·18
Sodium carbonate	—	...	0·85
Calcium sulphate	5·64	...	—
Magnesium sulphate ...	1·34	...	—
Sodium sulphate.....	3·41	...	11·33
Sodium chloride	2·81	...	3·38
Silica.....	0·34	...	0·48
	25·74		20·47

A considerable organic purification was also effected.

In the discussion which followed Mr. W. Thorp doubted whether the well in the mixing tank was necessary, and feared that the use of a blast of air as an agitator might be somewhat costly. It was often forgotten that the work necessary to drive a given volume of air through water at a given depth was precisely equal to that required to raise the same volume of water to a corresponding height. Mr. Harland objected to the use of a large tank, on the ground that in many cases room for it was not available. Mr. B. E. R. Newlands spoke of the difficulties that were often met with in working a process of this description, due to the constantly varying composition of the water to be treated, and congratulated the authors on the measure of success they had achieved.

Mr. Archbutt, in reply, said that the well had been found of service, and was, therefore, retained; he did not think the cost of admixture was high. With regard to the tank room necessary, it must be remembered that, owing to the rapid subsidence, large quantities of water could be handled in a short time, even when a very moderate area was available.

A note by Mr. A. H. Allen, serving as an appendix to his recent paper on the "Chemistry of Whisky and Allied Products," was then read, the chief point of interest being a statement to the effect that cork and wood shavings exercised a considerable selective action on whisky, removing fusel oil and similar impurities. After a brief discussion the meeting adjourned.

Notes.

ANHYDROUS SULPHURIC ACID.

Ordinary vitriol, however strong, never contains more than about 98 per cent. of real sulphuric acid. At Teutelew's Chemical Works in St. Petersburg the well known plan of freezing the acid, and thus getting crystals of the really anhydrous acid, is in successful operation. Using acid of 96–97 per cent. strength, crystallisation is effected by cooling to $-10°$ C., and throwing in a crystal of H_2SO_4 to start solidification. The first crop of crystals is not quite anhydrous, but by repeating the process pure crystallised H_2SO_4 is obtained. The crystals necessary to start crystallisation can be obtained by cooling a specially strong acid made by mixing vitriol with Nordhausen acid.

H.M.S. "VULCAN."

The progressive trials of H.M.S. "Vulcan," referred to in our last issue, were commenced on the 30th ult., but came to an untimely end. The ship had done two runs each at 10 and 12 knots, and four at 14 knots; she then tried 16 knots, but, on the third run, the now unfortunately familiar occurrence took place—two of the boilers commenced to leak in the tubes, one very badly, and flames issued from one furnace door burning one man, but not, it is said, very severely. The reasons for the accident have not yet been determined, and the case is stranger than usual, for here we have a ship, after steaming continuously at 18¼ knots for eight hours, breaking down after a short run at a much lower speed. Messrs. Humphreys & Tennant and the Engineer-in-Chief of the Navy have been examining into the matter, but with what result is not, as we have said, yet known.

RAILWAY SIGNALLING.

At a recent meeting of the Cleveland Institution of Engineers, Mr. W. J. Cudworth read a paper on "Railway Signalling." The author stated that the semaphore began to be generally adopted in the year 1851, and was then a new invention and the subject of a patent. In a report of that date it was stated that the reconstruction of twenty signals on that system would cost about £200. At present there are 212 levers in the three signal cabins in connection with Darlington Station alone, and the cost of signals, cabins, interlocking, and connections would probably be not far, if at all, short of £7,000. The author stated that in the Middlesbrough district the smoke from the iron-works often causes trouble, and makes electric repeaters necessary when they would not be otherwise required. To show how closely the junctions often were placed to each other, the author gave the distances between the following signalling cabins between Middlesbrough and South Bank:—Sussex Street to Middlesbrough East, 325 yards; Middlesbrough East to Guisborough Junction, 383 yards; Guisborough Junction to Whitehouse Crossing, 1,146 yards; Whitehouse Crossing to Cargo Fleet, 873 yards; Cargo Fleet to Tees Tilery, 1,285 yards; Tees Tilery to Eston West, 903 yards. The interlocking frame in use on the central division of the North-Eastern Railway is known as Stevens' mitre lock. In the whole North-Eastern system there are 387 junctions of passenger lines with other passenger lines, 259 junctions with goods lines, 1,901 junctions with sidings, and 788 cross-overs, and a total of 3,335 connections with passenger lines, whilst in Great Britain and Ireland there are altogether 39,397 of such connections, and nearly the whole of these are carefully signalled at heavy expenditure.

CROSS TALK IN TELEPHONES.

Mr. J. J. Carty has recently read a paper before the American Institute of Electrical Engineers, in which he again urges his view that telephone disturbances are due to static and not to magnetic induction. Mr. Carty does not merely bring forward a theory, but he supports his case by experiment. On the face of it anyone would say that the disturbances due to static induction must be infinitely less than those due to magnetic induction. In a given case the disturbance due to the two inductions can be calculated, but Mr. Carty gives no information. The higher the pressure and the smaller the current used in the telephone circuit, the greater will be the relative effect of static induction, but it seems incredible that in ordinary practice the static could possibly be greater than the magnetic effect.

HARBOUR WORKS AT HAVRE.

The works about the basins, the harbour, and the roadstead, either finished, commenced, or projected during 1890, are the construction of two new sheds for goods on the quays, making the total number 18, with a length of 6,652ft., and a covered space of about 66,000 square yards. The number of hydraulic cranes is 17, with a lifting power of 1¼ tons, a floating one of the same force, and two stationary ones of 3 tons. A floating one of 10 tons will shortly be completed. The enclosure of the Bassin Bellot and of a portion of the Bassin de l'Eure is also projected. Notwithstanding the increased accommodation afforded by the Bassin Bellot, there have been occasions during the past year when the quay accommodation has been found insufficient for the vessels wanting berths, and, as about 540 yards of the quays of the eastern portion of the basin are now taken up by petroleum ships, it is proposed to make a dock for this traffic further on, at a cost of £46,000, half of which will be paid by the State and half by the Chamber of Commerce, which will raise a loan of £23,000 for the purpose. The Chamber of Commerce had already voted a sum of £20,000 towards the purchase of a more powerful dredger, in place of the one which was sunk at the end of last year.

TELEGRAPH EXTENSION UNDER DIFFICULTIES.

The *Pekin Gazette* recently contained a statement from the Viceroy of Yünnan, reporting that the line of telegraph communication in Yünnan has been extended to Momein, on the borders of Burmah. The statement explains that the project of constructing a line from Yünnan city to Momein for the purpose of establishing communication with the south-western frontier was set on foot immediately after the telegraph system of Yünnan was connected with that of Szechuan, Kueichow, and Canton. The task of making the preliminary surveys was intrusted to a Chinese official, aided by a foreign artisan. Part of the materials were procured from the surplus stock in Szechuan and the remainder had to be conveyed from Shanghai by way of Luchou in Szechuan under the care of officers specially deputed for the purpose. On reaching Yünnan the materials were divided into portions and stored at various places on the way between Yünnan Fu and Momein. The task of surveying the route and procuring the supply of poles occupied from March, 1888, to February 23rd, 1889. The construction of the line was commenced on the latter date and was completed on the 30th of May following. The distance from Yünnan Fu to Momein is 1,600 li (530 miles), and the route lies through a mountainous and densely-wooded country, where frequently no trace of habitation occurs for over a hundred li. The work was carried on by day under a blazing sun, which caused intense thirst, while by night the men were obliged to camp out in the open and were continually disturbed by the howling of wolves and tigers. The Mekong, the Salween, and the Shweilei rivers had all to be crossed in fever-stricken localities. The passage of the Salween, in particular, is attended with horror. Its waters are muddy and turbulent, and so deadly that the feet of men and hoofs of horses rot and drop off from contact with them. The officers and men of the expedition crossed the river on rafts constructed of coils of wire, and only reached the opposite bank after a very hard struggle. The season being summer, the malaria was at its worst, and no fewer than ten members of the party succumbed to its effects during the three days occupied in carrying the telegraph line across the river. The difficulties connected with the construction of this extension line have been far greater than any experienced in first introducing the telegraph system into Yünnan, and it is asked that the officers engaged on the work may receive reward on the same scale as is accorded in practice for the safe transmission of urgent messages from the field of battle.

THE ANALYSIS OF CHROME IRON.

Since chrome iron cannot usually be attacked by acids including aqua regia, nor brought into a soluble form by fusion with carbonate and potassium chlorate, and since the method of Fresenius and Hintz (viz., treatment in a current of heated chlorine gas), although accurate, is difficult and tedious, the following method may be recommended, says *Stahl und Eisen*, providing that, as is usually the case, only chromium, iron, silicon, and manganese are to be determined. One gramme of chrome iron is mixed with 8–10 grammes of dry bisulphate and fused for about an hour in a platinum crucible; it is then removed from the flame, 2–3 grammes of bisulphate of potassium added, and the whole again heated for a few minutes to convert the basic sulphates, which have been formed by the long-continued fusion, and which are difficult to decompose into neutral salts. The fused mass is extracted with boiling water and hydrochloric acid in a porcelain basin, and the silica filtered off, dried, and weighed. If any chromium oxide is included in this, the fusion must be repeated. Evaporation to dryness is not necessary. One quarter of the filtrate is neutralised, as far as possible, with caustic potash or soda and 0·5 gramme of magnesia suspended in water added; the liquid is kept hot until the precipitate has completely settled, and the latter is then filtered off, washed, and ignited, after which it is rubbed to a fine powder and fused in a platinum crucible with potassium chlorate and carbonate fusion mixture. The chromate is extracted from the fused mass by hot water, and, after reduction with sulphurous acid, precipitated by ammonia. The manganese is determined by the usual calorimetic method in another portion—one-tenth of the original filtrate. Before doing this, however, the chromium must be removed by precipitating the sulphuric acid with barium chloride, neutralising with sodium carbonate, and precipitating with barium carbonate. The iron is titrated with potassium permanganate, the colour of the chromium being found not to interfere, provided that the solution be sufficiently dilute.

THE COTTON INDUSTRY.

Though the position of cotton spinning in Lancashire is bad so far as regards American cotton, the employers have not been able to agree upon organising a general stoppage of the spindles during the whole of the approaching Whit week. An effort has been made in this direction, but it has failed. Weft spinning, as distinct from twist spinning, is unremunerative. Not only is the margin very poor, but stocks of moderate dimensions are found to be accumulating in first hands. Coptwist is a trifle better, for spinners can see a little profit. During the past few days the market has stiffened somewhat, and rather more cloth business has been done. The Oldham Cotton Buying Company has had a satisfactory quarter. The company has bought for spinners 27,251 bales in three months. This is a moderate proportion of the cotton bought by spinners as a body. The money represented by the business is £520,000. The company is now well established, and efforts will shortly be made to open out connections in the United States for a business with planters.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

20th April, 1891.

6752. White, W. ..... Stop valves.
6757. Oddy, F. ..... Caps for cap spinning and twisting frames.
6765. Brookes, A. G. ..... Spooling machines (*Foster*).
6769. Ward & Lancashire ... Knitting machines.
6779. Kerkes, P..... Signalling excessive fall of water level in steam boilers.
6792. Lee, J. W. ..... Apparatus for facilitating the stopping and starting of tramway vehicles.
6795. Coward, W. H. ..... Pulverising mill.
6801. Harris, A. ..... Filters for purifying the feed water of steam boilers.
6803. Mudd & Airey ..... Stuffing-boxes and glands and metallic packing.
6804. Garnier, T. R. ..... Ore concentrators.
6806. Boult, A. J. ..... Automatic water supply regulators for steam boilers (*Henry*).
6809. Barcroft, H. ..... Apparatus for propelling and steering boats.

21st April, 1891.

6812. Lobnitz, H. C. ..... Endless chains and buckets of dredging machinery.
6815. Barr, J. ..... Self-closing taps.
6817. Weir & Weir..... Apparatus for condensing steam and for obtaining fresh water from saline or other waters.
6821. Pye, R. ..... Appliance for moistening, heating, cooling, and ventilating factories.
6826. Eastwood, H..... Smoke burning bridge and fuel economiser.
6830. Smith, Smith, & Eastwood..... Apparatus for controlling the admission of steam or other elastic fluid to the cylinders of steam or other engines.
6840. Gedge, W. E. ..... Repeating guns (*The Ostrander Repeating Gun Company*).
6841. Rung, G. A..... Apparatus for sounding or measuring the depth of water.
6848. Wardale, J. D. ..... Fluid pressure engines for operating capstans.
6858. Fairfax, J. S..... Brake piston indicator for railway rolling stock (*Brown*).
6859. Altmann & Gray ..... Rail gauge adjuster with self-indicating index.
6860. Purdon, Walters, & Woodcock ..... Roller and ball bearings.
6873. McKee, R. ..... Drills for boring wells.
6876. Taylor, J. D..... Railroad signalling apparatus.
6877. Anderson, W. N. ..... Doors for lifts and means for operating the same.
6879. Lake, H. H..... Knitting machines (*Gormley*).
6881. Walcott, J. E. ..... Apparatus for covering electric wires.
6889. Newton, H. E. ..... Grease trap or intercepter (*Griffiths*).
6892. Hatfield, S. P. ..... Ordnance batteries.
6893. Adams, J. A. ..... Spring motors.
6894. Lake, H. H..... Apparatus for preventing incrustation in steam boilers (*The Nye Boiler Cleaner Company*).
6895. Ockenden, W. ..... Construction of boiler furnaces or flues.
6897. Hanna, H. B. ..... Steering of ships.
6898. Pyke, J. G. ..... Drilling machines.
6902. Edwards, E. ..... Fire engines (*Kieslich*).

22nd April, 1891.

6907. Mackett, A. E. ..... Mitre cutting machines.
6925. Garrett & Gozzard..... Automatic ball valves.
6931. Reichelt, Rattrit, Specht, & Marsh..... Spring motors.
6932. Harling, J. ..... Hydraulic engine.
6935. Gill, J. ..... Signalling on railways.
6940. Baird, R. ..... Apparatus for preventing priming in steam boilers.
6941. Hahlo, Liebreich, & Hanson ..... Drop and circular box looms.
6942. Beardmore, W. ..... The manufacture of armour plates and apparatus therefor.
6946. Jackson, Bentley, & Nuttall ..... Apparatus for grinding or treating pulp for use in paper-making.
6949. Key, W. ..... Treatment of the discharge gases from gas engine cylinders.
6950. Riley & Boswell ..... Valves.
6959. Kent, H. ..... Gearing for the transmission of power.
6962. Dutton, S. T..... Railway signalling apparatus.
6976. Couves, C. C. ..... Apparatus for delivering oil about a ship at sea.
6982. Horn, W. W. ..... Printing presses (*Lawrence*).

23rd April, 1891.

6988. Ashworth & Ashworth Carding engines.
6990. Weston, G. ..... Method of relieving steam or other slide valves.
6991. Stott, J. H..... Running off machines.
6999. Fisher & Murgatroyd Apparatus for cleaning and lustreing yarns of silk or other fibrous substances.
7001. Fawcett & Hartley..... Stop rods in looms for weaving.
7002. J. H. Collins & Sons ... Crushing and pulverising machine.
7008. Horrocks, J. ..... Safety and anti-vacuum valve.
7015. Evans, A. G. ..... Railway signalling apparatus.
7024. Foster, C. J. ..... Pulp screening machines.
7038. Fiège, R. G..... Adjustable mechanism for drilling and other machines for determining depths of holes.
7047. Purnell, J. J. ..... Governor for gas and oil engines.

24th April, 1891.

7055. Monie, H..... Ring-spinning machines.
7061. Freakley, W. ..... Furnace and water circulator for steam boilers.
7062. Wilson, A. B..... Flax fibre carding machines.
7064. A. C. Caddick & Co..... Apparatus for making gas.
7068. Claringburn, J. A. ..... Knitting machines.
7072. Bradley, J. H. S. ..... Hammerless guns.
7073. Harrison & Harrison... Knitting machines.
7082. Mumby, G. ..... Indicating apparatus.
7084. Burton, B. ..... Machine guns.
7085. Brown, C. A. ..... Furnaces for steam generators.
7096. Morris, R. ..... Bolt locks for rifles.
7097. Smith, R. N. W. ..... Sliding cylinder in connection with a jacquard machine.
7108. Saunders & Sterzing ... Permanent way of railways.
7109. Fisher, F. W. ..... Safety valves.

25th April, 1891.

7115. Austin, H. K..... Construction of bearings for shafts and spindles.
7116. Higginson, J., Jun. ..... Revolving flat cards.
7117. Pickles & Pickles ..... Winding machinery.
7120. Partington, E. ..... Disintegrating fibres in the manufacture of paper pulp.
7128. Heathorn, T. B. ..... Apparatus for steering, propelling, and retarding the motion of boats.
7136. Knowles, T. ..... Carding engines with revolving flats.
7139. Common, A. A. ..... Improved locomotive engine.
7142. Denton, W..... Vertical or marine boilers.
7150. Lebédeff, N. ..... The manufacture of iron and steel.
7157. Altmann, A. ..... Governors for gas and petroleum motors.
7166. Dolder, A. A..... Carding machines.
7170. Young, M. ..... Printing machines.
7172. Scrymgeour, D..... Method of utilising liquid fuel in fire-boxes.
7182. Price, H. S..... Apparatus for the transmission of power by ropes (*Hall*).
7183. Snowdon, J. A. ..... The manufacture of pitch chains.
7185. Horn, W. W. ..... Bolt cutter (*Dutcher*).
7187. Lillie, S. M. ..... Evaporating apparatus. (26th September, 1890.)
7191. Morton, T. ..... Apparatus for the return of water of condensation to steam boilers.

ELECTRICITY.

20th April, 1891.

6767. Lucas & Garrett ..... The electrical production of ozone.
6773. Von Orth, L. ..... Regulating clocks by electricity.
6774. De Reuter & Gower ... Electric conductors.
6782. Callendar, H. L. ..... Dynamo-electric machines.

21st April, 1891.

6831. Parcelle, A. L..... Dynamo-electric machines.
6870. Cadett, J. W. T. ..... Electric motors.
6906. Wilkinson, G. ..... Arc lamps.

22nd April, 1891.

6954. Sargeant, W. S. ..... Switches.
6978. Boult, A. J. ..... Dynamo-electric machines (*Stone*).

24th April, 1891.

7095. Coad, T. ..... Portable lamps.

25th April, 1891.

7167. Harden & Pearl ..... Arc lamps.
7168. Webster, G. ..... Voltaic cells.
7174. Grimston & Perrett ... Arc lamps.
7178. Hall & Hammond ..... Dynamo machines.

CHEMISTRY.

20th April, 1891.

6741. Bolz & Lühning ..... The manufacture of illuminating and heating gas.
6786. Johnson, J. Y. ..... The manufacture of hydrazine or diamidogen and its salts (*Badische Anilin & Soda Fabrik*).
6794. Jones, F. J. ..... Apparatus for washing or scrubbing gas.
6810. Singer & Berens ..... Manufacture of white lead and apparatus therefor.

21st April, 1891.

6883. Vautin, C. T. J. ..... Recovery of gold from solutions.

22nd April, 1891.

6972. Pitt, S. ..... Production of amidonaphtholsulpho acids and of dyestuffs therefrom (*Leopold Cassella & Co.*).

23rd April, 1891.

7026. Willcox, B. ..... The manufacture of iodine substitution products of phenols and cresols (*Farbenfabriken vormals Friedrich Bayer & Co.*).

24th April, 1891.

7092. Lister, A. A. ..... Extracting tar and ammonia from gas.
7106. Huillard, A. ..... Process of decolourising tanning liquors or tannic extracts.

25th April, 1891.

7140. Mason, S., Jun. ..... Method of and apparatus for purifying and refining alcoholic liquors and other fluids.
7188. Merichenski, M. ..... Carburetters.

MISCELLANEOUS.

20th April, 1891.

6798. Boult, A. J. ..... Kilns or furnaces (*Falasconi*).
6808. Lang & Wigham ..... Protecting iron and steel against oxidation.

21st April, 1891.

6814. Carlton & Reid ..... Annealing or treating steel or iron.
6823. Newman, T. ..... Pipe wrenches.
6862. Mahieu, A. E. J. ..... Process for bleaching thread, yarn, and fabrics, and other textile materials.
6874. Clark, A. M. ..... Augers (*Brede & De la Nux*).
6878. Porter & Bardwell ... Wrenches.
6884. Featherstone, E. C. ... Fastener or bolt.
6885. Imray, O. ..... Chair for railway rails (*Hilgenberg*).
6888. Mehner, H..... Refrigerative mixtures for motive power and other purposes.
6899. Hanna, H. B. ..... Boat lowering davits.

22nd April, 1891.

6916. Maxwell, T. ..... Liquid preparation for the protection of bright or unpolished metallic surfaces.
6919. Bell, R. W. ..... Metallic packing.
6939. Moorhouse, S. ..... Fusible plugs for steam boilers.
6973. Marrion & Ford ..... Nut locks.

23rd April, 1891.

7014. Tangyes, Ld., & Floyd The glands of stuffing boxes.
7048. Ibbotson, A. B. ..... Fish plates for railway rails.
7050. Lyte & Lyte ..... Method of coating iron and steel with lead.
7052. Boggett, W. ..... Method of obtaining electricity.

24th April, 1891.

7069. Willis, J..... The manufacture of iron or steel ingot moulds.
7090. Robinson, O. ..... Vices.
7091. Cole, T. W..... The production of motive power and apparatus therefor.

25th April, 1891.

7118. Hanchett & Brown ..... An improved packing.
7146. Munns, W. H. ..... Car couplings (*Mullins*).
7149. Hartigan, J. F. ..... Railway station indicators.
7171. Robertson, G. ..... Dies or swaging blocks.
7175. Bellingham, G. J..... Railway waggon couplings.
7189. Willans, P. W..... Metallic packing.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

YEAR 1890.

1235. Mannesmann.	1236. Mannesmann.
1369. Fricker.	4265. De Faucompré.
4370. Westwood.	4861. Marsden.
5862. Zeitler & Cocchi.	5881. Marsden.
6054. Cunliffe.	6084. Williams.
6397. Hill.	6401. Martin.
6407. Dawson.	6474. Parratt.
6487. English.	6488. English.
6550. Daphtary.	6699. Simpson.
6787. Cavalli.	6801. Holmes.
7105. Lord.	7252. Lindsay.
7261. Milward.	7268. Dawson.
7496. Ferguson.	7512. Offen.
7527. Vivian & Bell.	7659. Rutter.
7786. St. George.	7787. St. George.
7815. Tonks & Tonks.	7915. Anderson.
7932. Elmore.	7943. Baker.
8069. Douglas.	8121. Seage & Seage.
8144. Preston & De Pusett.	8206. Pitt.
8243. Lake (*A. Leonhardt & Co.*).	8284. Thalmann.
	8328. McKee.

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8844. Shoosmith.
8492. Ansboro.
8688. Birley & Dempsey.
8740. Cornwall & Pause.
8844. Huelser (*A. Kuhnt & R. Deissler*).
8906. Jénin.
8982. Spittle & Millington.
8998. Daguzau.
9015. Brand.
9159. Singer.
9168. Boos.
9241. Mudd.
9253. McDougall & McDougall.
9340. Tonks.
9440. Schlund.
9446. Schlund.
9495. Halliday & Shore.
9497. Walton.
9576. Guest & Brookes.
9591. Hebblewaite, Kay, & Stelfox.
9618. Foley.
9657. Thompson & Davies.
9694. Veal.
9704. Porter & Lewis.
9718. Vassaux.
9734. Humber & Neild.
9737. Lamont.
9745. Mecredy.
9761. Poole.
9789. Atebrt.
9804. Murrell.
9813. Morris.
9841. Phillipson & Rushforth.
9842. Fraser.
9866. Edwards (*Messrs. Beger & Markworth*).
9954. Smith & Smith.
9981. Harrild & Buckland.
10027. Shanks.
10115. Precht.
10218. Ward & Gray.
10315. Raymond.
10411. Dransfield.
10475. Dawson.
10506. Tozer.
10698. Gorhde.
11200. Martin.
11806. Gulliford.
13121. Crossley.
14518. Allison (*Sessions*).
14865. Bennett & Dunn.
16864. Bowring.
16607. Bonne (*Daniels*).
17207. Caspar.
17581. Thom.
18091. Hearth, Hearth, & Willis.
19419. Melachrino.
19554. Sandham. (2nd May, 1890.)
20029. Kent.
20451. Dunlop.
20466. Smeaton.
21015. Chesshire.
21146. Allison (*Turney*).
21206. Eyles. (10th June, 1890.)

8416. Fehmel.
8678. Macdonald.
8716. Edwards (*Lange*).
8781. Bousfield.
8850. Taylor.
8897. Rothhole.
8909. Woodall.
8952. King (*Kennedy*).
8997. Walker.
9050. Potter.
9168. Newton & Hawkins.
9172. Withers.
9244. Thompson (*Weber*).
9278. Thompson.
9331. Whitby.
9341. Chorlton & Scott.
9445. Schlund.
9480. Platt.
9496. Robson.
9567. Pooley.
9581. Binns & Collier.
9603. Waylen.
9611. Eggenberger.
9654. Thompson (*Vigié*).
9676. Johnson (*Badische Anilin & Soda Fabrik*).
9716. Price & Bannister.
9720. Abbott.
9735. Douglas.
9740. Cobbe.
9755. Jaegermayer&Michel.
9768. Green.
9808. Murrell.
9806. Lake (*Groom*).
9816. Tangyes, Ld., Meacock, & Ravenscroft.
9844. Pearce & Pearce.
9986. Duffield.
9942. Dillmann.
9975. Diegeldorff.
9989. Wood.
10062. Bradbury.
10148. Gourdé.
10253. Harrild & Buckland.
10867. Paterson.
10431. Bedeau.
10502. Boult (*Lambert*).
10612. Bown & Capewell.
10710. French.
11803. Falk.
12512. De Merladet.
14077. Wilmot.
14752. D'Humy.
16132. Mitchell.
16412. Johns & Slattery. (17th March, 1890.)
17806. Trimmings.
17788. Brookes (*H. Drews*).
18657. Sterling.
18816. Vernon.
19458. Thompson (*Colby*).
19703. Steinbach.
19852. Spooner.
20306. Oxley.
20465. Miller.
20988. Fowler. (18th August, 1890.)
21195. Fuller.

1891.

294. Duckett & Duckett.
439. Mills (*Sims*).
612. Hardy.
661. Redfern (*Deimel*).
1277. De Strens.
1560. Price.
2015. De Saint-Cyr.
2282. Friedberger.
2288. Bartlett.
2414. Garlick. (21st July, 1890.)
2422. Jones.
2497. Terrot.
2605. Musgrave.
2670. Tenner.
2742. Horn (*Dugot*).
2888. Coffee.
2966. Thompson (*Kriener*).
3348. Dodge.
3344. Dodge.
3433. Wünderlich.
3464. Michaud.
3963. Zimmermann.
4070. Potter.
4139. Bonne (*Kreissig, Sonntag, & Hartig*).
4238. Luce.
4251. Kirtley & Phillips.
4345. Barker (*Cole & Pedder*).
4541. Gage. (14th August, 1890.)
4700. Nadler & Obermayer.
4866. Edwards (*Held*).
4938. Bruce & Still.
4943. Boult (*McGee & Regan*).
4992. Beckett.
5021. Lake (*Gandini*).
5052. McLeod.
5078. Cadbury & Cadbury.
5129. Beard.
5153. England.
5224. Sagendorph.
5239. Haddan (*Kenehan*).
5246. Clousher & Peterson.
5249. Lake (*Perkins*).
5253. Lake (*Perkins*).
5280. Thompson (*Willing & Violet*).
5287. Lattau.
5322. Hockin.
5308. Harding. (9th June, 1890.)
632. Brau.
675. Ball.
1486. Thompson (*Kerr*).
1898. Reverdy.
2145. Hargreaves, Scranton, & Porter.
2294. Lake (*Guignard & Hedouin*).
2416. Wyatt. (29th September, 1890.)
2600. King & King.
2687. Cook.
2727. Seaman.
2779. Skilton.
2889. Thompson (*Sanford*).
3004. Johnson & Hutchinson.
3864. Lake (*Nickerson & Berrenberg*).
3774. De Pezzer.
4007. Jungbluth.
4132. Johnson.
4212. Browne.
4217. Fairweather (*Utility Manufacturing Company*).
4461. Kosinski & Kisielnicki.
4673. Hyatt.
4716. Longsdon (*F. Krupp*).
4887. Willey.
4941. Boult (*Adams*).
4962. Goerke.
5004. Mitchell.
5051. McLeod.
5058. Smith, Hartley, & McDougall.
5137. Bray.
5166. Pitt (*Barnett & Barnett*).
5245. Moore.
5247. Dewey.
5251. Newton (*Worthington*).
5278. Connelly. (15th October, 1890.)
5283. Schott (*Heyer*).
5309. Bruck.
5343. Brockie.
5344. Reynolds.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Steam and Air Engine.—*E. Field, London.*—According to this invention a mixture of steam and heated compressed air is used as a motive fluid in engines, which may be of any ordinary type, but it is preferred to use a well-jacketed compound engine; all pipes conveying the hot fluids should be well lagged. The general arrangement of the apparatus is shown in side elevation in Fig. 1 below. Air is drawn from the atmosphere and is compressed to any convenient pressure by a compressor A, worked by an extension of the piston rod of the motor B, as shown, or operated independently, as may be most convenient. After compression the air is passed through a pipe C into a heater D placed in the flues of a boiler E, the air being raised in the heater to a temperature of 400° to 500° Fahr., and being afterwards conveyed by a pipe F to a "mixer" G. Steam from the boiler is led also to the mixer by a pipe H, and the resulting mixture of steam and hot air is led to the valve chest I of the motor cylinder B by the pipe J. A pipe K with a suitable stop valve is provided for the passage of a supply of steam from the boiler to the valve chest when such independent supply is desirable at starting under conditions which will presently be referred to. Fig. 2 illustrates the mixer (lettered G in Fig. 1) in sectional elevation, L being the hot air inlet, M the air inlet valve, N the steam inlet, O the steam inlet valve, P being the steam nozzle, and Q the passage by which the mixture of steam and hot air passes to

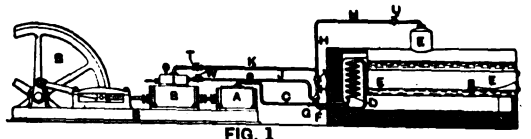


FIG. 1

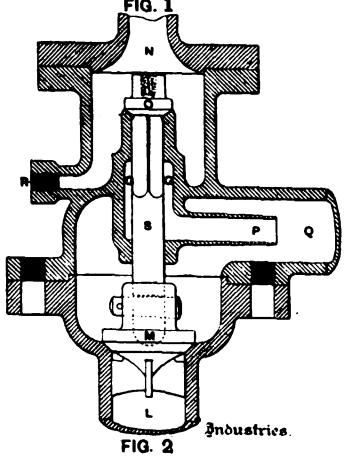
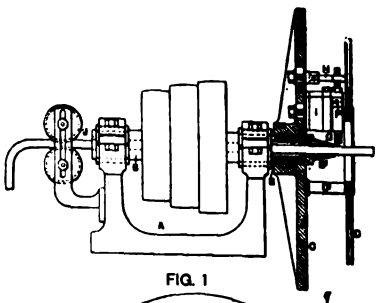


FIG. 2

the boiler. R is a drain for the withdrawal of water of condensation. It will be observed that the air and steam inlet valves are of different areas and are secured to a spindle S common to both of them in such a manner that the valves may both open or shut simultaneously; a compound regulator is thus formed, the areas of the valves being inversely proportioned to the pressure upon them in pounds per square inch, the pressure of the heated compressed air in this example being assumed as less than the pressure of the steam. The method of working is as follows:—The engine is started with steam only, by opening the valves T and U, the mixture main J and valve V being already open; after a few revolutions the compressor will have forced sufficient air through the heater to raise the pressure of the air up to that of the steam; the hot air valve M (Fig. 2) will then be lifted by the excess of air pressure, consequently the steam valve O (Fig. 2) will likewise be opened; hot air and steam will then rush through the mixer, forming a volume considerably greater in bulk than the mere aggregate of the volumes of the steam and hot air, but at a pressure equal to the mean pressure of the steam and hot air; and the engine will run faster, for if the volume of mixture be not used by the engine an increased pressure of mixture will be the result. The direct steam communication from the boiler to the engine will then be closed by the shutting of the valve T and the engine will continue running at its proper normal speed, the steam supply to the mixer being regulated by a governor or by any other suitable means at V or W, or the mixture may be regulated by a valve at W. Thus the valve arrangement above described is entirely self-acting, closing when full pressure has been attained in the slide jacket, and opening immediately on any reduction of pressure taking place in the slide jacket of the engine. When the mixture in the mixture main has attained approximately the same pressure as that of the compressed hot air in the hot air main, the compound valve will be in equilibrium, and both steam and hot air valves will be closed by the weight of the valves and stem, and will remain so until the pressure is reduced in the mixture main by the demand of the engine when the hot air valve will be relieved of some of the pressure on its upper side. To reduce the speed of the engine it is only necessary to throttle at V the steam passing to the mixer. The construction and operation of the mixer may be variously modified. Claims: The production and use of a mixed motive fluid composed of heated compressed air and of steam in proportions regulated by a mixer; the use of the mixer illustrated in Fig. 2, and the use of the whole apparatus, including other modifications of mixers described in the specification.—No. 4482. March 21st, 1890. 8*d*.

Apparatus for Armouring Insulated Wires.—*F. Walton, London.*—An apparatus for the above purpose is shown in the annexed illustrations, of which Fig. 1 is a side elevation, partly


FIG. 1

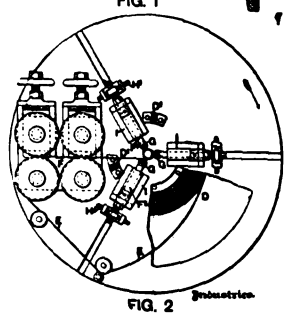


FIG. 2

in section, and Fig. 2 a front view. A is a lathe head carrying a revolving tubular mandrel B, with a face plate C, having at some distance in front of it a reel D carried by three studs D^1. On this chuck are also mounted guide rollers E and two pairs of corrugating rollers F, one of each pair having its bearings adjustable by a screw. Besides these rollers there are mounted on the chuck three pressing rollers G, each of them held in a stem F^1, which can be adjusted in two directions, in distance radially to or from the centre of the chuck by means of a nut F^2 and lock nut F^3, and in obliquity to the axis of the chuck by means of a wrench lever H fitting on the stem F^1 and adjustable by set screws H^1. The stem of each of the rollers G is fitted in a block I, which is bolted to the chuck. On the reel is wound a continuous length of metal strip, which is led by the guide rollers E somewhat obliquely between the corrugating rollers F and under one of the pressing rollers G. The insulated conductor is passed between grooved rollers, through the tubular mandrel B, its projecting conical nose B^1, and between the pressing rollers. The mandrel being caused to revolve, and with it the chuck and all the parts carried thereon, the strip unwinds from the reel, becomes corrugated in passing between the rollers F, and then by means of the pressing rollers G it is helically coiled around the conductor, forming a flexible tube which encloses it. The three rollers G, besides being adjusted each in respect of radial distance from the axis and of inclination to it, are fixed at such distances from the face of the chuck as to suit the helical pitch of the strip as it is coiled on the conductor, and the convolutions of the strip being pressed forwards by the action of the rollers G cause the conductor, which they enclose, to advance with them. Claim: For armouring an electrical conductor with metal strip coiled thereon in interlocking convolutions, the mandrel B, chuck C, reel D, corrugating roller F, and pressing rollers G, combined and operated substantially as described.—No. 21045. December 24th, 1890. 6*d*.

Breech-loading Ordnance.—*J. Astbury, Smethwick, Staffordshire.*—The invention has reference to breech-loading ordnance of a kind described in a prior patent, No. 670 of 1877, and consists of a mechanism for ejecting the case of the exploded cartridge. In the accompanying illustrations is shown at Fig. 1 a longitudinal section of the breech end of a gun, and at Fig. 2 an end view

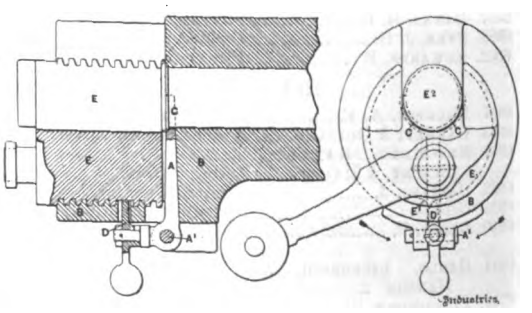


FIG. 1. FIG. 2.

of same with mechanism embraced by this invention. The bell-crank lever A is pivoted at A^1, and the vertical limb of which lies in a recess in the breech of the ordnance B. The upper end of this vertical part is bifurcated at C semi-circularly, and encloses the body of the cartridge, and also engages the back collar thereof. The lower part of the lever A extends horizontally rearward, and carries loosely a small trip lever D, the upper end of which projects upwards and within the breech B, and the lower end of which is counterweighted. There is a tooth E^1 provided on the bottom of the breech block E, which (at the particular moment of acquiring a full opening of the trough E^2 of the breech block, for the purpose of extracting the cartridge, when winding

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the handle backwards as shown) engages the nose of the trip lever, and striking or pushing it out of its path, thereby deflects that lower limb of the bell-crank and consequently pushes, or jerks backwards, the spent cartridge case abutting on the back side of the bifurcation of the other limb. Claims: (1) In breech-loading ordnance, of the nature described, an automatic cartridge extraction gear, consisting of a bifurcated bell-crank lever, containing on its lower limb a trip lever, actuated by the prime motion only as imparted through the handle to the breech block, and transmitted from a tooth situated upon the latter, through the clutch, deflecting thereby, *en passant*, the lower limb of the bell-crank, and so discharging or extracting the cartridge case at the upper or bifurcated end of same; and which clutch, being clear, imparts no such motion to the bifurcation during rotation in the opposite direction, substantially as described; (2) in breech-loading ordnance, of the nature as described, the arrangement and combination of parts constituting the extraction gear.—No. 7116. May 7th, 1890. 6*d*.

Feed-water Heater.—*H. H. Lake, London.* (*G. H. Burpee, New York, U.S.A.*)—In the annexed illustrations is shown a feed-water heater constructed on the principle of this invention, and heated by the hot gases and products of combustion escaping into the smoke flue. Fig. 1 is a vertical transverse section, Fig. 2 a

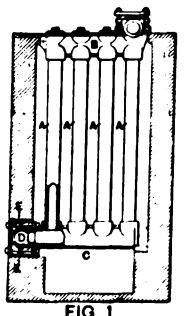


FIG. 1

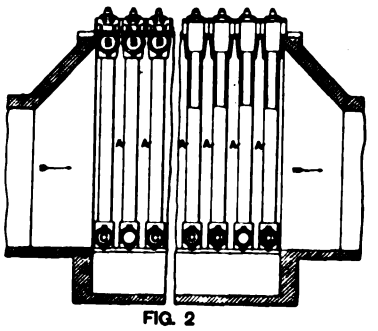


FIG. 2

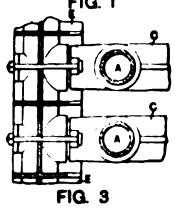


FIG. 3

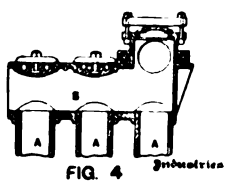


FIG. 4

partial and irregular longitudinal vertical section, and Figs. 3 and 4 enlarged details. A are the vertical circulating tubes, B the top boxes, C the bottom boxes, and D the lower longitudinal connecting pipe. The pipe D, which is held between the two plates E, is provided at one side with nipples to receive the ends of the pipes C which are made tapered, and has at the other side, opposite said nipples, hand holes covered by plates held fast by T bolts, the heads of which engage slotted projections on the pipes C (Fig. 3). The lower ends of the vertical tubes A are tapered, so that the ends are smaller than the central part of the tube. The upper ends of the said tubes, however, are so tapered that the ends are larger than the centre of the tubes. These tubes are passed through the hand holes in the upper box B, and when the lower end has entered the nipples in C pressure is applied to fix them. The covers for the hand holes in B are fixed substantially as shown (Fig. 4). Five claims are made.—No. 21243. December 31st, 1890. 8*d*.

Crushing Mills and Amalgamators.—*C. E. Hall, Sheffield.* (*Chas. Morel, Grenoble, France.*)—This apparatus is for the purpose of crushing, grinding, and sieving hard substances in the presence of a liquid, and it consists of one or more hard metal or

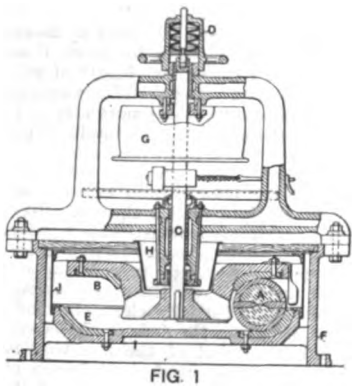


FIG. 1

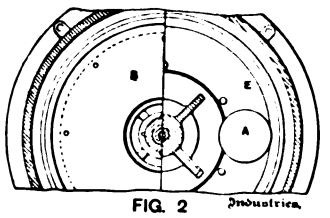
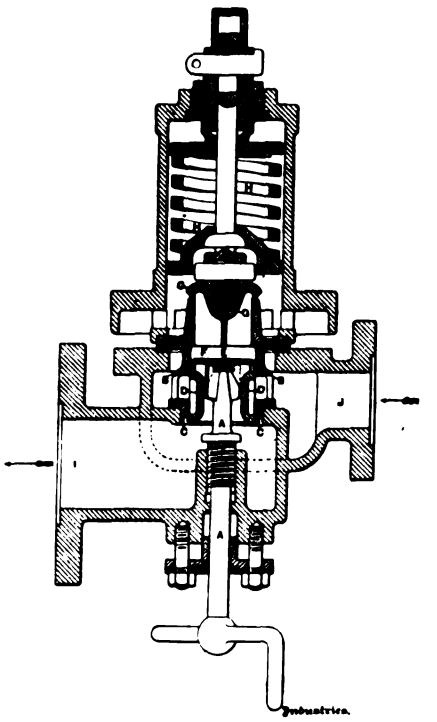


FIG. 2

other balls rolling in a circular path upon a horizontal fixed ring, against the side of which they are pressed by their centrifugal force. Fig. 1 is a sectional elevation and Fig. 2 a sectional plan of a modification of this invention, in which a ball A is driven by a circular disc B keyed to the vertical spindle C and pressed upon the ball by its dead weight or by a suitable arrangement of adjustable springs D, which are sufficiently elastic to permit the disc to rise in the event of any matter of exceptional hardness coming between the ball and the renewable wearing path E bolted to the fixed frame F. G is a belt pulley for driving the vertical spindle C. H an annular opening through which the material to be crushed is fed, together with water, I is an agitator for driving the crushed material through the screen J (whose perforations are not shown). Other modifications of the apparatus are described, in one of which several balls are forced round upon a circular track by radial pushing arms attached to the vertical driving shaft of the machine, which in this instance is driven from below by bevel gear. Copper amalgamating plates, corrugated and otherwise, are employed with a quicksilver filling for catching the free gold resulting from quartz-crushing. Claims: The three modifications of apparatus described in the specification, including a corrugated amalgamator and delivery shoot.—No. 17520. November 1st, 1890. 8*d*.

Bending Machine.—*R. Kelly, Liverpool.*—The object of this invention is to provide a machine or tool whereby metal pipes and round, flat, or angle iron or other metal may be readily bent into any required curve, and the apparatus described consists of a lever into which are fitted wheels, free to revolve on pins passing through their centres and also through the lever. The said wheels have plain or shaped edges to suit the material operated on. One of the pins is fixed to a stationary bed-plate, whilst the other pin moves with the lever. On the bed-plate is an adjustable cramp piece. The material to be bent is placed between the wheels, one end is secured in the cramp, and the handle or lever is turned round the stationary centre so that the free end of the material is bent to the desired extent round that one of the wheels which turns upon the same centre as the centre about which the lever rotates; the size of this latter wheel determines the radius of curvature. The cramp is an eccentric friction piece of a well-known type. Claims: The bending machine as described.—No. 8038. May 23rd, 1890. 6*d*.

Reducing Valve.—*J. & G. Weir, Cathcart, N.B.*—This is a semi-automatic apparatus, in which the screwed spindle A may be screwed up to keep the loose double-beat valve D on its seats B C, or screwed down to allow it to fall away therefrom; the



valve not being attached to the spindle is, therefore, free to move up and down when the spindle A is not in the closing position. The top of the admission valve is made with a disc E attached to it by webs, the disc fitting quite loosely in a cylindrical part of the chamber F formed in the same piece as the valve seats. At the top of this chamber is a spring-loaded escape valve G, the spring H being adjusted to correspond with the maximum pressure to be admitted to the evaporator or other apparatus by the passage L. J is the inlet for the steam from the boiler. Should the pressure within the admission valve and in the passage I rise beyond the prescribed limit steam will leak past the edge of the disc E, lift the valve G and escape, attracting the attention of the attendant, who will then adjust the admission valve D by means of the spindle A, closing it until pressure is so reduced in I that steam ceases to escape past the disc to the spring-loaded escape valve G. Until this adjustment is made the action of the escaping steam upon the disc E will close the valve D sufficiently to prevent the pressure in I from becoming too great. Claims: The combination illustrated, consisting of the equilibrium valve and its adjusting spindle, the disc attached to the valve and working in a cylindrical chamber, and an adjustably loaded escape valve.—No. 7967. May 22nd, 1890. 6*d*.

Grease Cups.—*E. H. Benners & S. Leach, Elisabeth, U.S.A.*—This grease cup is arranged to deliver automatically grease to the moving parts of machinery in accordance with the speed at which those parts are working, and consists of a cylindrical cup having a plunger fitted therein in connection with a weighted disc adapted by the motion of the parts to successively vibrate against the plunger to force the latter against the grease contained in the cup or cylinder, the supply being greater as the speed increases and less as the speed diminishes. Two examples are shown, in which a gravity plunger is fitted within a cylindrical oil container, and, upon a spindle carried by the plunger, is a disc caused to travel up and down within certain limits, the oil cup or chamber being intended for use upon moving parts of machinery. The faster the oil cup vibrates or reciprocates the harder will the disc strike the plunger, and the greater will be the quantity of grease forced out of the oil cup by the plunger. A pair of washers are placed at the opposite ends of the path of the disc to prevent noise as far as possible. A small air passage is formed in the spindle of the plunger, and is controlled by a screw in order to permit the plunger to be removed to refill the cylinder, otherwise removal of the plunger would be difficult, as a partial vacuum would be formed below it. Claims: A grease cup as described, with a plunger and movable disc for hammering the same, with a screw adjustment on the plunger spindle to limit the travel of the disc.—No. 3436. February 25th, 1891. 6*d*.

Water Gas.—*Hugh Williams, Stockport.*—This invention has for its object the production of a permanent illuminating gas consisting of hydrogen gas produced from the decomposition of superheated steam in combination with other gases obtained by the decomposition of air, liquid hydrocarbons, and carbonaceous

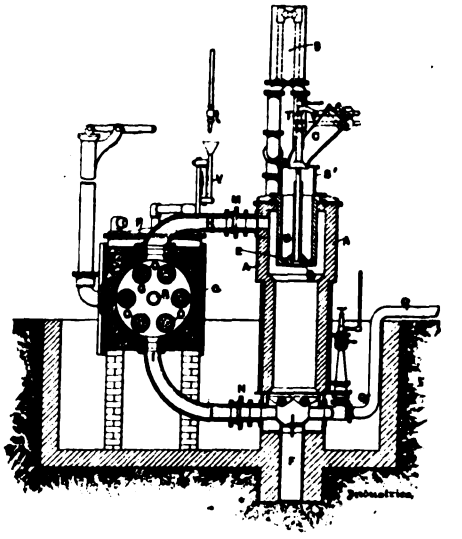


FIG. I.

matter. A portion of the apparatus is shown in sectional elevation in Fig. 1, and in side elevation partly in section in Fig. 2. A pair of gas producers A A^1 are worked together, the operation being commenced in one producer and partially completed in the other, each serving alternately as primary and intermediate producer, the working of the pair being to a certain extent continuous. Each producer is fitted with a distilling retort B B^1 charged with fuel through C at its upper end and discharging the resulting coke at its lower end into the corresponding producer for fuel by the valve D, which is provided with free holes E for reasons which will be seen later; each producer has also rocking grate bars operated from the exterior, and a siphon ashpit F. The producers are started by being charged with fresh fuel, which is lighted and brought to a state of high incandescence by the establishment of an air blast and through draught maintained for the desired period, the retorts B being also charged with fuel, which, when sufficiently carbonised by the heat of the hot gaseous and solid contents of the producer A, is allowed to fall into the producer and the retort receives a fresh charge. Each producer is connected with the interior of a fixing retort chamber G by a pair of gas passages H I or J K controlled by valves at M M^1, N N^1, a passage proceeding from the upper end of each producer into the chamber G at its upper side, and the other two passages proceeding from lower end of producer to the lower side of G. The chamber G contains six fixing retorts O each charged with fragments of iron, and a carburetter P provided with internal baffle plates is mounted on the top of G so as to receive heat

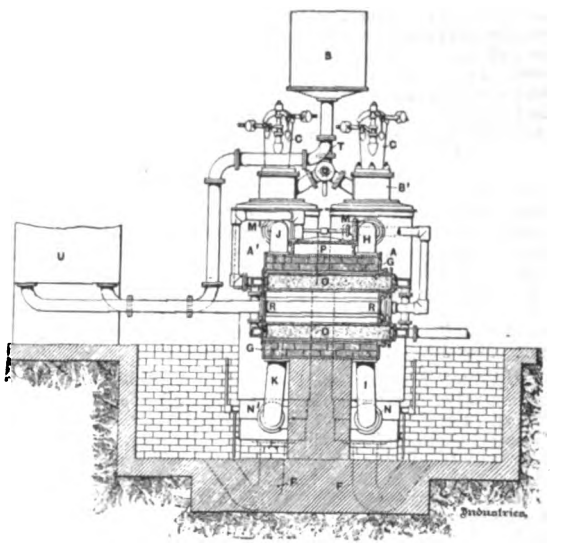


FIG. 2.

therefrom. When the operation of gas production is commenced in producer A, for example, the retort B^1 in the companion producer A^1 is charged with fresh fuel and steam from an injector and combined with the air which has been passing into A by a pipe Q, and the valve at N being shut the gases resulting from the air, steam, and carbonaceous matter in A pass from the upper part of that producer into G and around the retorts O and pipe R therein, heating them, and, passing out at the lower side of G by the pipe I, flow into the lower end of the adjoining producer A^1, into which a jet of steam is simultaneously introduced, the whole passing up through its contents, and (the valve at M^1 being

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closed) forcing its way through the holes E into and through the heated contents of the retort B^1, aiding the carbonisation therein, and, mingling with the gases which have already begun to rise, passes to a condenser D by the pipe T controlled by a valve permitting only one retort to communicate with the condenser at a time. The interior of the condenser is so arranged that tar and other matters which may form may gravitate back into the retorts, and anything failing to be carbonised therein goes into the producers so that ultimately all the fuel is converted in gas and ashes. Going onward from the condenser the gases pass through scrubber U, thence through reheating tube R, to the carburetter P, into which hydrocarbon liquid runs at V to be vaporised, the gas thus carburetted proceeding to the retorts O of the chamber G in which it is fixed, any water vapour present being also decomposed and free oxygen eliminated. From the fixing retorts the gas is taken to holders for storing. When this cycle is completed the valves at M M^1, N N^1 are readjusted, and a similar operation to that commenced in retort A now commences at retort A^1. Claims: The apparatus as shown and described; the gas producer provided with a retort, means for charging and for discharging the contents of the retort into the producer as fuel; also such gas producers in pairs worked as described above, and with connections so arranged that the tar and products of condensation flow back into the retorts; the fixing retorts charged with fragments of iron and means for highly heating same in combination with the foregoing and with the purifier and liquid hydrocarbon carburetter. The process as described for the manufacture of illuminating gas.—No. 5434. April 10th, 1890. 11*d*.

Expansion Gear.—*W. Walker, Salford.*—This invention consists of a trip gear in which the point of cut-off is automatically controlled by the governor. Figs. 1 and 2 illustrate the arrangement in side and end sectional elevation as applied to a Cornish cut-off valve, but it may be conveniently applied to the valves at opposite ends of steam engine cylinders, as will be understood. Fig. 3 is a view of the toggle or detent in section. A hollow sleeve A is oscillated to and fro through a constant range by the engine, which vibrates the arm E at each revolution; within this hollow sleeve is a pair of discs B, which alternately operate the valve by pins C. These project from each disc and raise and

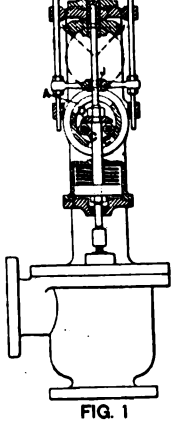


FIG. 1

FIG. 3

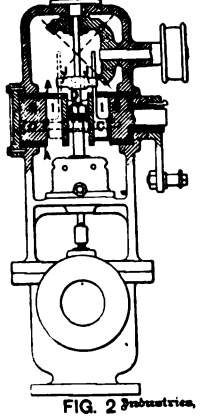


FIG. 2 Industries.

lower the collar D on the valve stem. The sleeve and discs are caused to rotate together, so long as a detent or toggle formed upon the short arm of a double-armed lever F carried by each disc and moving therewith bears against a portion G of the sleeve. Each lever is kept in its working position by a spiral spring enclosed in a cylindrical box I, and the stops J are adjustable by the governor H in the path of oscillation of the longer ends of the double-armed levers F, which must sooner or later come into contact with them, whereupon the short arm of one or other of the levers will be caused to compress its spring and release the disc from the influence of the sleeve A, leaving the former free to be rotated by any conveniently rapid means to allow the valve to close sharply, the valve being eased down by a dashpot at the lower extreme of its fall. Claims: The curvilinear bell-cranked or double-armed lever with a "toggle end," and working on a single pin joint, and kept in its driving position by a spring enclosed in a circular box; the hollow sleeve and the driving discs in combination with the foregoing.—No. 6899. May 5th, 1890. 8*d*.

Expansion Valves.—*G. & J. Stones, Smethwick.*—In this expansion valve an ordinary D valve is formed in a single casting with an outer shell, whose walls come down on to the port faces; the steam passages formed in the space between the laps of the valve and the inside of the walls aforesaid communicate each with a separate chamber formed by a division extending across inside the external shell in the line of the travel of the D valve. A cylindrical tube open at the ends passes through the outer shell and through the central partition in a direction at right angles to the line of travel of the D valve, and in this tube are two ports, communicating separately with the chambers supplying the opposite ends of the D valve with steam, these ports being controlled by a piston valve which slides in the cylindrical tube above referred to, and constitutes an expansion valve. The two valves, although, in a sense moving together, can be worked and regulated quite independently of one another, the movement of the main valve, for example, having no influence upon the operation of the expansion valve which would not be the case with the ordinary arrangement of expansion valve working upon the back of a main slide. Claims: An expansion valve forming part of a D slide valve and arranged as described, so that the motion of one valve can be regulated and determined without regard to the motion of the other.—No. 7264. May 10th, 1890. 6*d*.

Tube Bending Machine.—*John Laidlaw, Glasgow.*—Fig. 1 below is a plan, and Fig. 2 a part side elevation showing the rollers of a machine in which tubes may be bent without the necessity of filling the interior of the tube with material in order to prevent it from crumpling during the process. The peripheries of the semi-circularly grooved rollers A are maintained in contact, and advantage is taken of the fact that the act of bending a tube tends to make it oval in cross section, the widest portion being at right

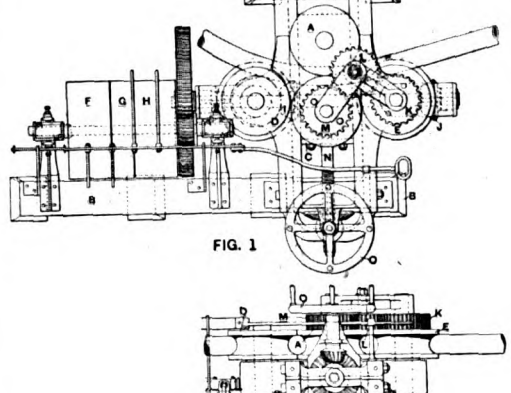


FIG. 1

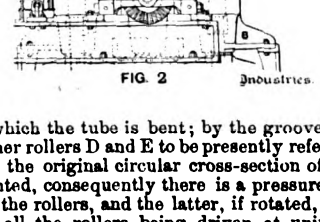


FIG. 2 Industries.

angles to the plane in which the tube is bent; by the grooves in the rollers A (and in other rollers D and E to be presently referred to) being formed to fit the original circular cross-section of the tube, ovalling is prevented, consequently there is a pressure set up by the tube against the rollers, and the latter, if rotated, will draw the tube along, all the rollers being driven at uniform speed. B is the machine frame or table, C is a slide which carries the two rollers A upon fixed centres, D and E are rollers which rotate upon centres secured to the frame, and are driven by any convenient means, such as the pulleys F G and H and spur gearing, operating a shaft carrying the bevel wheels I and J gearing with bevel wheels secured to the rollers D and E. The roller E is geared to one of the rollers A by spur wheels K L and M, which are maintained constantly in gear by means of the linked frame shown, and a screw N operated by the hand-wheel O serves to adjust the frame carrying two rollers A relatively to the stationary rollers D and E, so that the curvature of the tube may be varied. Claims: In bending machines the two rollers A, grooved, and movable together, in combination with the two fixed rollers, to give the curvature; the linked frame and driving gear K L M, and the arrangement of gearing by which the rollers A A D and E have uniform surface velocity.—No. 9500. June 19th, 1890. 6*d*.

ELECTRICITY.

Cut-outs.—*F. Bryan, London.*—The inventor's object is to provide an instrument which can be adjusted to brake an electric circuit whenever the current attains a predetermined strength. Referring to the accompanying illustrations Fig. 1 is a front view, Fig. 2 a plan, and Fig. 3 an end view of an instrument for the above purpose. A A^1 are two mercury cups, the former fixed to the base B and connected to terminal C, and the latter fixed to metal frame D fixed to B and connected to terminal C^1. An iron bar E bent to a circular curvature is fixed adjustably in D. A

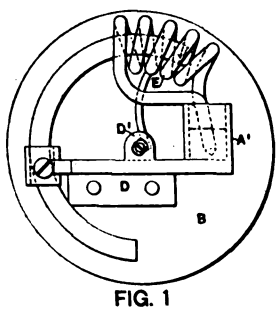


FIG. 1

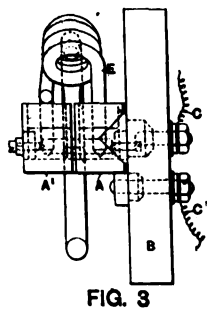


FIG. 3

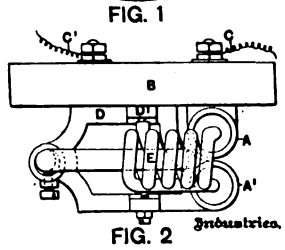


FIG. 2 Industries.

coil of copper wire surrounding but not touching E is carried by an arm pivoted to the frame D at D^1, and has its two ends projecting into the cups A A^1. In the position shown the circuit is completed from C through A, the coil F, A^1 and D to C^1, but should the current become too strong the coil will be attracted by the core and the circuit broken. By adjusting the length of the core projecting into the coil the movement of the latter may be made to take place under various strengths of current. Claims: An appliance for cutting out an electrical circuit when the current exceeds a certain strength, wherein a wire coil, enclosing an adjustable magnetic core and forming part of the circuit while it is in a certain position, is pivoted so that when the strength of current causes a certain amount of mutual attraction between it and the core, the coil is made to move out of position and so to open the circuit, as described.—No. 7422. May 13th, 1890. 6*d*.

CHEMISTRY.

Colouring Matters.—*The Society of Chemical Industry, Basle, Switzerland.*—The production of red basic colouring matters by condensation of the alkyl derivatives of meta-amidophenol with succinic acid anhydride has already formed the subject matter of a series of patents, and, according to the present invention, analogous dyestuffs are obtained from the condensation product of resorcine with succinic acid (resorcine-succinëine) by the action of secondary amines at a higher temperature. The reaction with dimethylamine proceeds in this operation in a manner quite analogous to that with the fluoresceine. For the production of the succinic acid-rhodaminol or the succinic acid-rhodamine the following may serve as an example:—13·2 parts of resorcine-succinëine and 13·8 parts of a solution of 40 per cent. of dimethylamine are heated, together with 70 parts of alcohol, in a close vessel up to from 170° to 200° C. during fourteen hours. The product of the reaction is then diluted with water, and, after the addition of 21·9 parts of soda lye of 33 per cent., is heated in the water bath for the purpose of the evaporation of the alcohol and of the superfluous dimethylamine. The alkaline solution is then agitated repeatedly with ether or toluol, the colouring base of the succinic acid-rhodamine passing over into the ether, whilst in the aqueous solution the succinic acid-rhodaminol remains dissolved in the form of its soda-salt. The latter is separated and is finally obtained pure. The soda-salt and the potassium-salt dissolve easily in water, showing a red colour, also in alcohol, and they dye on silk in the soap bath a light pink colour. From the aqueous solutions acetic acid and dilute mineral acids precipitate the disengaged succinic acid-rhodaminol in the form of a red-brown magma, which dissolves with difficulty in water and dilute mineral acids, but easily in alcohol. For the separation of the succinic acid-rhodamine the above-mentioned extract in ether of the reaction-mass is agitated with a little warm dilute hydrochloric acid or is treated with hydrochloric acid gas, whereby the dissolved colouring base is eliminated in the form of its hydrochlorate. This latter separates out as a green-glistening crystalline mass, which is purified by re-dissolving in dilute hydrochloric acid. Claims: (1) The preparation of succinic acid-rhodaminol and succinic acid-rhodamine from the condensation product of resorcine with succinic acid, by the action of dimethylamine at a temperature of 170° to 200° C., substantially as herein described; (2) the succinic acid-rhodaminol colouring matter, produced as described.—No. 10047. June 28th, 1890. 6*d*.

MISCELLANEOUS.

Nut and Pipe Wrench.—*D. H. Carpenter, Orlando, Fla., U.S.A.*—The upper jaw of this wrench has one or more transverse notches or grooves having salient edges to bite the surface of an object to be acted upon rather than to bear against the sharp angles thereof, which are received into a groove. The upper jaw is combined with a jaw, which may be either fixed or movable and adjustable in relation to the first-named jaw, and which is arranged so that an angular object placed between the two will be engaged on its sides and not at its angles or corners. The acting surface of the movable jaw is eccentric to adapt the wrench for use on pipes. The eccentric jaw has teeth which engage with teeth on the wrench, and secure in position the jaw and the movable saddle which carries it. Claims: A wrench as above described, provided with a fixed or movable jaw, whose active or gripping surface is eccentric; the saddle carrying the movable jaw and the teeth on the latter and on the fixed bar are claimed for the purpose described.—No. 2450. February 10th, 1891. 6*d*.

Manufacture of Brushes.—*H. Waters & W. Woodman, both of Birmingham.*—A slide moved vertically by means of a treadle carries a tool for bending staples of the usual U-shape, and also a tool which cuts from a continuous length of wire a piece long enough to form one staple. Any well-known mechanism is used for feeding the continuous wire intermittently to the cutting off and bending tools. Adjacent to the staple former is a trough containing the bristles which lie at right angles to the wire from which the staples are formed. A slide with fingers carries a certain quantity of the bristles into position underneath the formed staple, and at right angles thereto. The centre of the bunch of bristles lies over a trumpet-shaped guide, at the lower end of which a brush-back is placed having holes therein. An inserting tool causes a staple to descend upon the bunch of bristles, which it pushes down the trumpet-shaped guide, the inclined mouth of which partially closes the ends of the staple together, and also bends up the ends of the bristles. The continued downward movement of the inserting tool forces the staple and the lower part or bend of the bunch of bristles into the hole in the brush back, where the ends of the staple come into contact with a clenching tool, which is in position at the opposite side of the brush back, and which bends out and clenches the staple against the latter. Claims: Securing bunches of brush bristles by staples having ends which are clenched over; the combination of the inserting tool, the trumpet-shaped guide, and the clenching tool, together with a staple-forming device; means for collecting measured quantities of bristles and placing them in position under the inserting tool.—No. 4338. March 20th, 1890. 1*s*. 1*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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A JAPANESE COMMERCIAL MUSEUM.

THE illustrations given in Figs. 1 and 2 represent a front view and a ground plan of a Commercial Museum erected at Osaka, Japan. Although an attempt was made some four or five years ago to fully establish one in Tokio, which was to have been maintained by the various Departments of Agriculture and Commerce, of Foreign Affairs, and of Education, and by the Chamber of Commerce, it is still to some extent unsuccessful. The museum at Osaka, as will be seen, is divided up into various sections. On the ground floor are the sections of exports, packing, and drugs, medicines, and spices, while there are also on this floor a laboratory, general office, and reception room. On the first floor are the sections of imports, and domestic products and manufactures, with a library, an advertisement room, and meeting rooms. There is also an agency for facilitating and introducing sales and purchases of domestic and foreign articles.

From a printed report, which emanates periodically from this museum, we find that all articles exhibited there are provided with an explanatory notice giving the place and date of purchase, place of production, cost, &c., so that local productions may be compared with those of foreign countries. A commercial college, we are informed, is also in progress, which will further assist to place Osaka at the head of Japanese commercial cities.

THE INSTITUTION OF MECHANICAL ENGINEERS.

(*Concluded from page* 441.)

MR. MARSHALL said he had not expected to be called upon so early in the discussion, but there was one point which no doubt had struck all present. He alluded to the enormous size of the boilers in this vessel. He thought that with a heating surface of nearly 5 square feet per indicated horse-power, the boilers should certainly give twice the power they did. The temperature of the funnel gases appeared to him to be low: in the s.s. "Colchester" trials they reached 800° Fahr., while the engineer of the "Iona" got 672°, a fact which he could not understand if tested in the flame box. (Mr. Fothergill here explained it was taken in the uptake.) He thought the results of these trials demonstrated the desirability of forced draught, as they showed a better combustion, lower temperature of gases, and a shorter and more manageable length of grate than could have been obtained under natural draught. He acknowledged his indebtedness to Professor Kennedy's data for much valuable information.

Mr. J. Fiddes Brown (the chief engineer of the "Iona") said that he wished to preface his remarks by a few words in explanation of the reason why he made the subsequent trial, especially so when it was so closely preceded by such an elaborate and careful trial by Professor Kennedy. He said that at the expiration of the Committee's trial, and when the results were roughly estimated, they did not appear quite as good as he had anticipated, and as compared with the coal consumption of the two previous voyages, which was a mean consumption during about 150 steaming days. The consumption of coal was not nominally higher during the trial, but he expected it to be less, because about 50 per cent. of the coal burnt during the 150 days was received from foreign coaling stations. With the supply from these stations the loss is often more than 10 per cent., due to shortness of weight and inferior quality, so that the mean consumption during the regular voyage would include this loss, and also the steam for the steering engine, which is supplied from the main boilers. He therefore expected that the coal consumption in the Committee's trial, where the coal was carefully weighed, would show better results than under ordinary circumstances. There appeared to him one or two conditions under which the Committee's trial was made which tended to affect the result, and that was his main reason for making the subsequent trial. The temperature of the feed-water during the Committee's trial was about 50° below the usual temperature, and this he thought indicated that there was a considerable loss of heat through the water passing to, and being retained in, measuring tanks. The supplementary water during the Committee's trial amounted to 6·1 per cent. of the total feed-water, which was a very excessive amount. If the excess were only 5 or 10 per cent. it might be neglected, but it amounted to fully five times the usual quantity. It was no doubt supplied and measured, but he thought that 80 per cent. of it never got farther than the feed pumps through leakage of the feed pump glands. The supplementary feed diagram graphically represented a record during nine days' voyage previous to the trials he made.

A JAPANESE COMMERCIAL MUSEUM.

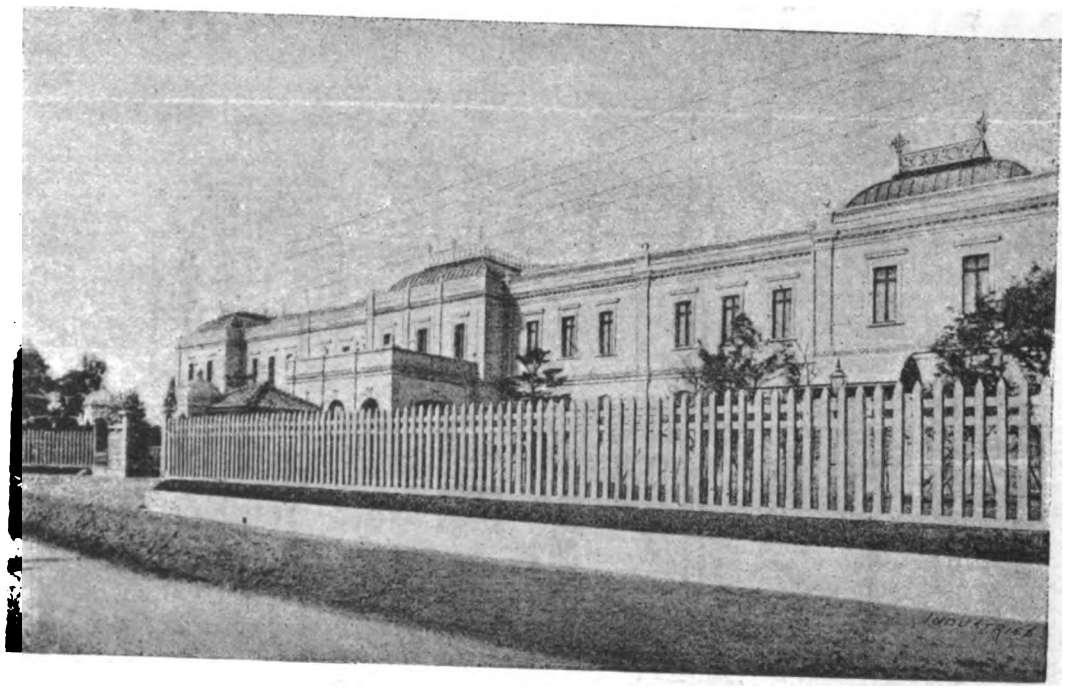


FIG. 1.—FRONT VIEW OF BUILDING.

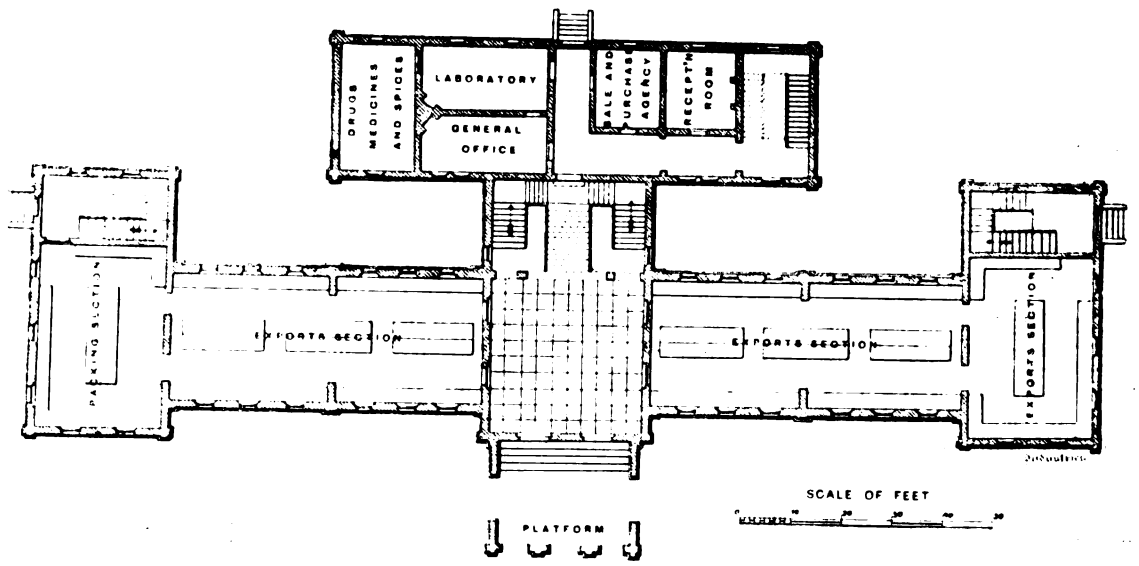


FIG. 2.—GROUND PLAN

The mean of the diagram equalled 1·28 per cent. of the total feed. From 4.40 p.m. on the first day recorded to 4.30 p.m. on the second day—during which no supplementary water was added—the boiler levels fell 1⅞in., equal to a loss of 2,212lb. of water, or 1·13 per cent. of the total feed.

To estimate correctly the amount of heat carried away by the furnace gases, the temperature ought, he thought, to be taken as near as possible to their exit from the tube boxes, as was done in the second trial, and not half-way up the funnel as in the Committee's trial. From a series of simultaneous observations with a pyrometer in each position, he found an increase of 105° Fahr. at the lower position, which was 23·5ft. below the top position. This suggested that the temperature of the gases on leaving the tube boxes would be 452° + 105°, or 557°. There was about 110° Fahr. excess in the second trial to account for, which was probably due to a less weight of air being used. He was unable to estimate the weight of air directly, not having any means for taking samples of the furnace gases, but he thought an approximation could be arrived at by estimating the velocity at which the air passed at each furnace and chamber valve. The mean differences of pressure as shown by the water gauge were:—First trial between sides of valve openings, 0·55in. at ash-pit and 0·34in. at combustion chamber; second trial, 0·45in. at ash-pit and 0·78in. at combustion chamber. The temperature of the air was 123° and 62° at the first trial, and 133° and 80° at the second trial respectively. Knowing exactly the amount at the first trial from Mr. Wilson's analysis, he said there could thus be found the coefficient of efflux for these particular openings, which would be the same in both trials. On this basis 22·9lb. of air was used per lb. of coal in the second trial, 14 per cent. of which passed direct to the combustion chambers, whereas in the first trial only about 8 per cent. passed direct to the chambers. He thought that the mean indicated horse-power in the second trial could safely be considered under the true power, the indicators being connected by the usual long pipes and bends. Shortly before the first trial was started, a set of diagrams was taken at 64 revolutions and 155lb. boiler pressure, the indicators being connected as in the first trial. The diagrams represented 733 i.h.p. The steamer, he said, had the same deadweight in both trials, and the weather was similar, and if we supposed the power to drive a ship to vary approximately directly as the cube of the speed, and compared either the speed per hour or the revolutions in this manner, the horse-power would be about 738—which is an increase of about 4 per cent. on 707 i.h.p.—the mean of the diagrams. Taking the power as given by the long-pipe connection diagrams as 733 i.h.p., the coal consumption would be reduced during the second trial to 1·33lb. per indicated horse-power per hour, and assuming the feed water to be 12·69lb. per indicated horse-power per hour, the evaporation during the second trial would be 9·5lb. of water per lb. of coal at the feed temperature.

Mr. Willans traversed the causes which led to the good results shown. Referring to jacketing, he thought 4 per cent. of jacket water exceedingly small. In his opinion the great thing was to work a boiler moderately, and an engine as hard as is possible.

Mr. Burstall desired to correct Mr. Mudd's observations as to the leakage from the feed. He had charge of this particular section of the trials, and gave it as his

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STEAM ENGINE GOVERNORS.

(*For description see page* 459.)

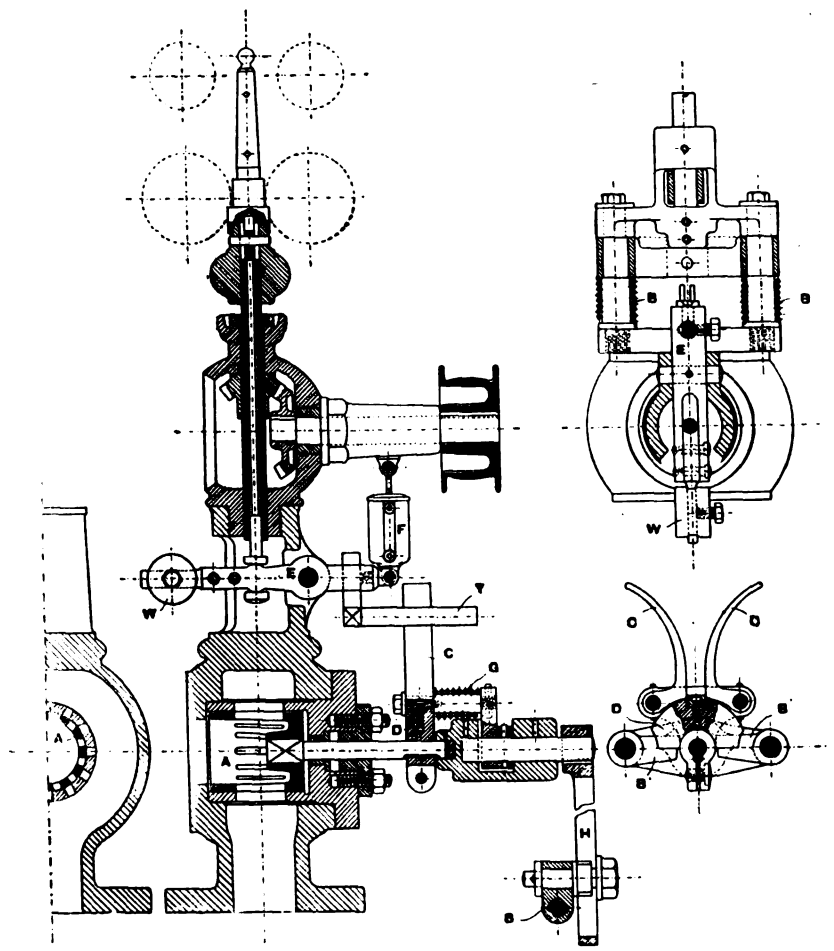


FIG. 14.

opinion that the leakage was only small, being about 200lb. in all, in place of the 3,000lb. as stated by Mr. Mudd.

Mr. Terry joined issue with Professor Kennedy on his estimate of the paper before them. He did not consider the paper at all a dry one. He was associated with the manufacture of forced draught machinery, and he should like to know the actual volume of air used, and the leakage of air past the corrugations of the furnaces and the bars in the immediate neighbourhood, as this appeared to him a point where considerable loss might occur.

At this point the meeting was adjourned to the following evening.

On the resumption of the proceedings on Friday, Mr. Halpin said he thought the Institution should be congratulated on the success of the paper. He was of opinion that it would be better to measure the feed-water by meter instead of the tank arrangement, and thought the amount of circulating water should be given in future trials. He would also like to know whether better results followed the use of small condensers with a large quantity of water or *vice versâ*. He thought the jacket question had not been carried far enough, and opined better results would have followed if the intermediate cylinder had also been jacketed. He was glad to find flat valves worked so satisfactorily, but thought the clearances abnormally large. He agreed with Mr. Marshall that the boilers were enormous; in fact, he regarded a boiler as a machine tool, and in this case thought the output, or efficiency, was low. While acknowledging it as a step in the right direction to keep the furnaces small, the chimney appeared to him to be six times too big, and the ratio of 6 to 1 far too large. Under these circumstances he failed to see the use of forced draught so far as this trial was concerned, as the quantity of coal burned per foot of grate was comparatively so small that he thought the Committee would have done better to have stopped the whole thing—*i.e.*, forced draught. The speaker controverted the figures given on page 15 of the paper, as to thermal units, and thought units per hour per square foot transmitted would be better. He stated that in Mr. Longridge's paper, read before the Institution of Civil Engineers, this was shown to be 11 units per square foot per hour, whereas in the "Iona" it was only $2\frac{1}{4}$.

Mr. Schönheyder, referring to the trial, wished to know why the Committee changed from the main feed pump to the donkey pump. The speaker thought the feed and air pu np diagrams perfectly useless in this case, and unreliable. He thought the makers were right in giving the large proportions of boilers that they did.

Mr. Phillips thought it would be desirable to take a diagram from the under-side of the air pump bucket. In his opinion the machinery was far too powerful, and quite ample for 1,000 h.p., and, under these circumstances, he failed to see the necessity for forced draught. He was of opinion the engines must have been very much linked up, and asked if it would not have been better to have worked with lower boiler pressure and links more open. The speaker dealt with the diagrams to show that the results as to pressure and horse-power were not what might have been expected. He took it that the steam was very much wire drawn, and regretted that the arrangements for testing the priming had broken down, as, if boilers so lightly driven primed, he could not conceive of any boiler being constructed which would not prime. Regarding the supplementary feed he found on working it out that this was simply enormous, and should certainly be looked into.

Mr. Bruce considered the value of these reports to consist mainly in the basis they formed for comparison, and considered the "Iona" had great advantages in regard to the excellent quality of the coal used, to which he in great measure attributed the excellence of the results obtained. In his experience, boilers of equal size yielded 800 h.p. readily, and he thought the results of the trial would not prove encouraging to shipowners. The speaker referred to the general arrangement of the forced draught, and asked why all the air was put under the bars, and not divided between top and bottom, a method, he understood, Mr. Fothergill advocated in a previous paper, and concluded by challenging the method of obtaining the temperatures.

Mr. McFarlane Gray thought the experiments very satisfactory. Speaking of the calorific tests, he wished to know if the latent heat of the steam had been deducted from the results, and pointed out the error that would have arisen if such had not been done. In referring to the funnel damper being only one-sixth open, with the object of keeping heat in contact with surfaces as long as possible, the speaker dealt with the questions of heat by radiation and conduction, and ridiculed the idea of "bottling up" the gases where heat was to be gained by conduction only.

Mr. Mair-Rumley thought all the members would join with him in thanking Professor Kennedy for the valuable services he had rendered to the Institution. In his opinion the boilers and engines were decidedly large for their work. The speaker called attention to the fact that, whereas the engines of the "Iona" showed twenty-one expansions, and those of the "Meteor" only nine expansions, the efficiencies of the two sets of engines came within about 2 per cent. of each other. Referring to Mr. McFarlane Gray's deprecatory remarks as to "bottling up" the gases, he would point out the fact that in mill engine trials the damper is often closed until it is almost tight.

Mr. Constantine asked for more information as to boiler and admission pressures, and wished to know why funnel gases could not be utilised for heating feed-water. He desired to corroborate the last speaker's remarks as to the beneficial results obtained by partly closing the dampers.

Mr. Legros spoke as to the extreme accuracy of the calorimeter used, and, with the instrument before him, explained its *modus operandi* at length. He also explained that the breakdown of the means devised for priming was in great measure due to the fact that it was only determined upon at the last moment. A good deal had been said about the position of gauges, and in connection with that he would remind the speakers that speaking in that room was very different to acting on board ship. He thought the gas samples showed that the combustion had been very perfect.

Mr. Fothergill said he had not much to criticise in the paper, but would like to reply to one or two of the points raised. About the size of boilers he would ask them to consider what the ship did, and to bear in mind that with this vessel 3,000 tons was carried at an average rate of $8\frac{1}{3}$ knots on a coal consumption of 1·3lb. per indicated horse-power per hour. As regards forced draught, the results had proved that it was satisfactory. As to dampers, he regretted that Mr. McFarlane Gray did not quite catch his point, and, in spite of what that gentleman said, he still contended that the slight pressure did bring the gases more searchingly into contact with every nook and corner of heating surface than would obtain if the gases had a clean run through and got away more rapidly. Some members had objected to the machinery because of its being larger than necessary; this might be so, but then they had a reserve of power, and could work up to 900 h.p. easily if wanted. As to large funnel area, it was made so because, if the fan broke down, it would suffice for natural draught in the ordinary way. As to the use of forced draught, he could only say that it brought out the advantage of every foot of heating surface. The speaker directed his concluding remarks to showing from the tables of consumption that the results of the trials corresponded very closely with the results obtained in actual working.

Mr. Mudd, speaking on the size of the engines and boilers, showed that these could have been worked up to greater power, but was glad the trial had been made rather as one of ordinary working conditions than as a test of what power they could get. As to Mr. Burstall's remarks on the leakage, he could only refer to the previous trial of the chief engineer, extending over a period of nine days, and from which it was conclusively proved that the supplementary feed, when working with all joints tight, was not nearly so great as appears from the figures of this trial. Replying to Mr. Halpin, the speaker said that in his experience it did prove economical to "wire draw" the steam between the boiler and the engine, and thought that partly closing the stop valve did to a certain extent stop priming, when the priming partook of the nature of a "fog." As to Mr. Philip's inquiry for a diagram from the underside of the air pump bucket, he might at once say that such a diagram would be valueless, as there was no foot valve. Replying to Mr. Bruce's assertion that the results obtained were in great measure due to the quality of the coal consumed, he controverted such a statement *in toto*, and explained that these engines were their standard 900 h.p. type, and would give 950 h.p. easily.

Professor Kennedy called attention to the lateness of the hour, which prevented him replying at anything like length. He was sure the discussion had been expressive and satisfactory. He was glad to be able to inform them that Mr. Mudd had given him drawings of the engines, which would be reproduced in the *Proceedings*. He most strongly objected to corrections being made from one set of trials to another. All the trials were absolutely distinct, and as such he wished the different sets of results to stand each on its own merits. Speaking on the question of the large percentage of supplemental feed-water used during this trial, he must only say that it was abnormally large during the time it lasted.

The President said he did not think he need trouble the meeting with any remarks after the excellent discussion that had taken place, and brought the proceedings to a termination with the usual votes of thanks.

Mr. Boswell's paper, "On Some Details in the Construction of Modern Lancashire Boilers," was unavoidably held over.

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STEAM ENGINE GOVERNORS.

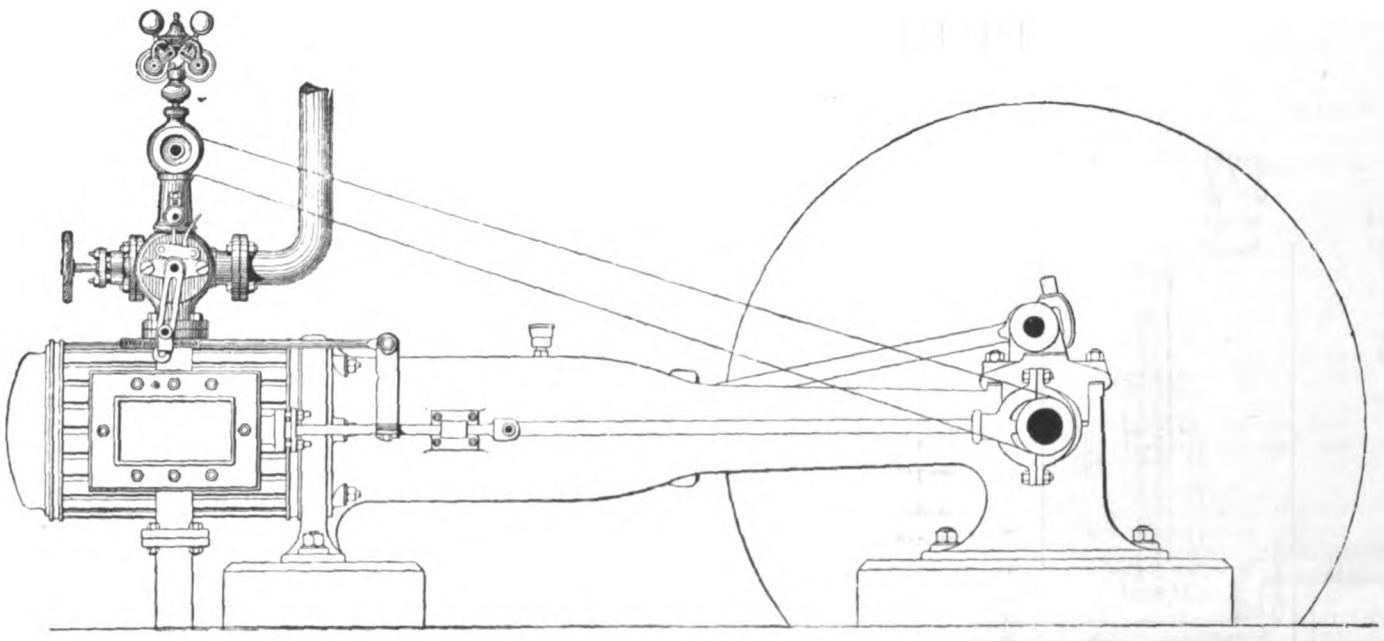
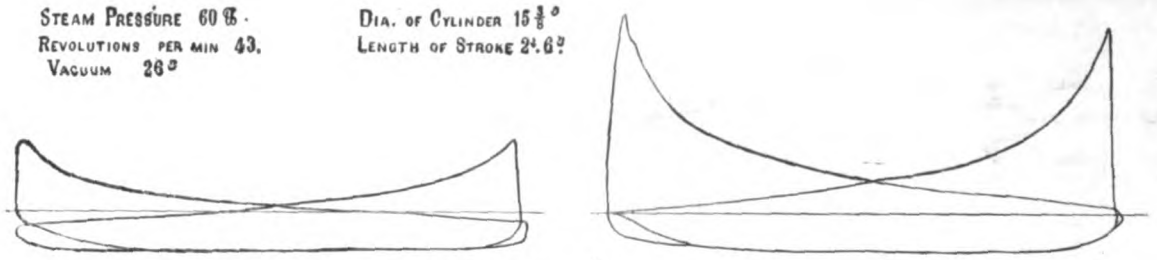


FIG. 15.

STEAM PRESSURE 60 ℔.
REVOLUTIONS PER MIN 43.
VACUUM 26″

DIA. OF CYLINDER 15⅜″
LENGTH OF STROKE 24.6″



ORIGINAL SCALE $\frac{1}{30}$.

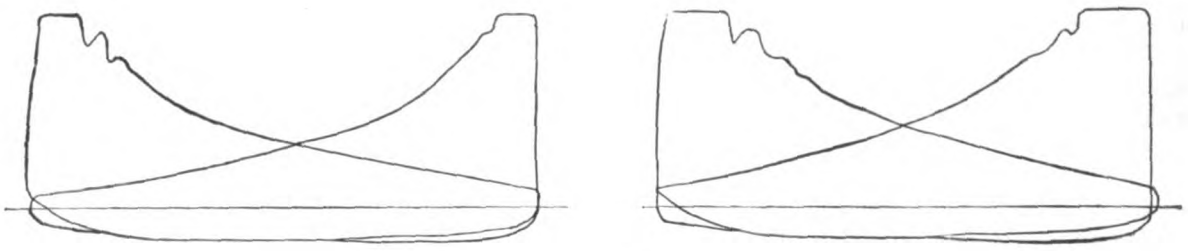


FIG. 16.

STEAM ENGINE GOVERNORS.*

(*Concluded from page* 436.)

THE size of a throttle valve is generally determined from the diameter of the engine steam pipe in which it is inserted, without regard to the conditions under which it is required to work; and since the steam pipes are often made considerably larger than necessary to pass the required amount of steam, with the supposed object of reducing the friction in the pipe, it follows that the passage through the throttle valve is often too large when fully opened. The result is that when the maximum load is put on the

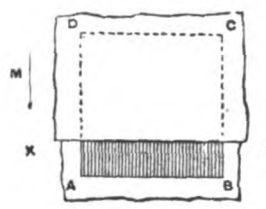


FIG. 17.

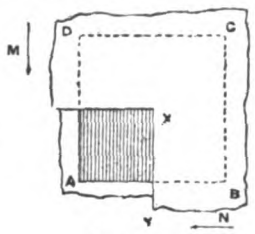


FIG. 18.

engine, the governor muff has only risen through a fraction, say one-quarter or one-fifth of its total lift, and only this small fraction of the total lift is utilised in regulating the engine. When, in such a case, a small variation—say an increment—in the load occurs, only an exceedingly small downward displacement of the governor will be required to counterbalance this variation, and the governor will generally overshoot the mark, since, owing to the additional friction which the governor mechanism encounters when changing from rest to a state of motion, the muff will not drop until the speed of the governor has been reduced to a lower point than corresponds to the increment of the load. The throttle valve is thus opened too far, and the speed of the engine is increased. The same action is then, of course, repeated in the opposite direction, and the governor is therefore caused to oscillate whenever a variation occurs in the load of the engine; and in this manner very irregular running of the engine is produced, and even greater variations of engine speed may result than would be produced with a less sensitive governor. If the throttle valve is too small, the governor muff must move over a long distance to counterbalance any small variation of the load, and unsteadiness is again the result. In such cases the limits of the engine speed may even greatly exceed the speeds corresponding to the extreme positions of the governor. If we suppose that we have two equally sensitive governors working under identical conditions, one of which, say A, is fixed upon a throttle valve having twice the area of the other, say B, then it is evident that, with a certain variation of load, the displacemement of B must be equivalent to twice that of A, and consequently the sensitiveness of the governor combination A will be double that of B. By extending this argument it will be seen that the sensitiveness of a governor and throttle valve combination varies as the size of the passage through the throttle valve.

These considerations point to the importance of determining the correct size of a steam engine throttle valve according to the conditions under which the engine is required to work; but this calculation offers some difficulty in the case of an engine which exists merely in the shape of a design, since the chief factors involved can themselves, in the majority of cases, only be determined by empirical methods In a completed engine the date required can be obtained experimentally by inserting a stop valve in the main steam pipe, and measuring the minimum opening of this valve with which the engine will run at the required speed with full load on, the governor being of course disconnected during the experiment. If then, it is required that the governor shall occupy the middle position with the same load on the engine, the area of the throttle valve must be twice as large as the opening of the stop valve determined in the experiment.

In the "Universal" throttle valve fitted by Messrs. Schäffer & Budenberg, in connection with their Four-Pendulum governor, as shown in Figs. 7, 8, and 9, the area of the passage through the throttle valve can be regulated by hand, and the sensibility of the governor combination can therefore be adjusted to suit different conditions under which the engine may be required to work. In order to illustrate the action of this apparatus, let A B C D in the accompanying Fig. 17 represent the opening of a throttle valve, and XX^1 represent a throttle slide, which is capable of closing the passage in the direction of the arrow M. Further, suppose that the throttle valve is open to the extent of one-quarter, as shown in Fig. 17, when the full load is thrown on to the engine. The lift of the governor will then be utilised to the extent of one-quarter. In the throttle valve under consideration, the opening A B C D can be closed laterally in the direction of the arrow N (Fig. 18) by means of a screw wheel. In Fig. 18 this valve is shown half closed, but the passage through the double valve is the same as in Fig. 17, the throttle valve being in this case open to the extent of one-half when the engine is working under the full load. It follows that in Fig. 17 the sensitiveness of the apparatus is twice as great as in Fig. 18, because in the former the rise of the governor muff required to effect the opening is only half of that in the latter case. In this way the same size of passage through the throttle valve can be made to correspond to different positions of the governor muff. It will be noticed that the motion of the governor muff is transmitted by means of a small connecting rod and lever to a rotary valve, which is provided with four square ports, working over corresponding ports in a cylindrical valve. This valve, which also serves as a stop valve, is adjustable by means of the hand-wheel in the direction of its axis, for the purpose of varying the width of the passage through the throttle valve, as previously explained. The entire lift of the governor muff nevertheless remains available for regulating the steam supply, and the lift of the governor can be utilised to any desired extent, even under a minimum load, by regulating the throttle stop valve. The apparatus can, therefore, be adjusted to suit all conditions of working. As an interesting feature in connection with this apparatus, it may be mentioned that the stuffing-box on the

* Paper read before the Manchester Association of Engineers on the 11th ult., by Mr. C. F. Budenberg, M.Sc.

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THE ACKROYD-WILLOUGHBY SMOKE PREVENTER AND FUEL ECONOMISER.

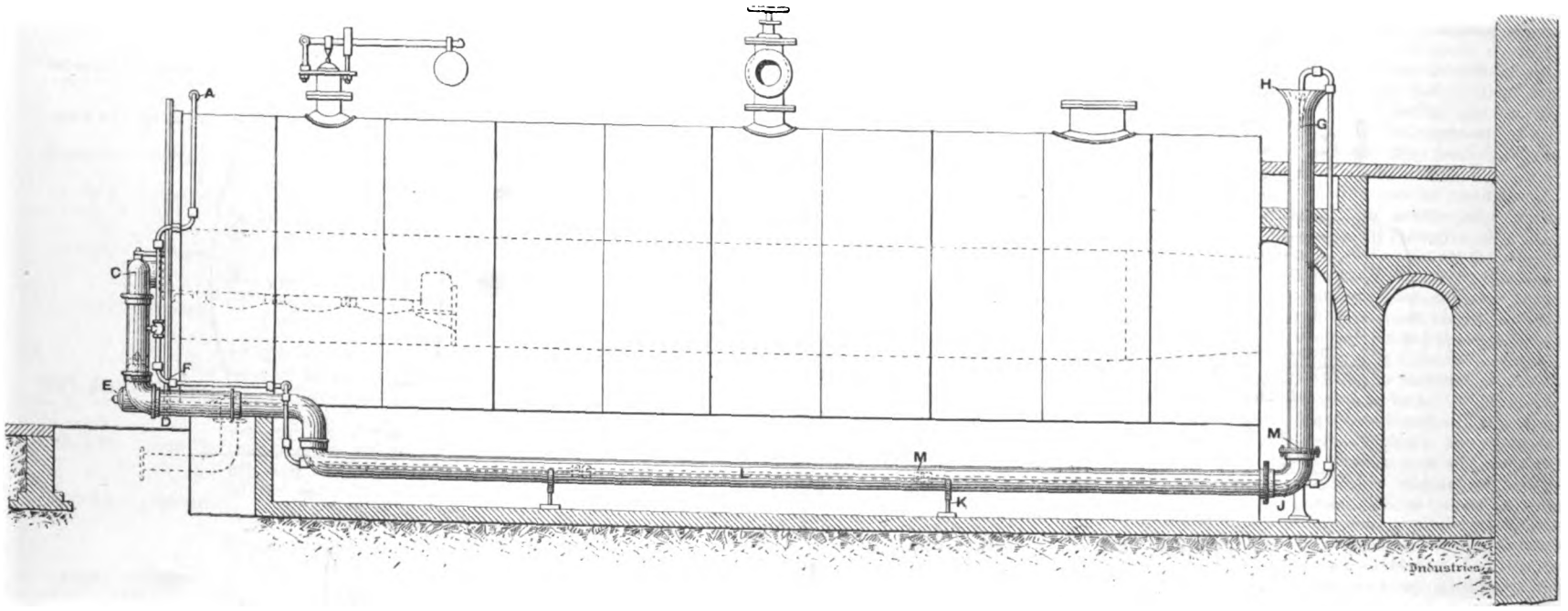


FIG. 1.—LONGITUDINAL SECTION.

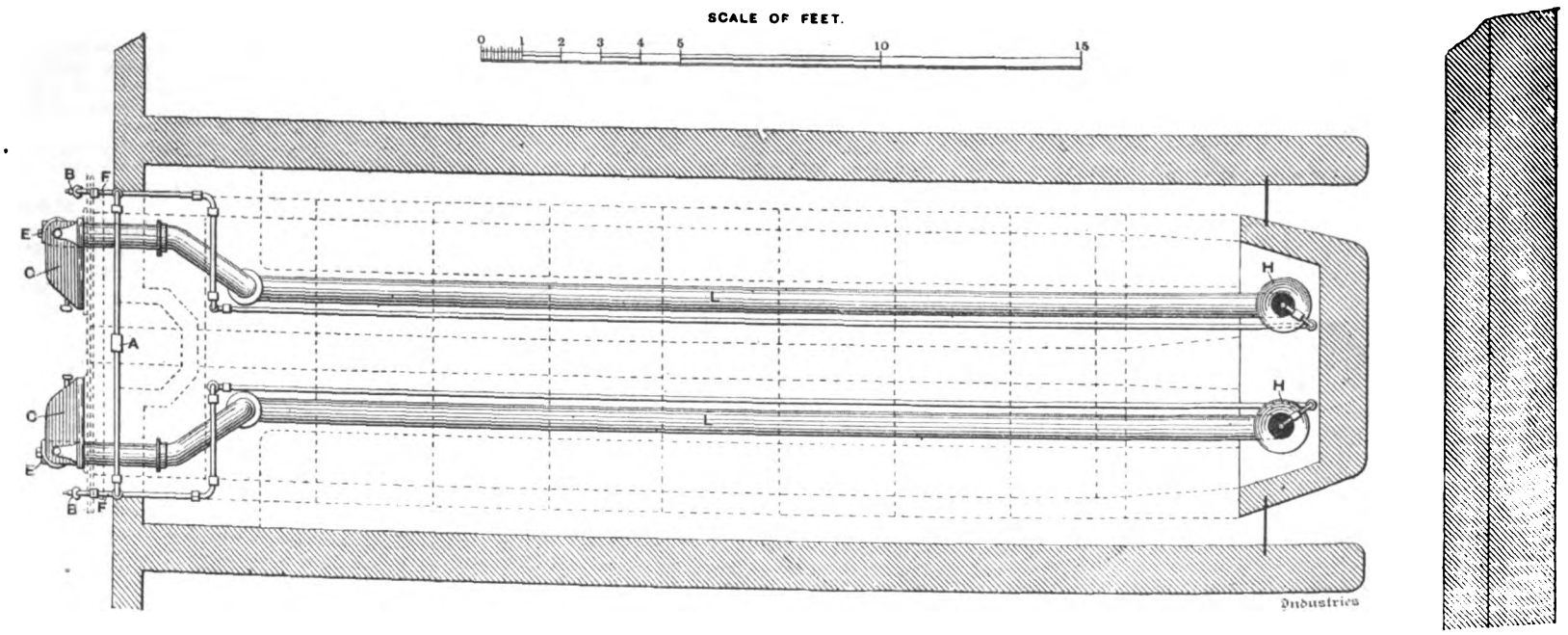


FIG. 2.—SECTIONAL PLAN WITH BOILER REMOVED.

throttle valve spindle is dispensed with, the joint being made by means of a conical valve, which is kept tight by the pressure of steam in the valve. The stop valve does not, of course, depend for tightness upon the rotary valve, but is provided with a separate seating for the purpose.

Although it is beyond the scope of this paper to deal with expansion gears, it may not be out of place to refer to at least one type of self-contained automatic expansion regulator represented in Figs. 14 and 15. This governor is used in addition to the ordinary slide valve, and is fixed upon the valve chest like an ordinary throttle valve governor. The action of the governor only differs from an automatic expansion gear in allowing the contents of the valve chest to expand with the steam in the cylinder during a portion of the stroke. The inner valve A is opened near the commencement of each stroke by means of the crank H and the rod S, which is connected with the slide rod of the engine. The valve is returned to its central closed position by the springs B, when it is disconnected from its connection with the crank H owing to one of the two curved arms C coming into contact with a balance lever Y, the position of which is controlled by the governor. The rotary valve is therefore released and the cut-off is effected at an earlier or later point of the stroke according to the position of the governor to suit the load on the engine. The apparatus can be made very sensitive, because the only work of the governor proper consists in regulating the position of the balance lever Y. The cut-off cannot take place later than half stroke, and if the rotary valve is not disengaged at this point it will close slowly when the eccentric makes the return stroke. Fig. 16 shows a number of diagrams taken under different conditions of load from an old single slide valve engine fitted with one of these expansion regulators by Messrs. Cochrane, Grove, & Co., Middlesbrough, and these diagrams serve to show how completely the engine is controlled by the governor.

In conclusion, I feel that the time at my disposal has enabled me to place before you but a smattering of an extremely wide subject, and I can only hope that I may, at least, have stimulated some little additional interest in, what appears to me to be, one of the most fascinating branches of an engineer's study.

THE ACKROYD-WILLOUGHBY SMOKE PREVENTER AND FUEL ECONOMISER.

THE problem of the prevention of smoke, particularly from the chimneys of mills and works, has for many years been a subject of deep interest to engineers. During the last fifty years many schemes of the most varied nature have been proposed for the removal of the great smoke nuisance, which is becoming such an important factor in causing filth and disease in our manufacturing towns and cities. Many of these schemes have been based upon a very imperfect knowledge of the conditions of the combustion of fuel, and were directed to what was then called "the burning of smoke." A better knowledge of the chemical conditions which govern the combustion of coal has led to better directed efforts in this direction. In new installations where suitable conditions for a fairly satisfactory combustion of fuel can be arranged—viz., ample chimney power, proper admission of air, and a sufficiently high temperature in the furnace—special apparatus has to some extent been rendered unnecessary. Schemes for smoke washing have also been proposed and experimented upon, but have not hitherto received acceptance. The majority of the various plans proposed appear to have been directed merely to the prevention of smoke, and not so much towards economy of fuel, consequently no general acceptance of any special apparatus has taken place. In fact, few, if any, apparatus has ever been brought before steam users which was easy of application to existing plant, cheap in first cost and up-keep, and free from complications and difficulty in working, while at the same time producing a sensible saving in fuel.

An apparatus which seems to fairly fulfil these conditions has recently been introduced by Messrs. Ackroyd & Willoughby, of Birkenshaw, near Leeds. From the illustrations, Figs. 1 and 2 above, and Fig. 3 on page 468, it will be seen that its principal feature consists of pipes L carried through the back flue and through

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the bottom flue of the boiler. Air is taken in at the mouth of the pipes marked H, passes through the pipes L to the front end of the boiler, and delivers through pivoted fire-doors specially constructed to cause the heated air to impinge upon the fuel. Steam is taken from the front end of the boiler in pipes which are also carried through the bottom flue and up through the back flue to the mouth of the air pipes H, where they deliver steam through nozzles suitably arranged for the purpose. Steam is delivered through these nozzles for about three minutes after each firing. The result of this arrangement is that, during the time which elapses between each charge of the furnaces with coal, air is being delivered through these pipes at a temperature of about 440° Fahr. When the charge has been put on, the nozzles are opened, and the steam which is taken from the front end of the boiler and carried through the flues is delivered into the air pipes. Owing to the high point to which the steam is superheated in its passage through the flues, no trace of the effect of moisture on the air pipes is discoverable, and the heated air, when the jets are in operation, is delivered at a temperature of 451° Fahr. From the illustrations and description it will be seen that there are practically no working parts or gear likely to get out of order. It is simple of application, and can easily be adapted to any form of steam boiler. As will be seen, the action of the steam jets is under the control of the fireman, but in some cases it has been arranged, as can easily be done, to work them automatically. The apparatus, it would appear, where steam can be conveniently obtained, is equally suitable for furnaces, drying stoves, destructors, &c. An arrangement of this kind could also be easily applied to the boilers of steam vessels, and the prevention of smoke, particularly in regard to passenger steamers, would be, quite apart from the economy of fuel it would produce, a great boon, and largely increase the pleasure of a sea voyage. A considerable number of these smoke preventers have been already set to work, and recently most careful trials were made of the apparatus upon a boiler at Messrs. William Ackroyd & Sons, Lower Mill, Birkenshaw, near Leeds. The trials were made on two consecutive days, beginning at 9 a.m. and continuing until 5.10 p.m., with a stoppage of forty minutes during the dinner time. The weather was fine, with strong winds blowing from a westerly direction during both days.

The water fed to the boiler was accurately measured in a specially prepared tub which was filled to the level of the overflow and pumped empty each time. The actual weight of water which the tub could contain was ascertained by weighing, the temperature of the water being the same as during the trials. The pump used was a direct double-acting one, fixed close to the measuring tub, and all connections with the boiler, with the exception of the feed inlet and steam outlets, were blanked. The temperature of the feed-water was taken twice during the emptying of each tub. The height of the water in the boiler was noted at the commencement of the trial, the gauge glasses marked, and the water brought to the same level at the end of the trial.

The coal used was Burgy, from Spring Gardens Pit, Drighlington, near Bradford. It was of average quality, as shown by the analysis given in the accompanying tables. The calorific value of the coal was determined in a Thompson's calorimeter, and a mean taken of the results. The coal was weighed on a suitable weighing machine, 2 cwt. being weighed at a time. The fires were cleaned about 8 a.m., and again about 12.15, and the fires worked down at the end of the trial to the same thickness, as near as could be judged, as they were at starting. They were again cleaned at the end of the test, and the ash and clinker for the whole day weighed, after being cooled and kept dry. The firing was entirely by hand, the average intervals being from 12 to 15 minutes.

The temperatures of the atmosphere and the air in the pipes of the air-heating apparatus and of the flue gases were obtained by mercury thermometers, and readings were taken every half-hour throughout the trials. A special mercury thermometer, with the mercury under pressure of hydrogen gas, was used for obtaining the temperature of the flue gases at the back end of the boiler, to prevent mishap in case the temperature should exceed the boiling point of mercury.

The apparatus for drawing off samples of the flue gases for analysis consisted of a vertical tube having a slot about 4ft. long inserted in the flue at the back of the boiler.

The water carried over by the steam was directly determined by several experiments each day. The apparatus consisted of a sensitive beam scale, to one end of which was suspended a wooden box lined with zinc. The box was balanced, and 70lb. of cold water poured in. The temperature of the water was then carefully noted, and 4lb. of steam blown into the water from a pipe inserted in the main steam pipe under the boiler junction valve. The temperature was again read over, and the water allowed to stand for a corresponding length of time to that during which the steam was blown in, and the temperature again read to ascertain the loss by radiation. From these temperatures and the known weights of water, and water and steam blown in, the weight of dry steam was computed. The quality or dryness was found to be practically uniform throughout the tests.

The smoke observations were made over a period of two hours each day, and the character of the smoke emitted was defined by comparison with smoke-coloured diagrams. Particulars of the observations taken and the results obtained are given in the following tables:—

Results of Trial.

Particulars and Dimensions of Boiler and Chimney.

Type of boiler—	
Lancashire two flued, length 29ft., diameter 7ft. 6in., with 5 conical tubes in left flue, and 6 conical tubes in right flue.	
Flues—	
Gases enter bottom flue on leaving internal flues and return along each side flue to chimney.	
Heating surface—	
Total heating surface	941 sq. feet.
Fire-grate—	
Dimensions of fire-grates	7ft. by 2ft. 9¾in.
Total fire-grate area	39·37 sq. feet.
Area of air spaces	6·43 sq. feet.
Area of opening below grates	3·13 sq. feet.
Ratio of air space to grate area	1 to 6·12
Ratio of heating surface to grate surface	23·9 to 1
Steam space—	
Total steam space	275 cubic feet.
Chimney—	
Height of chimney above fire-grates	110ft.
Area of chimney at outlet	5·64 sq. feet.

Principal Observations.

	Apparatus Not in Use.	Apparatus in Use.
Date	March 3rd.	March 4th.
Time—		
Duration of trial	7·5 hours.	7·5 hours.
Air pressure—		
Mean barometric pressure	30·25in.	30·2in.
Steam pressure—		
Mean steam pressure above atmosphere by steam gauge	60·6lb.	60·4lb.
Temperature Fahr. corresponding to this pressure	307·7°	307·4°
Feed-water—		
Average temperature of water fed to boiler	173·5° F.	173·6° F.
Total weight of water fed into boiler	41,886lb.	39,688lb.
Average weight of water fed into boiler per hour	5,585lb.	5,292lb.
Water evaporated per sq. foot of boiler heating surface per hour	5·93lb.	5·62lb.
Coal and ashes—		
Total weight of dry coal fired	6,304lb.	4,946lb.
Average weight of dry coal fired per hour	840·5lb.	659·4lb.
Total weight of ash and clinker produced	1,193lb.	885lb.
Average weight of ash and clinker produced per hour	159lb.	118lb.
Temperature of air—		
Average temperature of external air	42° Fahr.	51° Fahr.
Average temperature of air inside at back of boiler-house	74° Fahr.	83° Fahr.
Average temperature of air passing into furnaces through ash-pit	42° Fahr.	51° Fahr.
Average temperature of heated air entering furnaces after passing through air pipes in flues	—	440° Fahr.
Average temperature of heated air passing furnaces after passing through air pipes in flues when steam jets on	—	451° Fahr.
Temperature of gases—		
Average temperature of furnace gases leaving boiler	491° Fahr.	487° Fahr.
Draught—		
Chimney draught by water gauge	·57in.	·6in.

Analyses of Furnace Gases and Coal.

Analysis of furnace gases, percentage volumes—		
Carbon dioxide	9·62	7·85
Carbon monoxide	1·48	trace
Oxygen	7·74	11·10
Nitrogen	81·16	81·05
	100·00	100·00
Or expressed in terms of gases and air—		
Gases of combustion	63·14	47·14
Surplus air	36·86	52·86
	100·00	100·00

Analysis of dry coal—	
Carbon	74·92
Hydrogen	5·30
Sulphur	4·20
Oxygen and nitrogen	7·50
Mineral ash	8·08
	100·00
Calorimeter tests of coal—	
Heat available in furnace per 1lb. of dry coal	12,730 th. units.

Principal Results.

	Apparatus Not in Use.	Apparatus in Use.
Air—		
Weight of gases produced per 1lb. of dry coal burnt	9·740lb.	10·493lb.
Weight of surplus air produced per 1lb. of dry coal burnt	5·171lb.	10·661lb.
Weight of H_2O vapour in air per 1lb. of dry coal burnt	0·095lb.	0·155lb.
Weight of steam from H_2O mixed with coal per 1lb. of dry coal burnt	0·041lb.	0·041lb.
Total weight of gas, air, and vapour per 1lb. of dry coal burnt	15·047lb.	21·35lb.
Temperature of cases—		
Increase in temperature of gases from temperature of external air	449° Fahr.	436° Fahr
Combustion—		
Weight of dry coal fired per square foot of grate per hour	21·35lb.	16·75lb.
Weight of dry coal fired per square foot of total heating surface per hour	0·893lb.	0·700lb.
Evaporation—		
Weight of water fed to boiler at a temperature of 173·5° per 1lb. of dry coal fired	6·64lb.	8·02lb.
Equivalent evaporation from and at 212° Fahr., assuming steam dry—		
(*a*) Per lb. of dry coal fired	7·11lb.	8·58lb.
(*b*) Per lb. of combustible burnt	8·77lb.	10·45lb.
Proportion of water evaporated into actual steam	96·48 per cent.	96·34 per cent.
Proportion of unevaporated water carried with the steam	3·52 per cent.	3·66 per cent.
Efficiency of boiler—		
Efficiency measured by thermal units transferred to the water	52·28 per cent.	63 per cent.
Increase of efficiency with apparatus in use		20·5 per cent.
Percentage weight of coal required to supply steam for the steam jets		3·5 per cent
Net economy of fuel produced by the apparatus		17 per cent.

Smoke Observations.

	Apparatus Not in Use.	Apparatus in Use.
Smoke—Black or dense, number of minutes per hour	15	0
,, Brown or medium, number of minutes per hour	5·5	2
,, Light coloured or faint, number of minutes per hour	3·5	15
,, None	36	43
Total	60	60

Summarising the principal results, it will be seen that the trials show that with the apparatus in use the evaporating efficiency of the boiler is increased 20·5 per cent., and the amount of smoke greatly reduced; in fact, dense smoke, which under the ordinary conditions of firing was emitted for fifteen minutes per hour, was entirely prevented, and the emission of brown smoke reduced from 5·5 minutes to 2 minutes per hour.

To the diminished weight of coal required when the apparatus is in use was added the calculated weight of coal required to generate the steam used during the periodic action of the steam jets. The amount of coal required for this purpose is about 3½ per cent. of the whole. After making this allowance, the results show that, with the Ackroyd-Willoughby apparatus in use, the cost of evaporating a given quantity of water is 17 per cent. less than under the ordinary conditions of firing, besides almost entirely preventing the discharge of carbon monoxide, and entirely preventing dense smoke—both very important advantages.

The arrangements were devised and the trials carried out by Mr. J. F. L. Crosland, M.Inst.M.E., chief engineer of the Boiler Insurance and Steam Power Company, Ld., 67, King Street, Manchester, aided by Mr. E. G. Field, an assistant engineer, and a staff of skilled inspectors, who have had an extensive experience in the conduct of engine and boiler tests. The flue gases and coal were analysed by Mr. H. Wood Smith, of Messrs. Wilkinson & Smith, analytical chemists, Manchester.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 12th May, 1891.

The Iron Market.—The situation continues to improve steadily, and prices have undergone a further augmentation. Bars are now quoted at 140s. 6d. and joists at 148s. 6d. per ton. This rise in price is in part owing to the fact that the forges are charging 128s. 6d. and 136s. 6d. respectively for the above classes of iron delivered in waggons at Paris, but at the same time there is a general understanding among the merchants which allows of the market being controlled better than heretofore. Only in the case of one or two exceptionally large orders an abatement of from 4 to 5 per cent. has been made. Old iron rails are in fair demand at 80s., and orders for castings are easily obtained at 112s. 6d. per ton. Messrs. Dietrich & Co., of Luneville, Meurthe-et-Moselle, have secured an order for 1,000 waggons from the Eastern Railway Company. In the same district the Pompey forges are very busy with about 5,000 tons of plates and angles, chiefly of Martin steel, for the Cosne bridge. In the North the market is very firm. The following are the quotations for the past week:—Bars, 124s. 6d. and upwards; joists with wide flanges, 132s. 6d.; 3mm. No. 2 sheets, 140s. 6d. to 145s.; and steel sheets, 160s. 6d. per ton at the works.

The Coal Market.—The situation continues unchanged. The prices in the North and Pas-de-Calais districts are as follow:—Manufacturing coal, 15s. to 15s. 10d.; screened, 17s. 6d.; coke, 15s.; and gas coal, 16s. 8d. per ton. In the Ardennes forge coal is quoted at from 12s. to 12s. 8d. per ton.

Centenary of the French Patent Law.—In view of the important centennial celebration of the establishment of the United States Patent System, which was recently held in Washington, it is interesting to note that the Society of Consulting Engineers and Patent Agents are taking steps to celebrate the centenary of the French law as regards patents for inventions, which was passed by the National Assembly on the 7th January, 1791, and which came into effect on the 25th May following. A committee, having at its head the President of the above-named society, has been formed, and efforts are being made to make the centennial celebration a success. It is proposed to hold the celebration on the 25th inst.

French Commerce in Iron.—The following figures show the movement in the French iron trade as regards the quantities of metal exported and imported during the first three months of 1890 and 1891:—

Imports during the First Three Months of

	1891.		1890.	
All classes of cast iron	33,041	tons	33,863	tons
Wrought iron on temporary admission	4,451	„	2,542	„
Wrought iron paying duty—				
Charcoal iron	499	„	1,548	„
Coke iron	1,536	„	1,062	„
Rails	7	„	7	„
Angle and tee iron	51	„	32	„
Rods	95	„	21	„
Hoop iron	35	„	29	„
Sheet iron	163	„	230	„
Iron wire	48	„	56	„
Iron oxide	39	„	39	„
Scrap iron	1,254	„	883	„
Iron slag	1,730	„	6,642	„
Steel on temporary admission	425	„	776	„
Steel paying duty—				
Rails	4	„	26	„
Tyres and axles	175	„	143	„
Bars and sheets	611	„	682	„
Ordinary sheets	24	„	24	„
Hoop steel	32	„	38	„
Steel wire	140	„	124	„

Exports during the First Three Months of

	1891.		1890.	
All classes of cast iron	20,671	tons	57,748	tons
Wrought iron—				
Charcoal iron	39	„	20	„
Coke iron	3,821	„	11,288	„
Rails	972	„	3,566	„
Angle and tee iron	401	„	1,198	„
Hoop iron	417	„	545	„
Sheet iron	883	„	3,201	„
Iron wire	834	„	563	„
Steel	8,228	„	9,644	„
Scrap (cast and wrought iron)	2,167	„	7,725	„
Scrap (steel)	48	„	15	„
Total imports	44,360	„	48,767	„
„ exports	38,481	„	95,513	„

BERLIN, 11th May, 1891.

Steam Tramways in Upper Silesia.—The construction of a line of steam tramways in Upper Silesia is again under consideration. A syndicate has now been formed at Beuthen, Upper Silesia, for the purpose of connecting Beuthen, Gleiwitz, Königshutte, and Kattowitz by steam tramways, and of serving the larger industrial towns which are situated in these districts. The same syndicate constructed last year a similar tramway line from St. Johann, near Biebrich, to Louisenthal, in the Rhine district, which has given very good results. It is expected that the line now projected will be equally successful.

Milk Preserving Manufactories.—Among the many manufactories for the preparation of sterilised milk in Germany, that of Mr. C. Drenckhan, at Stendorf, in Holstein, is one of the most important. The process employed is that of Mr. E. Scherff. The milk, after having been deprived of germs, is enclosed in bottles, which are sealed by the pouring of paraffin on the stopper. This firm also manufactures a milk powder, which is easily dissolved in water, and then has the appearance and properties of fresh milk. In order to prepare this powder, the milk is condensed and completely dried after the addition of a strong syrup.

Portland Cement Works.—The extensive limestone beds at Zscherben, near Halle, in Saxony, have been acquired by a company, which intends shortly to commence the construction of large Portland cement works near the railway.

The Iron Industry.—The Upper Silesian Iron Works are taking up the manufacture of small iron fittings for the permanent way of railways, which have hitherto been almost exclusively made in Westphalia. Bessemer pig iron from the Siegen district has recently been sold at £2 18s. 3d. delivered in Rhenish Westphalia. In consequence of this fact the Rhenish Westphalian Iron Union has again lowered its prices.

VIENNA, 11th May, 1891.

The Iron Market.—There was no improvement in the state of the iron market during the past week. There is an active business within the limits of the actual demand, which, however, remains below that of previous years. Speculative dealing has not given rise to larger purchases. Nevertheless the rolling mills are as well employed as usual in the manufacture of hoop iron and merchant iron. Plate rolling mills and foundries are also more briskly employed. There is a very large demand for wire and wire nails, and the manufactories find some difficulty in coping with the orders. The business in agricultural implements during the spring was satisfactory. Prices remain unaltered. The Bohemian Mining Company held its general meeting last week. The net profits amounted to £10,437, an increase of £2,646 over that of the previous year. The company pays a dividend of 5 per cent. The Prague machine works of Messrs. Britfeld & Co. have done a good business during the past year, and pay a dividend of 10 per cent. There was an important demonstration of working men in Vienna, Ostrau, and Bekés on the 1st inst., which, however, resulted in no disturbance.

The Coal Market.—Notwithstanding the fine weather of the past fortnight the coal market continues animated, and the Bohemian mines are well supplied with orders. The Ostrau mines have ceased to work since the 1st inst., in consequence of the strike, and the greater part of the coal for Vienna now comes from Silesia and Bohemia. The Koflach Railway forwarded more than 356,000 tons of coal from this district during the past working year, which shows an increase of 178,855 tons. The "Kronstädter Montan-Verein" is paying a dividend of 5 per cent.

Electric Lighting of Vienna.—The electric lighting of Vienna is chiefly carried out by the "Internationale Electricitäts Gesellschaft." The installation consists at present of 20,000 lamps of 16 c.p., and there are four compound steam engines, each of 600 effective h.p., working at 125 revolutions per minute. These engines can work either with or without condensation, and are used for driving directly an "A 8" Ganz alternator with a normal output of 400,000 watts. For service during the day a condensing steam engine of 300 effective h.p. drives an "A 7" Ganz alternator with an output of 200,000 watts. The total length of the cable laid by this company amounts to 28 miles.

BRUSSELS, 12th May, 1891.

The Iron Market.—Attention is now generally directed towards the strike, which may put a stop to the production of coal and cause coal mine owners to again raise their prices. The iron market is therefore depressed, and in a state of uncertainty. There is some demand for small material, but the sale of joists remains inactive. The supply of new orders is small, and leads to little business. The uncertainty of the market prevents arrangements being made for the future. There is an increase of the export to England. The statistics of the export and import trade show the extensive influence of the foreign demand on Belgian markets. There is a general decrease in the amount of metals exported, and it is expected that this decrease will be augmented, especially as regards iron. At the present time, steel works are more active than iron works. Constructing shops have also some orders, and are fairly well employed. The contracts for old rails for the State railways have been awarded as follow:—1,500 tons of Vignoles rails to M. Paul Strybos, of Antwerp, at £3 0s. 4d. per ton; 1,000 tons to M. Clabecq; 500 tons to the Providence and St. Fiacre Company. The contract for fishplates has been given to M. W. Daumont at £3 10s. 3d., and plates at £2 19s. 9d.

The Coal Market.—The strike makes an estimate of the state of the market very difficult. The export trade has slightly decreased, but internal trade has increased. There is an increased demand for coke, and many ovens which were blown out about two months ago are about to be blown in. The price of coke shows a tendency to rise, and to again reach 14s. 3d. per ton. Small sorts are quoted at 9s. 6d. per ton. This rise of prices must cause some uneasiness in the metal market. There is a good business in close burning coal for brickmaking, and some large sales have been effected from 6s. 9d. to 7s. 4d., according to the quantity. Coal for furnaces has been sold at 10s. 4d. per ton.

The Glass Market.—The state of the glass market has become still worse in consequence of the strike of coal miners. Manufacturers are accepting orders for America at a discount of from 80 to 84 per cent. Prices are therefore unremunerative, as it is impossible to reduce the net cost of production in consequence of the dearness of raw material, and especially of coal. Manufacturers have already asked for a decrease in the rates for transport, and an inquiry has taken place with regard to the rates on the State and the Grand Central Railways. The transformation of the "fours à pot" into "fours à bassin" has caused an increase of stocks which depresses the market. In consequence of this change in the furnaces, it is difficult to reduce the output, and manufacturers have therefore wisely agreed to blow out these furnaces during Sunday, and thus give the workmen a day's rest.

DÜSSELDORF, 12th May, 1891.

The Iron Market.—The prices of iron ores are as follow:—Raw spathic iron, 7s. 7d. to 8s. 4d.; roasted spathic iron, at 10s. 9d. to 12s. 3d.; Nassau hematite, with about 50 per cent. of iron, at 8s. 4d. Pig iron is quoted thus:—Spiegeleisen, 57s. 9d.; Rhenish Westphalian iron, No. 1, 52s. to 53s.; Thomas iron, 47s.; Siegen iron, 49s. to 50s.; Luxembourg puddled iron, 39s. 2d.; foundry iron No. 3, 47s.; German foundry iron, No. 1, 69s. 6d.; No. 3, 58s. 9d.; hematite, 69s. 6d.; Spanish foundry iron, delivered in the Ruhr district, 73s. 5d.; English pig iron, 56s. 10d. to 57s. 10d.; Spanish Bessemer iron, c.i.f. Rotterdam, 59s. 9d. to 60s. 8d.; German Bessemer iron, 61s. 8d. Ordinary bar iron, delivered within the nearest district, is quoted at 132s. 2d. Thin sheets are at 137s. 1d. to 147s. The prices are given per ton of 1,000 kgr., delivered at the works, unless otherwise specified.—Locomotive and waggon works are very well employed, and cannot supply all their orders.

The Coal Market.—The strike of the coal miners in this district has ended without any useful result being obtained, and nearly all the works are again in full operation. In Upper Silesia discontent continues among the workmen, and it is feared that it will spread still further. During the past week the "Königin Luise" Coal Mine, which is a Royal colliery, celebrated the hundredth anniversary of its existence. This mine now employs 9,000 workmen, and has a yearly output of 2¼ million tons of coal. It is thus the largest mine on the Continent. The following table shows the output in the Dortmund district during the past two years:—

	Number of Men Employed.	Output in Thousands of Tons.	Output per Head in Tons.
First quarter, 1889 ...	114,114	8,756	76·7
Third quarter, „ ...	114,148	8,997	78·8
Fourth quarter, „ ...	121,200	9,330	77·0
First quarter, 1890 ...	124,446	9,032	72·6
Second quarter, „ ...	127,049	8,524	67·0
Third quarter, „ ...	126,683	8,979	71·0
Fourth quarter, „ ...	132,038	9,033	68·4
First quarter, 1891 ...	134,642	8,917	66·2

From this table it is evident that in the course of two years, from the beginning of 1889 up to the strike in 1891, the number of workmen has increased by 20,000. The total output, however, has not increased at the same rate.—Prices in the coal market have not been properly adjusted since the recent strike, owing to the reserved attitude of both sides. There is some activity in the pig iron trade. Foundry coke is quoted at 15s. 8d. to 17s. 8d.; blast furnace coke at 12s. 9d. to 13s. 8d.; coke nuts at 16s. 8d. to 18s. 7d.

AMSTERDAM, 11th May, 1891.

The Eight Hours Question.—Sixty workmen of the Dutch Oil Factory at Delft have petitioned the managers to grant them, and all the other employés, "the boon of a working day of eight hours." The managers have sent a reply to the effect that they cannot entertain the suggestion, as they do not consider it to be for the advantage of anybody, least of all for that of the employés themselves. The managers say that they never shrink from adopting measures to the advantage of their workmen, even should such measures result in pecuniary disadvantage to the shareholders. If the shareholders do not like this, let them elect other managers, but the present managers declare that they are not going to give in upon such a question as this, which they deem a violation of the just rights of capital—rights as much to be respected as the rights of labour.

Tolls in Holland.—The Association for the Promotion of the Interests of Steam Navigation in Holland has made a strong protest against the passing of the Government Bill, now pending in the Lower House, for the better regulation of traffic and tolls upon roads, bridges, quays,

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factories, and in harbours, belonging to the State. The memorialists point out that if the Bill be passed the present system of levying tolls will be perpetuated, and they proceed to demonstrate that the interests of the public will be best served by an entire abolition of all tolls, and the consequent freeing of every Government highway in the kingdom.

THE AMSTERDAM CAB COMPANY.—This undertaking has not done well in 1890. A gross profit of £13,356 only left an available net profit of £28, so that there is no dividend for the shareholders.

THE AMSTERDAM DRY DOCK COMPANY.—The directors of the Dry Dock Company in Amsterdam have issued their annual report, which states that 179 vessels used the dock last year, against 166 in 1889, and that the dock buildings are in a very good state. After providing for the necessary depreciation, there remains an available net balance sufficient to pay a dividend of £7 10s. per share of £83 6s.—equal to over 9 per cent.

THE ROYAL STEAM PACKETS COMPANY.—The report of the directors, read at the general meeting of shareholders, states that the combined service of the company between the islands of the Indian Archipelago, in accordance with the Government contract, commenced on 1st January, 1891, with twenty-eight steamships, thirteen of which were new vessels, built in Dutch yards, as provided for in the terms of the concession. Both the construction and the equipment of these steamers have given great satisfaction. The balance sheet, which was approved at the meeting, shows a capital expenditure of over £750,000.

STOCKHOLM, 9TH MAY, 1891.

THE STORA KOPPARBERGS COMPANY.—The "Stora Kopparbergs Bergslags Aktiebolag," which is one of the largest industrial concerns in Scandinavia, did a very large business last year, but the profits have not increased accordingly. The company's manufacture of steel and iron amounted during 1890 to 41,023 tons, against 33,515 tons during 1889 and 25,630 tons during 1888. The production of timber was, however, smaller last year than during the two previous years on account of the unfavourable markets. The figures in question are:—37,337 standards during 1890, 46,416 standards during 1889, and 39,268 standards during 1888. The sales from the various departments were:—

	1890.	1889.	1888.
Copper works ...	£61,171	£52,251	£58,841
Iron works	312,860	239,466	193,002
Saw mills	311,122	276,025	209,096
Total	£685,153	£567,742	£460,939

The amount of business was, consequently, 20 per cent. greater during 1890 than during 1889, and nearly 50 per cent. greater than during 1888. The net profits, however, are smaller than for either of the two previous years, owing to last year's unsatisfactory markets for timber and iron. The net profits for 1890, including £379 carried forward from the previous year, amounted to £52,336, against £84,045 for 1889 and £62,159 for 1888. It is proposed to pay a dividend of 6 per cent. or £32,000, to add £11,111 to the "disposal fund," to add £2,777 to the pension fund and £5,555 to the reserve fund, and to carry £893 to the present year. The reserve fund will then amount to £104,444 and the disposal fund to £166,666. The share capital is £533,333. The company's property is estimated at £1,689,227.

COPENHAGEN, 9TH MAY, 1891.

BACON FACTORIES.—The Danish bacon factories are, on the whole, not doing so well as they were a year or two ago, and several of them have by no means done well last year. The Skive Bacon Factory, which belongs to a Mr. Thompson from London, will probably be let to some agricultural societies in the neighbourhood.

THE STOVE QUESTION.—The Danish Industrial Society in Copenhagen has offered a prize of £27 for the best essay on the question of iron stoves for rooms. This is undoubtedly a very sensible competition, as stoves entirely take the place of fire-places in Denmark, and are therefore of great importance for domestic heating.

NEW STEAMER COMPANY.—A new steamer company has been formed at Rouders, Jutland, for the purpose of trading on the Chinese coast. A steamer of 1,000 tons has been ordered from Messrs. Burmeister & Wain's Shipbuilding and Engineering Company, Copenhagen.

PROJECTED NEW RAILWAY.—A railway is projected for South-Eastern Sealand and the island of Möen, with a bridge between Kallehave and Koster. It is proposed that the State should contribute £88,888 to the new line.

MADRID, 11TH MAY, 1891.

SPELTER WORKS IN SPAIN.—It has been known for a long time past that there are some blende mines in the centre of Spain. These mines are not rich enough to justify the expenditure of a large capital, nor are the ores sufficiently good to bear the expense of being carried to England or Belgium. Moreover, the combination of zinc producers in all countries lessens the chance of finding a sale for all the ores raised. A rich capitalist, who is well known as a lead miner, has lately been thinking of establishing spelter works in the coal district of Puertollano. It seems doubtful whether the project will be carried out, but the idea is good, as the ores are close at hand and coal is very cheap. Small coals for a lead foundry have recently been quoted at 4s. per ton delivered at the smelting works.

FIRE AT THE BILBAO SHIPBUILDING YARD.—A destructive fire broke out on the 1st. inst. at the shipbuilding yard of Messrs. Rivas-Palmer, now known as the Shipbuilding Yard Company of the Nervion, Ld. The fire seems to have been accidental, as no trace of incendiarism has been found after close investigation. There must, however, have been great neglect, as the fire ought to have been discovered earlier if a proper watch had been kept. The foundry, modelling shops, boiler-making sheds, and engineering machines have been destroyed, together with valuable work in progress. The works were insured in the Sun Fire Office, London, but the company will suffer a considerable loss, and much delay must take place before the company can utilise a great part of the capital invested. All work has been stopped for the present, and 2,000 workmen are out of employment. It is supposed that four months, at least, will be required before work can be resumed. In the unsettled state of the labour market a longer time may be necessary.

THE LABOUR QUESTION IN SPAIN.—The 1st of May passed without any serious disturbance. Although there are many agitators, who make a living by delivering speeches and inducing workmen to strike, workmen generally seem to think that their condition is not likely to be improved by these means. In consequence of this the movements in favour of strikes are too feeble and isolated to cause disturbances in any important trade. The workmen in the mining districts of Asturias and of Linares are well aware that nothing is to be gained and something may be lost by a stoppage of work. They did not even take a holiday on the 1st inst. Since that date some few strikes have taken place in different parts of the country, but a very small number of men took part in them. There was a small strike among the workmen of the rail-rolling mill of the Altos Company of Bilbao, where sixty-eight men have been turned out in consequence of their demand for increased wages.

COMMERCIAL BANK AT BILBAO.—Some of the principal industrial firms in Bilbao have started a new bank, with a capital of £200,000. Shares were subscribed for to an amount exceeding £1,500,000, and soon after the allotment were being sold at 35 per cent. premium.

ROME, 11TH MAY, 1891.

IMPORTS AND EXPORTS OF ORES.—The following tables show the amounts of the principal ores imported into and exported from Italy during the year 1889, and may be compared with the tables recently given, showing the production of ores and of the metallurgical and chemical works in that year:—

Imports.

Products.	Quantity (in Tons).	Imported from
Lead ores	2,421	Tunis, Spain, and France.
Coal	3,999,117	Great Britain, France, Austria, and Germany.
Petroleum	71,331	United States, Canada, and Russia.
Pig iron	191,082	Great Britain, Spain, and Austria.
Iron and steel	309,245	Great Britain, France, Belgium, Germany, and Austria.
Tinplates	8,475	Great Britain, Belgium, and Germany.
Copper and its alloys	6,340	Spain, Greece, and France.
Lead		
Alum and sulphate of alumina	1,487	Great Britain, France, and Austria.

Exports.

Products.	Quantity (in Tons).	Exported to
Iron ores	183,281	United States, Great Britain, Canada, and France.
Lead ores	7,439	France, Belgium, and Austria.
Copper ores	9,034	Great Britain and France.
Zinc ores	107,066	Belgium and Great Britain.
Sulphur	331,902	United States and Canada, France, Great Britain, and Germany.
Salt	110,145	Sweden, Norway, United States, Canada, and Brazil.
Asphalt	4,825	Germany, Russia, United States, and Canada.
Boric acid	1,943	Great Britain, United States, and Canada.
Graphite	1,376	Great Britain, France, and Belgium.
Mercury	394	Great Britain and Germany.

NEW YORK, 2ND MAY, 1891.

A LARGE DRAWBRIDGE.—A large steel drawbridge over the Arkansas River at Fort Smith, Ark., which has been constructed by the Union Bridge Company, of New York, was successfully tested recently by running a train of four Mogul locomotives over it. The bridge is 2,370ft. long and consists of twelve spans, of which one is a draw span 370ft. long. The structure will carry both highway and railway traffic.

A NEW POWDER.—A new high-power powder, made by the Du Pont Powder Works, has been tested recently with satisfactory results at Annapolis. It gave an initial velocity of 2,130ft. a second, with a pressure in the powder chamber of only 14·8 tons per square inch. The average powder now used gives only 2,080ft. per second with a chamber pressure of 15 tons.

A NEW DOCK.—A new dry dock is being constructed at Port Orchard, Wash. When completed the dock will be 600ft. long, 70ft. wide, and capable of taking a vessel of 30ft. draught.

DEEP WELL IN WEST VIRGINIA.—An 8in. well, which the Wheeling Improvement Company is sinking in search of oil or gas, has reached, after several months of boring, a depth of 4,100ft. Both oil and gas have been struck in paying quantities, and, in addition, several thick veins of coal, layers of gold quartz, and iron have been traversed. It is stated that after a depth of one mile has been reached the Government will undertake the work, and continue the drilling as far as it is possible to go A complete record of all the drilling will be kept, which it is proposed to place in the Geological Survey's exhibit at the World's Fair in Chicago, and afterwards to preserve at Washington.

NEW CHEMICAL COMPOUND FOR TREATING COAL.—A new chemical compound, named "Kem-Kom," has been introduced by the Standard Coal and Fuel Company, Equitable Building, Boston, for treating coal and other combustible substances. The effect upon coal treated by this compound is to increase the heat, economise time and fuel, consume the smoke, destroy the soot, and materially reduce the quantity of ashes. It is claimed that by treating coal with Kem-Kom, from 15 to 30 per cent. of the coal is saved. It is further claimed that by using this compound on bituminous coal from 80 to 90 per cent. of the smoke is consumed, and that all the obnoxious gases are destroyed.

PHILADELPHIA, 1ST MAY, 1891.

THE READING TERMINAL RAILROAD.—Messrs. Wilson Bros. & Co., the architects and engineers of the Reading Terminal Railroad in this city, have awarded the contracts for the masonry work, consisting of foundations, 1,900 cubic yards; piers and abutments, 20,000 cubic yards; retaining walls, 26,000 cubic yards, to Messrs. Hart & Son and Messrs. J. J. Ryan, of this city. The cost of this part of the work is estimated at £100,000.

COAL MINING.—The National Board of United Mine Workers of America has issued an address to the members of the Order, setting forth that, in consequence of the aid furnished to the striking cokers in the Connelsville region, the funds which would otherwise have been available for a general strike on the 1st inst. were not sufficient for that purpose. It has, therefore, resolved to defer the eight hours movement and to continue the struggle in the coke regions to the end. The situation in the coke regions is at present more harmonious than it has been for some weeks. Those returning to work are not molested, and the Frick and McClure Companies claim large increases in their forces. The mine owners continue to insist that they will not submit, and think that at the end of the week they will be able to produce all the coke for which there is a market. In Pittsburg a strike among the coal miners is still probable; the river miners will not strike, but the railroad miners demand an increase in wages. At Springfield, Illinois, the miners are paid 2s. 7d. per ton, but the mine owners claim that they cannot afford to pay over 2s. 1d., and if the reduction is made the men will strike. It is stated that in Iowa all the coal miners, numbering 12,000, will strike to-day, and will not resume until the eight hours day is granted.

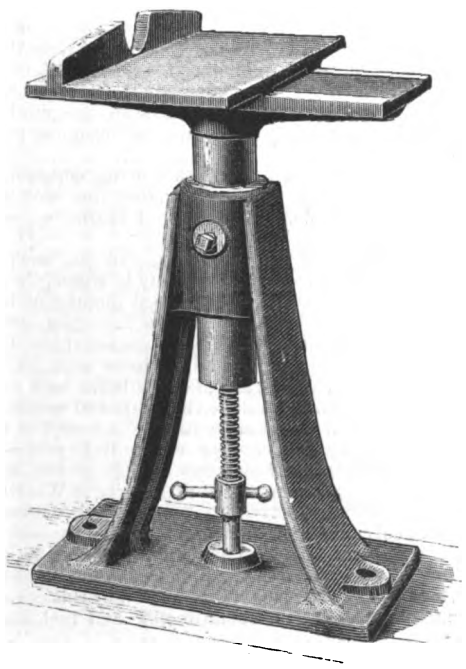
LARGE COMBINATION OF BREWERIES.—The Bergner & Engel Brewing Company, which is the largest in this city, is about to purchase the breweries of Messrs. Henry Mueller Brewery and of Messrs. Eble & Hirter, both in this city. In order to effect this purchase, the Bergner & Engel Company will increase its capital stock. The three breweries are valued at £1,000,000. This purchase will make the Bergner & Engel Brewery Company the third largest in the United States, the only larger ones being the Pabst Company, of Milwaukee, and the Annhauser-Bush Company, of St. Louis. The output of the Bergner & Engel Company for 1890 was 276,000 barrels, which is one-ninth of the whole output of the State of Pennsylvania. It is believed that the output of the combination for the present year will be about 400,000 barrels.

NAVAL MATTERS.—The cruiser "Newark," which has been in commission scarcely three months, has been ordered to undergo repairs, as there is a large leakage at the spar deck. It is not known whether this is caused by the strain to which she was recently subjected when docked, or whether the caulking was poorly done. Experiments are being made by the Navy Department with a new system of protection for gunners in exposed places on men-of-war. A peculiar kind of wire webbing, made up of interlocking steel spirals, which is exceedingly strong and flexible, has been prepared for that purpose.

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A NEW BORING STAND.

The illustration given below represents a very useful appliance which is being introduced by Messrs. J. Sagar & Co., Wood-working Machinists, Halifax. This stand can be used in connection with numerous machines



having horizontal rotary spindles for boring purposes, for example, in connection with circular saw benches, planing machines, &c. The stand can be moved up or down to locate the hole as required, and the top table, which carries the timber, can be moved towards the boring bit to the necessary depth.

THE IRON AND STEEL INSTITUTE.

(*Concluded from page* 448.)

The first paper read on Thursday, the 7th inst., was by Professor Roberts-Austen, C.B., F.R.S., on

Certain Pyrometric Measurements and the Method of Recording Them.

This paper contained a description of Le Chatelier's pyrometer and the mode of applying it. A thermo-electric couple, consisting of platinum and an alloy of platinum with 10 per cent. of rhodium, is connected to a dead beat galvanometer. Two rays of light—one from the galvanometer mirror, the other from a fixed mirror—are thrown on to a photographic plate traversed by clockwork. The latter ray is interrupted periodically by clockwork so as to give a dotted line, while the other ray traces a curve which is the record of the temperature. The apparatus is calibrated, and this is easily done up to the melting point of silver, but the melting points of gold and palladium are not so certain. The temperature is proportioned to the current and to the deflection, and the curve is remarkably uniform. Very trustworthy results are attained by the use of this apparatus, and its applications are manifold.

In the discussion which ensued, Sir Lowthian Bell stated that never before had he had a satisfactory pyrometer. That of Siemens took several minutes, but this gave almost instantaneous results. He had one at work for determining temperatures over 100 yards from the recording instrument. Sir Frederick Abel made a few remarks as to the sharpness of the indications. Mr. Stead wished to know how it was that the couple was not destroyed by the formation of an alloy when it was inserted in the molten metal.

M. Le Chatelier, who spoke in French, further described the method of observation and its use for determining specific heats.

Mr. Charles Wood asked if the instrument would not be affected by deposits covering the wires, or by their change from oxidation or deterioration. The apparatus did not appear to be portable.

Sir Lowthian Bell explained that deposits would take the same temperature as the region in which they were placed. He had not enough experience of the instrument to say anything about deterioration. At his works, they carried the apparatus about in a kind of Sedan chair if they wanted it portable.

Professor Roberts-Austen stated that alloying did not interfere in the case of gold or palladium, but the wires had to be protected in the case of a volatile metal like zinc. There was no oxidation of the wires, but a carbide of platinum may be formed if they are not protected.

The next paper was by M. F. Osmond, and was a

Note on the Micro-structure of Steel.

Professor Roberts-Austen gave a brief account of this short paper, which describes some micro-photographs of steel exhibited last year at the Mining Exhibition at the Crystal Palace.

The Secretary read the third paper, which was by Dr. E. J. Ball,

On the Changes in Iron Produced by Thermal Treatment.

This was a continuation of a previous paper by the author on the same subject, and was intended to rebut M. Osmond's contention that his results were due to the fused oxide. With this object, bars of iron containing 0·1 per cent. of carbon and upwards were heated to various temperatures in reducing atmospheres. The bars were hardened and tempered, and were tested for tensile strength and magnetic permeability. The aim of the author was to show that there is a critical point at about 1,300° to 1,400° C. The details of some of the experiments were reserved pending the completion of other and more complete researches.

The discussion was opened by Mr. Wrightson, who drew attention to the similarity between this critical point and the temperature at which cast iron becomes plastic. In his experiments, published some time ago, he determined the changes in the volume of cast iron during heating and melting by watching the behaviour of a cast-iron sphere in a bath of the molten metal. Just before it melted it was so plastic that a steel rod could be thrust through it.

Sir Lowthian Bell asked if occlusion of gases had anything to do with this point.

Professor Roberts-Austen thought that allotropy in connection with iron and steel was the most important question of the day. Osmond had found two critical points at about 855° C. and 650° C., one molecular, the other chemical. He felt very disinclined to accept Dr. Ball's third critical point, and thought that it would be referred to the higher point in Osmond's determinations.

Mr. Snelus mentioned the crystalline formation as having been much overlooked in all these researches. It might be produced by vibration or by heat. He would again refer to the effect of segregation of impurities as having a bearing on the subject.

Mr. Hadfield said that he had recently experimented with a very pure iron containing 99·8 per cent. of metallic iron, and only traces of sulphur, phosphorus, and carbon. The tensile strength of the original forged samples was 22½ tons per square inch, but by heating to various temperatures, and subsequently air-cooling or quenching, the strength was lowered even to 17·9 tons. He quoted the details of these and other experiments to show that iron did not always change to the hard or β-state.

Professor Roberts-Austen explained that iron does not remain in this β-state unless carbon is present. He thought that Mr. Hadfield's experiments supported his contention.

Sir Frederick Abel agreed with the last speaker. It would, he thought, be of great advantage if results of this nature were published as soon as possible to prevent other workers going on the same lines.

The fourth paper, which was also read by the Secretary, was by Mr. T. Turner, on

Economical Puddling and Puddling Cinder.

This paper dealt with the different methods of puddling employed, and the chemical considerations connected with them. A large number of references to various authorities were given, and the whole question was dealt with at considerable length. The weight of the material charged, and the amount of fettling and fuel used, was gone into, and the action of the various impurities, such as phosphorus, was discussed. The author put forward his paper as a contribution to the discussion of the subject, and not as an assertion of his views.

In the discussion which ensued, Mr. Snelus said that he thought the author did not appear to have seen his paper on the Danks furnace, published in 1872, in the Journal of the Institute. This paper elucidated many of the points which now appeared as difficulties, and went fully into the question of the increase of weight of the blooms over the iron charged. He had proved that phosphorus is removed from the metal when it is in the fluid state.

Mr. Stead endorsed Mr. Snelus' views, and stated that his views on the phosphorus question had been misrepresented. The whole question of puddling was very difficult to treat, as so much depended on the work put in to the metal, an amount which was greatly influenced by the expectations of the puddler in the way of half-crowns. There is also great loss by oxidation after the metal is balled. Sir Lowthian Bell's papers ought also to have been referred to.

Sir Lowthian Bell said the paper was intended to promote discussion, but the author was certainly mistaken on many points. Such a paper as this ought to be printed and distributed early, so as to give them time to look into it well.

Mr. Bauerman thought that the paper was of interest, but it contained much that was old.

Sir Frederick Abel agreed with Sir Lowthian Bell, especially on the question of early publication.

The next paper, on

A Graphic Method for Calculating Blast Furnace Charges or Burdens,

was by Mr. H. C. Jenkins, and was read by the Secretary. The method consists of an adaptation of the graphic method of Professor Balling to a scale which can be used something like a slide rule. This consists of two scales at right angles to one another; one scale is mounted so as to slide in a groove parallel to the other scale. From the point where the zeros of the two scales intersect lines are drawn at an angle with the fixed scale, the angles being such that their tangents are equal to the ratios between the weight of silica to weight of base in the respective silicates which it is desirable to produce in order to form the typical fusible slags ordinarily met with in blast furnace practice. With such a scale it is a very simple matter to at once read off either the excess of silica in any ore, or else the amount required to properly flux off the earthy bases present. Examples are given of the application to some ores, and a simpler form of the rule is also described.

As no discussion ensued, the President stated that a paper by Mr. J. D. Weeks, on "The Coke Industry of the United States," was withdrawn by the author so that he might add some important information. The next paper was by Mr. W. H. Jaques, of the Bethlehem Iron Company, Pennsylvania, and late of the United States Navy. It consisted largely of descriptions of tests and trials, and parts of it would be read by the Secretary.

Recent Progress in the Manufacture of War Material in the United States.

This paper, of over sixty pages, contains a valuable record of the tests employed, and a discussion of the whole question of war material, and especially of armour plates. It should be read in conjunction with a paper by Mr. Biles (see *Industries*, Vol. X., page 291), on "Some Recent Warship Designs for the American Navy," recently read before the Institution of Naval Architects. The paper contains so much material that it is impossible to treat it suitably in abstract.

No discussion ensued, but M. Jules Garnier showed a photograph of a recently tested nickel-steel armour plate and some specimens of ferro-nickel containing 60 per cent. of nickel. He also described the method of eliminating sulphur from nickel and its alloys by melting them with basic fluxes.

After the usual complimentary motions the proceedings terminated.

PETROLEUM AND NATURAL GAS.

At a recent meeting of the Leeds Association of Engineers, Professor J. Goodman gave a lecture on "Petroleum and Natural Gas." The lecturer explained that originally it was thought that petroleum must be only obtainable in the coal regions, but later investigation proved this to be wrong, and that it existed in the form of carbides of metals. The nearer the surface the heavier the oils, those on the surface being actually solid, as bitumen, asphalt, and jet, while lower down heavy and dark oils are found, and from the deep wells light oils are obtained. The use of petroleum is of very ancient date. The natives used petroleum in America long before the white man ever set foot there, collecting it with material somewhat similar to blankets. Of course, this was surface oil, and it was used for its medicinal properties, the benzine and light oils being got away by evaporation. About 1849 Keir, a chemist, obtained some of this oil, and sold it at two dollars per pint as an embrocation. Later the demand became greater than the supply, and Keir discovered that by distillation he could concentrate the qualities, and he now obtained several dollars for minute quantities of his wonderful white oils. About this time a company was formed for the purpose of obtaining petroleum, and a small sample was sent to a professor in Boston, who, though he thought it was not satisfactory, found from analysis that it contained such valuable constituents that he reported most favourably,

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with the result that much more money was raised, and more systematic work carried out. The same Professor, being caught in a shower of rain, stepped into a Boston chemist's for shelter. Here he noticed one of the bottles of Keir's oils, bearing a legend that it was obtained from the bowels of the earth. This led the Professor to study the matter, with the result that he pointed out with fair accuracy where oil would be "struck" by sinking wells. The first successful oil-well was made by a method similar to that adopted for sinking an artesian well. When it was sunk to a depth of between 400ft. and 500ft. the drill dropped some distance through a crevice in the strata. The men left work from the Saturday to Monday, but one of them visited the boring on the Sunday, and found oil just running over the top of the well. The news spread, and in a short time wells were sunk in all directions, the oil fever being equal to anything in the height of the gold fever. The price of petroleum has varied enormously from 5d. per barrel in 1861 to 48s. per barrel in 1864, the price in 1884 being 4s. per barrel. Up to the year 1884 the value of the yield of the oil-wells was £89,000,000. The lecturer here illustrated by lantern-slides the method adopted in sinking the wells. The ordinary time for sinking a well is fifteen to thirty days, boring being at the rate of 50ft. to 100ft. per day, the work being carried on day and night. The well is sunk first through a strata of loose drift, then through bed-rock, and then, at the depth of perhaps 2,000ft., the oil-bearing strata of sand or sandstone is reached. Frequently the oil will not flow from this, but a number of torpedoes are lowered down to the bottom of the well and exploded by dropping a weight from the top, and the oil is usually "struck" by this operation. The usual diameter of the well is 5½in., and the average cost is about £700 per well. About 10 per cent. are "dry holes," and will not yield oil. Natural gas is almost invariably given off from oil wells before petroleum, and it has been known to blow out the tool bars during sinking. It is said to have been found at a pressure of 900lb. per square inch, but this is open to question. It, however, is undoubtedly found at a pressure of 130lb. per square inch, and is used to drive ordinary steam engines, the gas being used like steam and the exhaust gas conveyed away and used for heating and lighting purposes. In Pittsburg, 20,000,000 cubic feet of natural gas per day is used for heating purposes, being equal to 1,100 tons of coal per day. An 8in. pipe will convey gas equal to a supply of 400 tons of coal per day. An interesting discussion followed the reading of the paper.

SHIPBUILDING NOTES.

On the 25th ult. Messrs. Short Brothers launched from their shipbuilding yard the steel screw steamer "Nerano," built for the Pinkney & Sons' Steamship Company, Limited, Sunderland. Her principal dimensions are:—Length, 320ft.; breadth, 42ft.; and depth, moulded, 28ft. The vessel is constructed of steel to the highest class in Lloyd's Registry under special survey as a spar-deck steamer with cellular double bottom for water ballast. Triple-expansion engines will be fitted by Messrs. W. Allan & Co., of Sunderland.

On the 25th ult. there was launched from the yard of the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, the s.s. "Bonny," the first of three passenger and cargo steamships now under construction there for the British and African Steam Navigation Company, Limited, Glasgow. The vessel is specially fitted up for the African trade, and is built of steel to class 100A at Lloyd's on the three-deck rule for steam vessels. Her dimensions are:—Length, 328ft.; breadth, 39ft. 3in.; and depth, moulded, 24ft. 8in. The water ballast is in a cellular double-bottom tank The propelling machinery will consist of a set of triple-expansion engines, with cylinders 61in., 38in., and 23in. in diameter, by 42in. stroke. She will have two single-ended boilers, with a combustion chamber to each furnace. The working pressure will be 160lb. per square inch. The "Bonny" will be fitted with a complete installation of electric light.

On the 27th ult. Messrs. Richard & Henry Green launched from their yard at Blackwall "The Duchess of Devonshire," a steel paddle steamer of 200 tons gross. The leading dimensions are:—Length, over all, 178ft. 6in.; breadth, moulded, 20ft.; depth, moulded, 5ft. 3in. The engines, of the compound diagonal type, have been constructed by Messrs. John Penn & Sons, of Greenwich, and are of 385 i.h.p, with cylinders of 45in. and 22½in., and a stroke of 3ft. The vessel is built to the order of the Devon Steamship Company, of Exmouth.

On the 27th ult. Mr. John Lindsay launched from his shipbuilding yard at St. Anthony's-on-Tyne a wood screw steamer, the "Mary and Alice," intended for the general coasting trade. She will carry about 150 tons deadweight on an easy draught of water, and ship and engines have been built under special survey of the Bureau Veritas for their highest class. She will be fitted with a compound engine and steel multitubular boiler by Messrs. Hedley & Boyd, of North Shields. The vessel has been built to the order of Mr. Lindsay and partners.

Notices of Meetings.

THIS WEEK.

Royal Institution.—Friday, May 15th, at 9 p.m. Lecture on "Crystallisation," by Professor G. D. Liveing, F.R.S. Saturday, May 16th, at 3 p.m. Lecture II., on "The Artificial Production of Cold," by Mr. H. G. Harris, M.Inst.C.E.

Junior Engineering Society.—Friday, May 15th, at 8 p.m. Paper to be read: "Electrical Storage Batteries," by Mr. H. B. Vorley.

NEXT WEEK.

Royal Meteorological Society.—Wednesday, May 20th, at 7 p.m. Papers to be read: "On the Vertical Circulation of the Atmosphere in Relation to the Formation of Storms," by Mr. W. H. Dines; "On Brocken Spectres in a London Fog," by Mr. A. W. Clayden; "An Account of the 'Leste,' or Hot Wind of Madeira," by Mr. H. C. Taylor; "An Experiment Showing the Effect of an Electrical Discharge upon the Condensation of Steam," by Mr. Shelford Bidwell, F.R.S.

Chemical Society.—Thursday, May 21st, at 8 p.m.

PRICES CURRENT, 13th May, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

PIG IRON.

Middlesbro' Warrants, No. 3	39/10½	Cash.
Scotch Warrants, m/n	49/10½	„
Hematite Warrants, m/n	50/-	„
Stocks in Stores. Scotch	509,312	Tons.
Middlesbro'	117,344	„
Hematite	151,979	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	63/-	.....	57/-	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	„ „
Langloan	62/-	.....	57/-	„ „
Summerlee	60/6	.....	55/6	„ „
Glengarnock	60/-	.....	52/-	„ „
G.M.B. ex store	50/3	.....	50/-	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.B. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£24	5	0	to	24	10	0
Copper: British Cakes and Ingots	56	0	0	„	56	10	0
„ Chili Bars, G.O.B.'s	51	0	0	„	51	5	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	51	0	0	„	51	5	0
„ Manufactured (strong)	63	10	0	„	64	0	0
Lead: Common Pig	13	7	6	„	13	10	0
„ English Sheet	14	2	6	„	14	5	0
Tin: Straits	91	2	6	„	91	10	0
„ Australian	.....				.....		
„ English Ingots	94	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues quiet, with slack demand. Since our last report Chili bars have been weak at declining rates, but a steadier feeling is noticeable to-day, values being £51 to £51 5s. cash, with quiet business. Manufactured, £63 10s. to £64, "strong," according to specification.

Tin has continued flat during the week, and values have declined. Foreign to-day is quoted £91 2s. 6d. to £91 10s. cash.

Lead: Inactive, with values slightly easier.

Spelter is firmer, in consequence of strikes of Belgian workmen, and prices are likely to be dearer.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5½	to	0 0 6½
„ „ Liquid	gal.	0 1 0	—	.....
„ Citric	lb.	0 1 8½	—	.....
„ Oxalic	„	0 0 3½	—	.....
„ Sulphuric	ton	1 15 0	—	.....
„ Tartaric	lb.	0 1 3½	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	23 10 0	—	.....
„ „ (White)	„	27 10 0	—	.....
„ Sulphate	„	11 0 0	—	11 2 6
„ Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	„	6 12 6	—	.....
Bisulphide of Carbon	„	13 0 0	—	.....
Borax	„	29 0 0	—	.....
Benzole (90 %)	gal.	0 4 3	—	.....
„ (50/90 %)	„	0 3 1	—	.....
Copper Sulphate	ton	15 10 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	21 0 0	—	.....
„ White Sugar	„	26 0 0	—	.....
„ Brown „	„	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	20 10 0	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10½	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 6	—	.....
„ White	„	0 3 6	—	.....
Salts: Epsom {Bags	ton	3 0 0	—	.....
{Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	10 10 0	—	.....
„ Recovered	„	7 0 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	10 17 6	—	.....
„ „ {„ 60%)	„	9 12 6	—	.....
„ „ {Cream 60%)	„	9 5 0	—	.....
„ Crystals	„	8 7 6	—	.....
„ Bicarbonate	„	7 0 0	—	.....
„ Hyposulphite	„	6 10 0	—	.....
Solvent Naphtha	gal.	0 1 7	—	.....
Tartar, Cream of	cwt.	5 7 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: All qualities of carbolic acid continue very dull, although the best time of the year is now at hand. Benzoles have now a better tone. In sulphate of ammonia there is little business passing, but carbonate and muriate of ammonia are in fair demand for export. The depression in sulphate of copper is continued. Acetates of lead are firmer, but nitrate of lead is very quiet. Carbonate of potash and caustic potash are firm. Yellow prussiate of potash in demand. Oxalic acid more freely offered.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	35 0 0
„ Ceylon	„	29 0 0
Cottonseed	„	22 5 0
Cod	„	24 0 0
Lard	„	84 10 0
Linseed	„	22 7 6
Olive, Spanish	„	45 0 0
Palm, Lagos	„	26 10 0
Rapeseed: English	„	31 10 0
Seal: Pale	„	26 0 0
„ Brown	„	.....
Sperm	„	50 0 0
Whale	„	22 0 0
Turpentine	per cwt.	1 10 3
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 5¾
Spirit		0 0 7¾

In our description last week of the duplex-compound locomotive for the St. Gothard Railway, we omitted to mention that the locomotive had been built from the designs of M. A. Mallet, of Paris, and that it is one of a class known as Mallet's Compound Articulated System.

We have received from Messrs. W. F. Dennis & Co., 11, Billiter Street, London, E.C., a copy of the third edition of their "Useful Tables and Data for the Assistance of Consumers of Wire." The present edition of the tables, which can be obtained either on card or paper, contains several additions and improvements.

Boyd's Map of the Mineral Resources of South-West Virginia (1891 Edition).—This is a very useful pocket map, which has been prepared by Mr. C. R. Boyd, geologist, of Wytheville, Va., showing the mineral resources and railway facilities of South-West Virginia. Besides giving the geological deposits of the district in different colours, such as iron, lead, zinc, manganese, tin, gold, &c., the map, which is on a scale of six miles to the inch, also gives much information concerning the location of the leading industries, such as steel manufacture, zinc smelting, and tobacco factories.

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HOME INDUSTRIES.

LONDON, 14th May, 1891.

THE MONEY MARKET.—Money rates have been gradually growing harder with the growth of uneasiness regarding the European outlook. Gold is beginning to be attracted to this country by the advance in the Bank Rate and in the prices paid by the Bank of England for foreign gold coins. The foreign exchanges are going steadily in our favour, but notwithstanding this fact monetary prospects are very cloudy. For the moment the internal demands for currency reduce the Bank Reserve to a very low point, but the fear is that, even when this temporary pressure is over, money will still remain tight and grow more so. This week some stringency was apparent at the settlement on the Stock Exchange, heavy sums which have hitherto been at its disposal for the purpose of carrying stocks having been withdrawn by a large house which is preparing for demands from abroad. This has contributed to depress quotations, though no fresh influence was needed in that direction. The continuation of an uneasy feeling in Paris, as the result of the monetary crisis at Lisbon, reflects adversely on the London market, and as New York fails to throw off the influence of the steady gold shipments, the week has been one of descending prices and unrelieved gloom. Of course foreign securities have suffered most, including Rio Tinto copper shares, but it has been impossible to find any security which has not been affected.

INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.—The following list of special subjects is to be considered at the seventh International Congress of Hygiene and Demography (Section VI., Architecture in Relation to Hygiene), which will be held in London from the 10th to the 17th of August next:—1, Laying out and extension of towns, including the control of the construction of buildings and the reservation of open spaces; 2, Planning and construction of dwelling-houses, especially common lodging-houses, workmen's dwellings, and residential flats; 3, Hospitals for infectious diseases; 4, Construction and arrangements of asylums; 5, Sanitation of theatres and public halls. The meetings of the above Section will be held in Burlington House, Piccadilly, London, on the 11th, 12th, 13th, and 14th of August. Abstracts of all papers to oe read in the Section must be furnished to Mr. Ernest Turner, honorary secretary, 246, Regent Street, W., not later than the 15th of June, and the full text of the papers before the 30th of June. Abstracts of papers should not exceed 500 words, and should be type-written, to ensure accuracy in printing and translation. Papers and abstracts may be written, and speeches in the meetings delivered, in French, German, and English, No paper will be received which has been previously published or communicated to any other society. A limit of fifteen minutes will be fixed for a paper or speech introducing a subject, and a limit of ten minutes for all subsequent speeches or papers on the same subject. All communications relative to this Section should be addressed to Mr. Ernest Turner, 246, Regent Street, W. In matters relating to the general business of the Congress letters should be addressed to the Honorary Secretary-General, 20, Hanover Square, W.

ROYAL AGRICULTURAL SOCIETY.—At the Warwick meeting of the above Society, to be held next year, prizes for ploughs, divided in the following classes, will be offered:—Class 1, for the best single furrow plough for light land; 2, for the best single furrow plough for strong land; 3, for the single furrow plough best adapted for a press drill and broadcast sowing; 4, for the best two-furrow plough; 5, for the best three-furrow plough; 6, for the best digging plough for light land; 7, for the best digging plough for heavy land; and 8, for the best one-way plough. Entries for the competition are to be made to the Royal Agricultural Society, 12, Hanover Square, London, before the 25th July next.

THE ROYAL INSTITUTION.—Under the title "The Artificial Production of Cold," Mr. H. Graham Harris, M.Inst.C.E., commenced, on the 9th inst., a course of three lectures on the principles and various kinds of machines for ice-making and the production and maintenance of low atmospheric temperatures. He wished first to make clear the physical principles which were the basis of all the different kinds of machines for producing, and appliances for maintaining, cold. "Production of cold" was another term for "abstraction of heat," but it was a popular one, and, though not scientifically accurate, he had used it. The transference of heat from one body to another was, in some form or other, under our daily notice. To produce cold we had to take advantage of some way of transferring heat from where we did not want it. It would be requisite to speak of heat in measureable quantities, and the standard commonly used was the British unit of heat. After alluding to Joule's well-known mechanical theory of heat, the lecturer mentioned the different methods for producing heat, and dwelling on the production of it by compression, especially in gases, showed that the converse—*i.e.*, expansion—was accompanied by loss of heat—that was, the production of cold. Though heat could be removed by conduction, it was mainly on the principle that heat was lost in expansion that most cooling appliances were based.

BUSINESS ANNOUNCEMENT.—Messrs. Cole, Marchent, & Morley, engineers, of Bradford, have appointed Mr. Wilson Hartnell, of 11, Queen Victoria Street, London, E.C., as their agent for all classes of general engineering and oil mill machinery. Messrs. James Lee & Sons, leather belting manufacturers, of Hipperholme, near Halifax, have also appointed Mr. Hartnell as their agent for their best leather belting and Lee's patent link belting.

MANCHESTER, 14th May, 1891.

MANCHESTER ASSOCIATION OF ENGINEERS.—A party of members of the above Association paid a visit, on the 11th inst., to the mill belonging to the Astley Spinning Company, Ld., at Dukinfield, for the purpose of inspecting the large engines made by Messrs. Goodfellow & Matthews, which have been fully described in these columns (see *Industries*, Vol. II., page 396). The makers have recently applied a compensating arrangement to the governors, by which the position of the tripping pieces applied to the high-pressure cylinder are varied according to the velocity of the governor, and the running of the engine is thus steadied. The condition of the driving ropes was closely scrutinised in view of a discussion which took place on this subject about two years ago at one of the meetings of the Association. These ropes are running about 5,800ft. per minute, and have not been replaced during the six years the mill has been working. The interior arrangements of the mill are very good, a noticeable feature being in the card room, where the machines are arranged so that the sliver cans have not to be carried long distances from the carding engines to the drawing and slubbing machines. The labour involved is thus reduced to a minimum. The mules, containing 1,052 spindles each, run across the room, and a pair of them, or 2,100 spindles, are attended by a spinner and two piecers. Each of the floors above the first is 10in. wider than the one below, owing to the difference in the thickness of the walls.

THE ENGINEERING TRADES.—Engineers are, generally speaking, still well supplied with work. There is not much falling off in the supply of orders, although in the Continental markets there is hardly so much activity. An experiment is being conducted at a mill in the town with forced draught applied to an ordinary Lancashire boiler, and the results, although not yet finally formulated, have on the whole been satisfactory. Machine tool makers continue to be very busy, and are receiving plenty of orders. There is little of special interest to report in this department, as makers are actively engaged on their standard patterns. Cotton machinists are very busy, the amount of work in this department showing no signs of diminution. A number of new engineering works are being erected in the vicinity of the Manchester docks of the Ship Canal, the Unbreakable Pulley Company having nearly completed a large shop for the manufacture of pulleys and shafting. Another industry which is assuming large proportions is the manufacture of miners' safety lamps, two concerns in this district being now at work manufacturing special descriptions of lamps which contain improvements on the older types.

THE LINEN AND JUTE TRADES.—As Whitsuntide approaches there has been an increased demand from retailers, but, with regard to linens, the position of manufacturers has been rendered less satisfactory on account of the diminution in the demand from the United States, the Spanish West Indies, Australia, and other important outlets abroad. A remarkable fact in connection with the shipping business is that while the Plate district is not absorbing the usual quantity of linens, in exports of which there has been a serious decline, purchases of the cheaper jute fabrics have increased, which shows that owing to financial depression the one material is wherever possible being substituted for the other. There is an increase of business with Brazil, both Yorkshire and Irish firms having received better orders from local exporters. Prices keep steady. Manufacturers are placed in a somewhat awkward position by the continued firmness of yarns. Brown cloth has not advanced proportionately with the increased prices demanded by spinners, and finished goods have failed to keep pace with the upward movement in unbleached linens. Buyers here have these facts pointed out frequently, but they are slow to respond to the wishes of sellers.

IMPROVED DUST GRID.—We have recently inspected the action of a new application to the dust trunks used in connection with cotton openers, which is likely to be of great service where dirty cotton is used for spinning, such as Indian and American. The dust trunks are ⌂ shaped as ordinarily made, and a series of chambers are formed on the flat portion of the tube. Placed in a zig-zag direction around the curved portion of the tube castings are fixed by riveting. The castings are formed with downwardly projecting teeth, which catch the cotton as it is drawn along the tube by the air current and tend to open and cleanse it. As a space is left between the fixings the cotton passes through the gap, and about a foot further on another casting is fixed so as to catch the cotton which goes through the gap untouched. The effect is that the cotton receives a check periodically as it travels along the tube, and is opened considerably, much more dirt being shaken out. An examination of the droppings removed from the tubes shows that a much larger proportion of dirt and a less amount of fibre is eliminated than is the case with dust trunks of the usual construction.

GLASGOW, 14th May, 1891.

PIG IRON.—The sharp rise in the prices of pig iron is due to the extensive "bear" operations having left the operators in possession of a heavily oversold account. There is no change in the condition of trade which justifies this sudden rise. When the speculators in the South begin to "unload" the market will probably drop as sharply as it has risen. There are now 60 furnaces in blast against four at the beginning of the year, and against 87 at this date last year.

SHIPBUILDING.—At the present time there is no vessel on the stocks at Fairfield, and in the other yards, as a rule, there are no important orders. The "Napier of Magdala," which has been built by Messrs. Hawthorne, of Leith, for the use of the Clyde Submarine Mining Volunteers, was tried in the Forth on the 9th inst., prior to being sent round to the Clyde *vid* the Caledonian Canal. The establishment at Fort Matilda, where the "Napier of Magdala" will be stationed, is now very extensive. From this point a complete system of torpedo defences for the Clyde is controlled. The ramifications of the lines of defence extend down the firth for a considerable distance, and thoroughly command the passage between Fort Matilda and Roseneath shore. Messrs. Wm. Hamilton & Co., Port Glasgow, have contracted with Messrs. W. & J. Crawford, Greenock, to build a steel sailing ship of 2,000 tons register.

ENGINEERING.—Messrs. James Neilson & Son, Alma Boiler Works, Gallowgate, have just brought out a new boiler. The idea is originally American, and the first boilers constructed by the firm have been made to the order of an American firm. In general appearance the boiler is like the locomotive type. Before passing through a system of sixty-eight tubes 3¼in. in diameter, the heated gases pass through two tubes 15in. in diameter and one tube 4¼in. in diameter.

ELECTRIC PHOSPHORUS.—Dr. Readman at the May meeting of the Society of Chemical Industry gave a description of the new works and plant which have been erected at Wolverhampton for the manufacture of phosphorus by the Readman-Parker patents. The process consists in decomposing the mixture of phosphoric acid, or acid phosphates and carbon, by the heat of the electric arc imbedded in the mass, and the inventors urge that the local application of heat in this form is more economical than the heating of large retorts containing the mixture as in the ordinary process. Further details and results of the new process are promised at an early date.

LAUNCH OF THE "LORD OF THE ISLES."—The well-known steamer "Lord of the Isles," which sailed in the summer season between Wemyss Bay and Inverary, having been sold to the Victoria Steamboat Association for service on the Thames, the "Lord of the Isles" Company determined to build another steamer of similar character for service on the same route. This vessel has been built by Messrs. D. & W. Henderson & Co., Meadowside, Partick, and was launched on the 25th ult. The new "Lord of the Isles" is a paddle steamer of 450 tons, is 255ft. in length, 25ft. 6in. in breadth, and 8ft. 6in. in depth. The speed is expected to exceed that of the older vessel, which, at the speed of 20 miles per hour, accomplished the journey to Inverary and back—a distance of nearly 230 miles—easily in a day. The engines will be supplied by the builders, and will be of design similar to those constructed for the original "Lord of the Isles."

CLYDE FIRMS AND THE PORT OF LA PLATA.—It is announced that a syndicate has been formed to take over and work on lease the port of La Plata from the Provincial Government of Buenos Ayres. If any arrangement can be made which will place the trade of the port and the finances of the Government on a more satisfactory basis than is the case at present, very considerable advantage will accrue to many Clyde firms, who have large and, at present, unremunerative interests in the Argentine.

(*From our own Correspondents.*)

LIVERPOOL, 13th May, 1891.

THE LIVERPOOL ENGINEERING SOCIETY.—At a meeting of this Society on the 6th inst., the discussion on the paper of Mr. George Farren, on the "Denudations at Aber-Menai," was resumed. Some remarks were made upon the geological formation of the bank which forms a natural breakwater at the entrance to the Menai Straits, and the general opinion of the members appeared to be that to protect the bank from further destruction it should be protected, not by a large vertical monolithic breakwater, but by protected slopes, which would tend to break the waves. The excursions during the coming summer were arranged, and it was decided to visit the works of the Manchester new waterworks, different places of interest in Birmingham, the Dore and Chinley Railway now in course of construction, and the North Wales Slate Quarries.

THE LIVERPOOL UNIVERSITY COLLEGE.—At a meeting of the governors of the University College here, it was announced that several munificent gifts had recently been made to the college, amongst which we may mention £10,000 by J. T. Brunner, M.P., to endow a Chair of Economic Science, and £1,000 by Mr. Ludwig Mond, for the encouragement of the higher studies in chemistry.

INCRUSTATION IN BOILERS.—Messrs. Macdonald & Co., of 3, Wapping, Liverpool, are introducing a new composition, called the Bretel Vegetable Boiler Fluid, to prevent incrustation and corrosion in boilers. Numerous advantages are claimed for this composition, which, judging from the number of testimonials we have seen, would appear to be generally realised.

ELECTRIC LIGHTING AT SOUTHPORT.—The new theatre in course of erection at Southport is to be lighted by electricity. The generating plant in connection with the

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Winter Gardens will supply the current. About 220 lamps from 8 to 300 c.p. will be installed, and fittings of artistic design used throughout. Arrangements for obtaining various degrees of illumination for stage purposes will be made to be under the control of the light man. The contract has been placed with the Manchester Edison-Swan Company.

SHEFFIELD, 13th May, 1891.

The Iron and Steel Market.—There is a slightly firmer tone in the iron market this week. The price of hematites has risen about 1s. to 2s. per ton, and has been followed to a certain extent by ordinary merchant and foundry pig iron, which have lately been sold at less than cost price. Few new orders are reported in the steel casting trades beyond the usual amount of orders for locomotives and small material. This depression in the cast steel branches may be accounted for by the fact that nearly all the contracts for material required for engineering purposes under the naval programme have been awarded. There is still a very fair demand for railway material for the home railways. The Glasgow and South-Western are inviting tenders for five hundred sets of wheels and axles; the Midland continue to give out orders which are divided amongst the Lancashire, Yorkshire, and Staffordshire makers. Colonial orders are generally rather scarce, but some have been received from India. Prices are now as follow: Locomotive tyres, £13; waggon tyres, £10 to £12; Siemens or Bessemer axles, £10 to £11; springs, guaranteed by makers, £10. Billets and small bars vary in price, according to quality, from £5 to £10. Tool steel of the best qualities still maintains a good price, from £80 to £100 per ton.

Coal and Coke.—The demand for fuel of all kinds is brisk, and colliers are working full time. No reduction of price is contemplated, and the miners say they will resist any reduction in wages. Coke is steady, and the best qualities fully maintain their value.

Society of Chemical Industry.—A meeting of members of the Society of Chemical Industry and other influential persons was recently held in Leeds, in order to consider the formation of a Yorkshire Section of the Society. It was stated that the Society was founded in 1881, and at the present time numbers 2,500 members, being the largest Chemical Society but one in the world. Sections of the Society were already formed at many of the most important centres of chemical industry. Professor Smithells, in moving a resolution in favour of the object of the meeting, said that there were already about 125 members of the Society resident in Yorkshire. The resolution was carried unanimously, and Sir James Kitson, Bart., was elected Chairman of the Section. Information as to membership may be obtained from Mr. C. H. Bothamley, at the Yorkshire College.

Miners' Eyesight and Safety Lamps.—A very interesting correspondence is taking place between Mr. Court, the miners' surgeon connected with the Staveley works, and Dr. Simon Snell, ophthalmic surgeon to the Sheffield Infirmary, regarding the prevalence of "nystagmus" among miners where safety lamps are used. Dr. Snell is to publish his observations in book form shortly.

NORTH STAFFORDSHIRE, 13th May, 1891.

The Iron Trade.—At the adjourned meeting of the local blast furnace proprietors and their employés, held on the 8th inst., a reduction in wages of 7½ per cent. was amicably arranged. At present the firmer prices of Scotch warrants have exercised no influence on sales here, and where makers have advanced their prices buyers have declined to purchase. The demand for puddle mine and furnace mine has fallen off, and prices are now 13s. per ton for the former and 9s. per ton for the latter.

The Pottery Trade.—The arbitration to settle the wages dispute in this trade commenced yesterday at Stoke-on-Trent. The tribunal consists of three arbitrators—Mr. H. T. Hinckes, M.P., appointed by the Arbitration Board; Mr. B Stuart, of Ironbridge, appointed by the Manufacturers' Association; and Mr. J. Mawdesley, of Manchester, chosen by the operatives. Mr. W. Owen, operatives' secretary, conducts their case, and Mr. H. T. Buddam, barrister-at-law, the masters' case.

CARDIFF, 13th May, 1891.

Iron and Steel.—The firmer tone in the hematite iron trade continues. The decrease in the output has undoubtedly been a factor in improving the position of the market, and ironmasters show no disposition to relight the idle furnaces. Spanish ore continues high in price on account of a restricted supply during the year, together with the fact that arrivals of tonnage at Bilbao and other loading ports have been plentiful. Several large contracts for Rubio ore have been concluded for delivery in the Bristol Channel, at prices ranging from 13s. 6d. to 13s. 9d. c.i.f. Cardiff and Newport for 50 per cent. iron. There have been a few inquiries for steel rails, but no orders of importance have been given out. The demand for steel tinplate bars (Bessemer) has fallen off considerably on account of the proposed stop week in the tinplate trade. Quotations are nominally £5 12s. 6d., but this figure is difficult to obtain.

Coal and Coke.—Exports of steam coal continue heavy, and notwithstanding the usual monthly holiday last week the shipments reach a total of 264,706 tons. Inquiries for forward delivery are not so numerous, but on account of the low outward freights an extra quantity is being shipped to the depôts in the Mediterranean and East. Steam coal sells at—1st quality, 14s. 6d. to 14s. 9d.; 2nd, 13s. 9d. to 14s. 3d.; 3rd, 13s. to 13s. 6d.; and 4th, 12s. 6d. to 12s. 9d.

Terrible Explosion at Newport.—A terrible explosion occurred at Newport on the 11th inst. on the steamship "Tancarville," which resulted in the loss of five lives and injuries to a dozen men. This vessel, which was an iron ship with a tonnage of 1,541 tons, and was engaged in carrying crude petroleum in tanks between Philadelphia and Havre, was undergoing repairs in Messrs. Mordey, Carney, & Co.'s dry dockyard. The explosion occurred at 10 a.m. in the fore part of the vessel, where eight men out of seventy employed in repairing the vessel were riveting in a tank. Five of these men were killed, and the iron decks, bulwarks, and hatchways were torn asunder, and parts of them hurled to a distance of 200 yards. It has been suggested that the explosion was caused through the dangerous gases arising from the oil becoming ignited by the heated rivets, which were being fixed by the men in the tank. The damage done to the ship has been estimated at £8,000 to £10,000.

BARROW-IN-FURNESS, 13th May, 1891.

Hematite.—There is a steadier and more active tone in the hematite pig iron trade this week, and more business is being done all round. Not only are makers selling more largely, but stocks of hematite warrants have again been reduced to the extent of 6,576 tons, leaving still in the stores 155,609 tons. This is a large amount, but compares favourably with 380,000 tons in stock in the beginning of 1890. The sales during the week have been at the average of 50s. net cash for warrant iron, and makers have been disposing of Bessemer mixed numbers at 51s. 6d. net f.o.b. Thirty-nine furnaces are still in blast, and thirty-eight are standing idle.—A boring is about to be made in a new district near Gosforth, to the south of Egremont. Some borings were made in this district several years ago, but no ore was then discovered.

Steel.—Business in the steel trade is fairly good in the Bessemer department, but no new orders of importance are being received for Siemens-Martins qualities of steel. Heavy rails are quoted at £4 11s. 6d., and light rails at £5 10s., with £6 10s. for colliery sections. Further developments are being made in the Siemens-Martins department, and new rolling mills and powerful engines are being put down for this purpose. In steel castings and hoops a brisk trade is being done, but orders for blooms, billets, slabs, and tinplate bars are quiet.—During the week ending on the 9th inst. the largest output of Bessemer steel since the Moss Bay Works were first started has been recorded. These works made a total of 325 blows, or a total of 2,764 tons of ingots, this being done in one pit only. The steel rail mill, notwithstanding a half-day's stoppage, rolled 2,530 tons of rails during the week.

Iron Ore.—Orders for iron ore are comparatively few, and stocks of ore have accumulated at the mines. Prices are easier, at 10s. per ton net at mines for ordinary qualities.

MIDDLESBROUGH, 13th May, 1891.

Pig Iron.—Little business was done at the weekly iron market yesterday, though prices were well maintained. For prompt f.o.b. deliveries of No. 3 G.M.B. Cleveland pig 39s. 6d. per ton was quoted both by makers and merchants, but buyers would not offer more than 39s. 3d., and for summer delivery 39s. Makers are not pressing sales, because, with extra demands from the Continent and the large deliveries to Scotland, they are reducing their stocks at a good rate. Middlesbrough warrants are 39s. 9d. cash buyers, and 40s. cash sellers. The stock in Connal's store on the 11th inst. was 116,965 tons, a decrease this month of 1,334 tons. No. 4 foundry and No. 4 forge pigs are going in large quantities to Scotland, and the prices are firm. The former is quoted at from 38s. 3d. to 38s. 6d., and the latter at from 37s. 9d. to 38s. per ton. Local hematite is obtainable at from 50s. to 51s. per ton for mixed numbers.

Manufactured Iron and Steel.—The finished iron and steel trades are very dull, and in some cases prices are weaker. Iron ship angles are £5 7s. 6d; iron bars, £5 10s. to £5 15s.; iron ship plates, £5 10s. to £5 12s. 6d; steel ship plates, £6; steel angles, £5 15s., all less 2½ per cent. for cash on the 10th of month following delivery. Heavy steel rails are £4 10s. net at works.

Shipbuilding.—A new shipyard is to be established on the Port Clarence side of the Tees by the Haverton Hill Shipbuilding Company, which has been formed with a capital of £100,000. About ten acres of land have been acquired in a bend of the river. The land is at the proper level for launching vessels, and the ground is firm enough to carry heavy weights. It is within convenient distance of the various ironworks. The frontage allows of stocks being laid down for the simultaneous construction of from six to eight vessels of from 4,000 to 5,000 tons burthen. There will also be a repairing department. With the exception of the Tees Conservancy Dry Dock, and the slipway at the Cleveland Dockyard, there are now few facilities for repairs of the largest type of vessels in the Tees, and most of the repairing work goes to the Tyne. This department will probably be the first to be put into active operation, and there will soon be an addition of some 2,000 men to the working population.

SUNDERLAND, 13th May, 1891.

Shipbuilding and Engineering.—Orders for new vessels are scarce. Messrs. John Blumer & Co., North Docks, have, however, secured another contract for a sailing ship. The question of overtime continues to be discussed, but no definite agreement has as yet been arrived at.

Shipping.—The freight market has, on the whole, become more depressed. Outward rates are unremunerative, and at the same time terms for loading are very difficult to arrange. It is a matter of surprise that steamship owners do not send their vessels in ballast to the homeward loading ports, seeing how great is the detention and how small the outward freights. Prompt homeward business is fairly satisfactory, but for forward fixtures lower rates are offered. The local coal shipments continue to be more satisfactory, 71,970 tons being shipped last week, and 81,970 tons in the preceding week. The general import and export trade does not, however, improve.

Marine Engineers' Union.—The general council of this Union met here on the 8th and 9th inst. The revision of the constitution of the Union was the principal subject of discussion, and this work is to be continued at an adjourned meeting to be held here. It is stated that fully one-half of the membership of the Union consists of marine engineers located in the North-East Coast district.

NEWCASTLE, 13th May, 1891.

The Coal Trade.—The activity in the local coal trade has been further stimulated this week by the anxiety of shippers to get cargoes despatched before the pits are stopped for the Whitsuntide holidays. Work at the shipping staiths is consequently very busy, and more steamers are awaiting "turns" than are likely to receive cargoes this week. The demand for household coals has, as is usual at this season, fallen off. The general briskness of the industry is largely attributable to the greatly increased foreign demand for steam and gas coals. The shipments of coal and coke at Tyne Dock during the week ending the 9th inst. amounted to 118,033 tons, being a decrease as compared with the shipments for the corresponding week last year of 2,905 tons.

New Company.—The prospectus of Messrs. W. B Reid & Co., Ld., of the Leases Brewery, Newcastle, has been issued, the share capital being £150,000, in 15,000 ordinary shares of £10 each, and the mortgage debenture capital £150,000, in five per cent. mortgage debentures. Of the mortgage debentures £120,000 are issued to the public, the remaining £30,000 being retained by the vendor. Applications for these debentures will be received up to the 16th inst. The ordinary shares are not issued to the public.

Shipping.—Since the beginning of the month a few of the steamers that had been laid up since January or February have again found employment, and it is probable that others will be withdrawn from the mooring berths shortly. Although there does not appear to be, as yet, any very marked increase in the shipping business, the outlook has improved, and shipowners are more hopeful of getting steadier employment for their vessels and more remunerative rates of freight. Messrs. Newman & Dale, of London and Newcastle, have sold to an Austrian firm their steamer "Apex," and have purchased from a firm of Spanish owners a comparatively new vessel of large size. Messrs. Palmer's Iron and Shipbuilding Company launched, on the 9th inst., a splendid vessel named the "Francesco Crispi," ordered by the recently formed Italo-Britanico Steam Navigation Company, Ld., and Messrs. Swan & Hunter launched, on the 11th inst., a 7,000-ton cargo boat named the "Cundall," ordered by Mr. C. Furness, of West Hartlepool.

The Timber Trade.—Most of the sawmills are busy just now, as there is a large amount of building being done. The imports of pit props and sawn timber are daily becoming more numerous, and an appearance of greater animation is consequently presented at the docks.

Engineering.—The Tyne Pontoon and Dry Dock Company, Ld., of Wallsend, have given out the order for the construction of another and larger pontoon than the one which they have hitherto possessed. The pontoon in question will be 300ft. in length and 70ft. broad, and will be capable of lifting vessels up to 320ft. or 330ft. long. The pumping apparatus is to be of a very powerful nature, and will consist of four 15in. centrifugal pumps, each driven by a separate engine, and the whole supplied with steam by two large multitubular boilers. The order for this pontoon has been secured by Messrs. C. S. Swan & Hunter.

North-East Coast Institution of Engineers and Shipbuilders.—At a meeting of this Institution, held on the 11th inst., under the presidency of Mr. Wigham Richardson, Mr. W. Hök replied to the discussion on his paper, "The Unsinkability of Cargo-carrying Vessels." Mr. Harry Gray also replied to his paper on "Water Gauge Fittings for Steam Boilers." The Chairman, referring to Mr. J. Petree's paper on "The Basis of Ships' Scantlings," said that a point had been raised with respect to the disadvantages of English shipowners as compared with foreign owners. He pointed out the injustice of foreign owners being allowed to set the load-line at defiance. Though a ship might be built in England and placed under load-line rule, it was allowed either in foreign waters or English waters to carry more weight than an English vessel.

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THE ACKROYD-WILLOUGHBY SMOKE PREVENTER AND FUEL ECONOMISER.

(*For description see page* 460.)

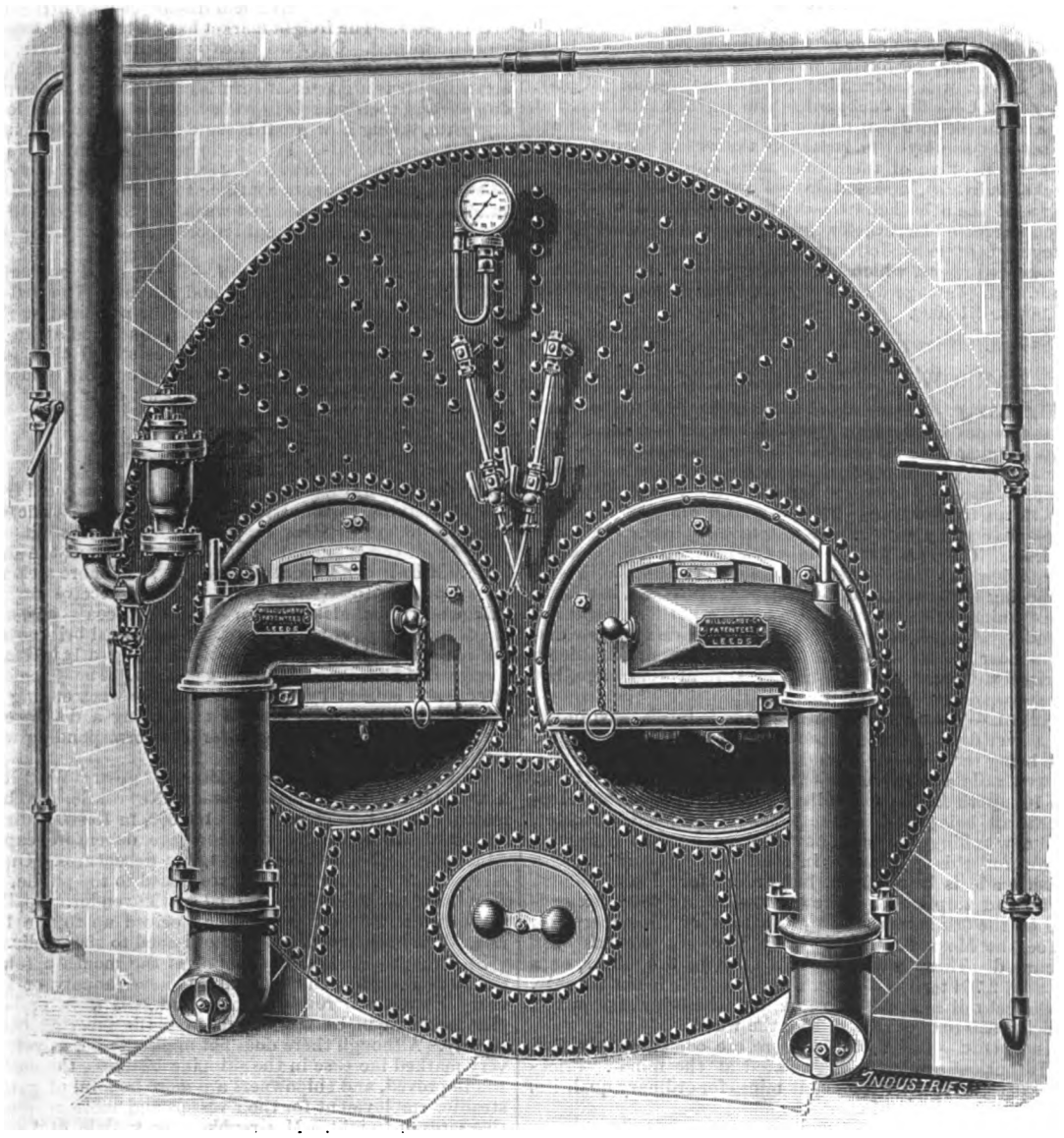


FIG. 3.—FRONT VIEW OF BOILER AND APPARATUS.

CLYDE SHIPBUILDING FOR APRIL.

THE paucity of inquiries for new vessels is becoming a matter of concern in certain districts, and has given rise to the opinion that over-building is taking place. It is, doubtless, that builders are at present experiencing a greater difficulty in securing orders than they were, and if anything like a moderate briskness is to prevail throughout the remainder of the year new work should be immediately forthcoming, the more especially as the Government work now in hand is being rapidly advanced, and the large vessels under construction for established lines are nearing completion. In the Govan district especially matters wear a very sombre aspect. During each month since January the output of tonnage largely exceeded the amount of new work booked, and for the month under consideration the former exceeded the latter by at least 24,000 tons. Of the new orders Messrs. Russell & Co., of Port Glasgow and Greenock, secured the lion's share, they having received instructions to build two sailing ships, one of 2,000 tons, for a Liverpool house, and the other, of 1,660 tons, for a London firm. Messrs. Blackwood & Gordon also received an order for a steel twin-screw steamer of 1,000 tons for the Ceylon trade of a London firm.

The output of 32,177 tons was made up of 20 steamers and 11 sailing vessels. To this aggregate Messrs. R. Napier & Sons, Govan, contributed 8,420 tons, while Messrs. Russell & Co. launched six vessels with a total tonnage of 6,680 tons. The most important vessel put into the water was the magnificent twin-screw steamer "Ophir," of 6,700 tons and 11,000 h.p., constructed by Messrs. Robert Napier & Sons for the Orient Steam Navigation Company. Her principal dimensions are:—Length, 482ft.; breadth, 53ft.; and depth, 37ft. She has been built to meet the Admiralty requirements for armed cruisers, and is specially designed for the mail service between London and Australia. She is fitted with two sets of triple-expansion engines to develop sufficient power for a speed of 18 knots. Great interest is being centred in this vessel, as she in many respects resembles the "Scot," now nearing completion at the Leven shipyard of Messrs. William Denny & Bros., Dumbarton. Among other vessels launched there were six saloon paddle-steamers, principal among which were the "St. Tudno," built by the Fairfield Shipbuilding and Engineering Company, Govan, for passenger service between Liverpool, Llandudno, and Beaumaris and the "Lord of the Isles," built by Messrs. D. & W. Henderson & Co., Partick, for service between Glasgow and Inverary. The former vessel is of 900 tons gross register, and measures 277ft. in length by 32ft. 6in. in breadth, while the latter is 22ft. shorter, with a beam of 25ft. 6in.

The following are the particulars of the vessels launched:—

SINGLE-SCREW STEAMERS.

"Brio," steel, 1,850 tons, built by the Campbeltown Shipbuilding Company, and fitted with triple-expansion engines by Messrs. Kincaid & Co., Greenock, for Messrs. Fenwick & Reay, Newcastle-on-Tyne.

"Clan MacKinnon," steel, 2,450 tons, built and fitted with triple-expansion engines by Messrs. Alexander Stephen & Sons, Linthouse, to the order of Messrs. Cayzer, Irvine, & Co., for the Clan Line of steamers.

Hopper barge, steel, 300 tons, 250 h.p., built and engined by Messrs. William Simons & Co., Renfrew, to the order of the Preston Corporation.

"Madeira," steel, 330 tons, built by Messrs. Russell & Co., Port Glasgow, and fitted with triple-expansion engines by Messrs. Kincaid & Co., Greenock, to the order of the Amazon Steam Navigation Company.

"Mira," steel, 1,000 tons, 1,200 h.p., built and fitted with triple-expansion engines by Messrs. A. & J. Inglis, Pointhouse, to the order of the Bergenske Dampskibselsbab, of Bergen, Norway, for the Norwegian Coast touring service.

"Moth," iron, 150 tons, trawler, built by Messrs. Mackie & Thomson, Govan, and fitted with compound engines by Messrs. Muir & Houston, Kinning Park, for the North Sea fishing trade of the British Steam Trawling Company, Hull.

"Rattler," sister ship to the "Moth," by the same builders, for the same owners.

"Scott-Harley," steel, 450 tons, built and engined by Messrs. John Fullerton & Co., Paisley, for the general trade of Messrs. Scott, Harley, & Co., Cork.

"Suzanne et Marie," steel, 1,600 tons, 2,000 tons deadweight capacity, 1,200 h.p., built and fitted with triple-expansion engines by Messrs. Lobnitz & Co., Renfrew, for the French and foreign trade of Messrs. Wirms, Josse, & Co., Havre.

TWIN-SCREW STEAMERS.

"Chilian," steel, 1,720 tons, built and fitted with triple-expansion engines by Messrs. Robert Napier & Sons, Govan, for the Pacific coasting trade of the Compania Sud Americana de Vapores, Valparaiso.

"Ophir," steel, 6,700 tons, 11,000 h.p., built and fitted with triple-expansion engines by Messrs. Robert Napier & Sons, to the order of the Orient Steam Navigation Company, for their Australian service.

PADDLE STEAMERS.

"Fairy Queen," steel, 300 tons, built by Messrs. T. B. Seath & Co Rutherglen, and fitted with compound surface-condensing engines by Messrs. Davies & Co., Paisley, to the order of the Mona Steamship Company, for the Isle of Man passenger traffic.

"Lord of the Isles," steel, 450 tons, built and fitted with triple-expansion engines by Messrs. D. & W. Henderson, Partick, for the Glasgow and Inverary Steamboat Company.

"Marchioness of Lorne," steel, 450 tons, built by Messrs. Russell & Co., Port Glasgow, and fitted with triple-expansion engines by Messrs. Rankin & Blackmore, Greenock, to the order of the Caledonian Steam Packet Company, for passenger service on the Clyde.

"Ravenswood," steel, 400 tons, built by Messrs. S. M'Knight & Co., Ayr, and fitted with compound surface-condensing engines by Messrs. Hutson & Corbett, Glasgow, for Messrs. P. & A. Campbell, for service between Bristol and Tenby.

"St. Tudno," steel, 900 tons, built and fitted with compound surface-condensing engines by the Fairfield Shipbuilding and Engineering Company, Govan, for the Liverpool and North Wales Steamship Company.

"Woolwich Belle," steel, 400 tons, built and fitted with compound surface-condensing engines by Messrs. William Denny & Bros., Dumbarton, for the Thames passenger traffic of the London, Woolwich, and Clacton-on-Sea Steamboat Company.

SAILING VESSELS.

"Alexander Block," steel barque, 1,400 tons, built by Messrs. A. MacMillan & Sons, Dumbarton, for Mr. William Mitchell, Londonderry.

"Ancois," steel, 1,700 tons, built by Messrs. Russell & Co., Greenock, to the order of Mr. G. Soley, Liverpool.

"Belmont," steel, 1,450 tons, 2,450 tons deadweight capacity, built by Messrs. Russell & Co., Port Glasgow, to the order of Mr. J. G. Hall, Boston.

"Collessie," steel, 1,300 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Messrs. Gray, Macfarlane, & Co., Glasgow.

"Invercauld," steel, 1,300 tons, built by Messrs. A. MacMillan & Sons, Dumbarton, to the order of Messrs. George Milne & Co., Aberdeen.

"Lucknow," steel, 1,400 tons, built by Messrs. Charles Connell & Co., Scotstoun, to the order of Messrs. W. & J. Crawford, Greenock.

"Mount Stewart," steel, 1,900 tons, built by Messrs. Barclay, Curle, & Co., Whiteinch, to the order of Messrs. Donaldson, Rose, & Co., Aberdeen.

"Senegal," steel, 1,400 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Mr. G. M. Steeves, Liverpool.

YACHTS.

"Dragon," composite cutter yacht, 14 tons, built by Messrs. W. Fyfe & Sons, Fairlie, to the order of Mr. F. Hall, Ardrishaig.

"Herione," steam yacht, 320 tons, 1,000 h.p., built and fitted with quadruple-expansion engines by Messrs. Fleming & Ferguson, Paisley, to the order of Messrs. J. & A. Allan, Glasgow.

"Mira," steam yacht, 320 tons, designed by Mr. G. L. Watson, Glasgow, and built and engined by Messrs. D. & J. Dunlop, Port Glasgow, to the order of the Hon. F. G. Wynn, Carnarvon.

Steam yacht, 14 tons, 40 h.p., built and engined by Messrs. Hanna, Donald, & Wilson, Paisley.

In addition to the above Messrs. Hanna, Donald, & Wilson built two composite vessels each of 23 tons for foreign owners.

ANALYSIS OF LAUNCHES.

	Steamers.		Sailing Vessels.		Yachts.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
Great Britain ...	14	15,280	7	10,400	4	681
France	1	1,600	—	—	—	—
Norway.....	1	1,000	—	—	—	—
United States ...	—	—	1	1,450	—	—
South America	1	1,720	—	—	—	—
Destination withheld	—	—	2	46	—	—
Total.....	17	19,600	10	11,896	4	681

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,, INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 15TH MAY, 1891.

THE IRON AND STEEL INDUSTRIES OF AMERICA.

THE remarks made by Sir James Kitson at the recent meeting of the Iron and Steel Institute, regarding the iron and steel industries of America, were, on the whole, not calculated to raise the spirits of his audience. The trade with which his hearers are concerned has passed through a short period of great activity and prosperity, and there is before it another period, possibly longer than the previous one, if not of stagnation, at least of scarcity of work. Engineering, in all its departments, is experiencing the beginning of a time of depression, while shipbuilding is rapidly falling off. Both in engineering and shipbuilding the years 1889 and 1890 must rank very high in the industrial annals of the United Kingdom, not only on account of the amount of work produced, but also because of the large returns made to employers and employed. Were it not for another fact dwelt upon by Sir James Kitson we might almost be inclined to accept with reasonably good grace what seems to be inevitable with our present system of industry—namely, alternate periods of great activity and of greater depression. But, as Sir James Kitson pointed out, the relative industrial position of Great Britain is rapidly changing, and in the future our manufacturers will have to contend with forces which until recently were either unknown or were so weak as to be left out of account in discounting the immediate future of any department of industry. He stated that the recent visit of the members of the Institute to America had shown them that the resources of that continent were inexhaustible, and whether under a system of Protection or of Free Trade, the United States was, in his opinion, a country bound to develop these resources, and to become, in the course of that expansion, a great manufacturer of iron and steel. The American furnaces were producing a larger quantity of iron than we produced in this country, but there were compensations in practice in our greater economy of production and in the better quality of our materials. If, perhaps, one word of warning was needed, it was in regard to the important point of the price of fuel. In the United States fuel was abundant and accessible, and coal and coke in the iron districts were lower in price, more accessible, and of equal quality to the fuel obtained in this country. It, therefore, appeared to him that those at home, both producers and workmen, who had the control here of the cost of fuel, ought to pause in their demands in view of the unlimited resources of America. No doubt it is true that American industries are hampered by high wages and want of economy, but even making allowance for all this we must expect a great expansion of the manufacture of iron and steel on the other side of the Atlantic, which will not only supply the wants of the countries situated there, but also compete with us in the other markets of the world. Sir James Kitson has enlarged on some of the points involved in an article in the *Contemporary Review*, in which he gives notes of the visit of the Iron and Steel Institute to America last year. We will not enter into the details of travel or of hospitality, but, in view of the importance of the subject, will mention a few of the industrial and economic conditions which are likely to affect the problem.

One feature which struck the English visitors was the fact that the American skilled artisan puts forth more physical effort and produces more work in a given time than the English workman or the workman of any other manufacturing community, and this conclusion was verified by observations in various parts of America. The productive power of American workmen is greater than that of English workmen in the same time. Their working hours are longer, but their remuneration is greater. The workmen in America, however, recognise that the extreme physical effort put forth sape the vital energies and cuts short the career—in short, they understand that continual work at high pressure does not pay in the end. This remark applies with equal force to the employers and to the employed. Competition between manufacturers is keener than in this country, and this fierce competition reacts on the men. The visitors were surprised to find in a democratic country like America that the workmen had so little power, and were to such a large extent the docile instruments of energetic employers. The foremen and managers of factories drive the men to an extent that employers would never dream of attempting in this country, and the trade unions do not seem able to protect the men in this respect. American manufacturers thus get the greatest possible service out of their plant. These facts have important bearings on the question of international competition. Another noteworthy matter is the number of ingenious mechanical labour-saving devices employed.

The immense natural resources of the country were evident at every point. In the neighbourhood of Pittsburg, the metropolis of the American iron industry, there was everywhere evidence of marvellous mineral wealth. The coal crops out on the flanks of the hills and the banks of the rivers. The seams are in many places 10ft. thick and upwards, and the coalfield is estimated to extend to an area of 1,400 square miles. Petroleum and natural gas are obtained in abundance, and add immensely to the manufacturing facilities of the district. Of the former, the State of Pennsylvania produces 250,000 barrels per month, and it has a yearly output of 30,000,000 tons of bituminous coal, and last year produced within a small fraction of one-half of all the pig iron, and more than one-half of all the rolled iron and steel made in the country. In the Pittsburg district alone 750,000,000ft. of natural gas are delivered to consumers each day through 1,125 miles of pipe, for the use of mills and factories, and to upwards of 30,000 warehouses, stores, hotels, and dwelling-houses. Pittsburg's 21 blast furnaces in 1889 produced 1,203,435 tons of pig iron, while 33 rolling mills showed a production of 1,105,573 tons of steel, and 638,450 of rolled iron. Its 49 iron foundries represent a capital of over £2,000,000 sterling, its 15,000 coke ovens yield 9,000,000 tons of coke, used in the manufacture of pig iron. It is the leading centre for the production of steel rails. At the Edgar-Thomson steel works the visitors saw blast furnace plant which was the most complete and advanced in the United States, one furnace having the remarkable output of 2,300 tons of pig iron per week. The only fuel used

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for heating the furnaces and the boilers is natural gas. The employers of Pittsburg are men who are directly engaged in the management of their own businesses, and seemed for the most part to have risen to the head of establishments by their natural skill and business aptitude. They are exceptionally active, energetic, and full of resource and enterprise, and are mainly practical rather than scientific men. It will, however, be found that many of the younger men who are responsible for the scientific work have for the most part passed through the course of study of one of the numerous technical schools which have been established in America during recent years. Altogether the impression produced on the visitors by Pittsburg was that, with its immense natural resources, and the activity and intelligence of those who manage its works, that city is able to compete with any manufacturing city in the world. Sir James Kitson thinks that with such extroadinary advantages as its manufacturers possess their industrial position is impregnable, without the artificial barriers which they take so much pains to set up around them.

The English visitors were also much impressed with the energy and activity, and the consequent phenomenal development, of Chicago. Its varied interests make its people less strongly in favour of Protection than are the people of such a district as that of Pittsburg. The President of the Iron and Steel Institute at one of the receptions given in its honour ventured to speak in favour of Free Trade, and his observations were received with warm approval by the members of the Chicago Corporation. It was evident that a fear existed that the European market for Chicago products might be interfered with if the policy of the McKinley Tariff Act was persisted in. That Act seems to have been specially framed to stop the export of tinplates from England and Wales to the United States, which is now the only business of great amount and value between those countries. The present business in tinplates with the United States amounts to 6¼ million boxes per annum, weighing about 400,000 tons. The duty paid under the old tariff was £4 10s. per ton; under the new tariff it is about £9 17s. per ton, so that the increased cost of duty on tinplates will amount to £2,140,000, and the total duty to £3,940,000. If the duty on tinplates should be maintained the Americans will doubtless, in due course of time, make all their own tinplates. The question will then arise whether the farmers and artisans of the United States will be content to pay a high price for canned goods and domestic utensils, for which tinplates are largely used, simply in order to put money into the pockets of a few manufacturers.

It was found that the manufacturers of the South held different opinions on fiscal questions from the people of Pennsylvania, and that in many cases they were very pronounced in favour of Free Trade. The Southern States have made great developments in industry and trade during the past dozen years, and are now able to strive against their Northern competitors. The manufacturers of the Southern States believe that, with their abundant resources and cheapness of production, they can hold their own against all competitors without the aid of Protective duties. Sir James Kitson gives some interesting details of his observations in the Southern States, but into these we have not time to enter. He concludes by asking what are the leading characteristics of those who are engaged in the chief industries. He answers that these are quickness to adopt improvements, and readiness to adopt scientific methods in the processes of manufacture. He points out that in the departments of iron and steel manufacture, great as has been the industrial growth of America, marvellous as are the mechanical achievements of Americans, we can still claim that the inventions which have brought the manufacture of iron and steel to its present state of perfection are of English origin. The Americans have not invented, they have improved. Sir James Kitson says that the high standard of education, and especially of technical education, of the people of America undoubtedly is much to their advantage. He recognised everywhere a promptness to discard old plant and an alertness to adopt the newest and the most scientific methods of production. He thinks, however, that there need be no ground for apprehension as to the competition of the United States. Our insular position, our abundant supply of labour, our accessibility to mineral products, make it, in his opinion, certain that England, as a producer of iron and steel, will continue to hold the leading place in the neutral markets of the world. On the whole, we are inclined to agree with this opinion, but we can afford to neglect neither the education of our workmen and managers, nor any mechanical improvements which may lead to increased economy and efficiency.

POSTAL REFORM AND THE DECIMAL SYSTEM.

On the 8th inst. an influential deputation from the Associated Chambers of Commerce and the Decimal Association was received by the Chancellor of the Exchequer and the Postmaster-General, with reference to certain proposed reforms in the Postal Service, and to the introduction of the decimal system as regards weights and measures. Colonel Hill, M.P., President of the Associated Chambers of Commerce, introduced the deputation, which included Sir A. Rollit, M.P., Mr. Shaw-Lefevre, M.P., Mr. C. H. Wilson, M.P., Mr. William Leng, M.P., Dr. Farquharson, M.P., Mr. O. Morgan, M.P., Mr. S. Montagu, M.P., Mr. A. Illingworth, M.P., Mr. H. S. Wright, M.P., Mr. Arnold Morley, M.P., Sir E. Harland, M.P., Sir Vincent K. Barrington, Sir William Thomson, F.R.S., Sir G. L. Molesworth, Sir Philip Magnus, Major Campbell Johnston, Mr. J. W. Menzies, R.A., Mr. Rowletts, Professor H. S. Foxwell, Mr. F. Hendriks, and representatives of the more important Chambers of Commerce. Colonel Hill said that the deputation wished to bring under the notice of Ministers four subjects—first, the application of the surplus of the Post Office revenue above a certain sum to the improvement of the postal service; secondly, the establishment of an Imperial penny postage, which was estimated to cost about £75,000; thirdly, a reduction in the cost of telegrams; and fourthly, the introduction of the metric system of weights and measures as the first stage in the adoption of a complete decimal system. Mr. Shaw-Lefevre, M.P., advocated that the excess of the postal revenue above £3,000,000 should be devoted to the giving of increased postal facilities.

Mr. Goschen, in reply, said that the Post Office authorities were willing to carry out necessary reforms in the service, and the Treasury did not wish to hamper them in their endeavours. A large expenditure, however, must yet be incurred in the buying of sites and the construction of buildings in large provincial towns, which had been made necessary by the increased business of the Post Office. The introduction of Imperial penny postage would involve a loss of more than £75,000. Although, in consequence of the new system of 2½d. postage, the weight of letters carried during the first four months of 1891 had increased by 14·24 per cent. over the weight carried during the corresponding months of 1890, the revenue received from the carriage of those letters had decreased by 43·6 per cent. The penny rate would probably involve a considerable loss unless the letters were carried by slow ocean steamers. With regard to the telegraphs, he would prefer to extend the telegraph system to localities which would not pay rather than to diminish the cost of telegrams. Representatives from this country would attend the Postal Convention which was about to be held at Vienna. In reply to Mr. S. Montagu, M.P., Sir William Thomson, Mr. J. E. Dowson, and Mr. A. Smith, who advocated the introduction of the decimal system of weights and measures, Mr. Goschen said that such a change would confuse for a time the transactions of almost everybody in the country, and he could not recommend the Government to appoint a Royal Commission on the subject. He admitted that the reform would be attended with great advantages, but much present inconvenience would have to be borne in effecting the change advocated.

H.M.S. "SAPPHO."

The above vessel was launched from Messrs. Samuda's building yard at Poplar on the 9th inst. The "Sappho" is a steel twin-screw armour-protected cruiser similar to the "Apollo" and others of that class, and is one of the ships ordered under the new Naval Defence Act of 1889. Her dimensions are:—Length, between the perpendiculars, 300ft.; breadth, extreme, 43ft.; mean draught of water, 16ft. 6in.; displacement, 3,400 tons; indicated horse-power, 9,000; estimated speed, 20 knots. The hull is built entirely of Siemens steel, and is divided into numerous watertight compartments. The stem and stern post—the former of which is fitted with a powerful ram, being strengthened by a strong prow-plate going some 15ft. into the vessel—are formed of steel castings. The engines, boilers, magazines, and all the vital parts of the ship are protected by a 2in. steel deck running the whole length of the vessel, and above this deck is an armoured breastwork of 5in. compound armour-plates and 7in. teak backing protecting the cylinders. The engines, which are by Messrs. John Penn & Sons, of Greenwich, are of the triple-expansion type, with inverted cylinders, and with large boiler capacity. The armament consists of two 6in. quick-firing guns, six 4·7in. quick-firing guns, eight 6-pounder guns, one 3-pounder gun, one 9-pounder field gun, four ·45 Nordenfeldt guns, making in all twenty-two guns, besides which she has four 14in. Whitehead torpedo guns. She has also an armour-plated conning tower on the forecastle, and a steel torpedo director tower on the poop. The ship, when launched, had nearly all her fittings on board, the masts and all the rigging up, and all the auxiliary machinery in place and fixed. Her sister ship, the "Scylla," will shortly be ready for launching from Messrs. Samuda Brothers' yard.

THE GERMAN EXHIBITION.

On the 9th inst. there was opened at Earl's Court a German Exhibition, which is the fifth of a series of Exhibitions which have been organised by Mr. J. R. Whitley. The object of the Exhibition is to illustrate the arts, inventions, manufactures, products, and resources of Germany. The exhibits have been selected exclusively by a German Committee, and represent the most important branches of German industry. The main gallery of the Exhibition has been divided into eleven groups, in each of which the objects belonging to a particular department are arranged. This is a decided improvement on the arrangement at the previous Exhibitions at Earl's Court, when the exhibits were scattered about on stalls with no systematic attempt at order. The great feature of the German Exhibition will, however, be the extensive exhibit of German paintings. The Exhibition will be open until October next.

COAL, IRON AND COGNATE INDUSTRIES.

The Board of Trade Returns for the month of April, and the four months then ended, have been issued, and, so far as the general trade of the country is concerned, are of a satisfactory character.

For the month there is an increase in the exports of £574,699, and in the imports of £3,302,295, as compared with the corresponding period of last year. For the four months there is a decrease in the exports of £194,989, and an increase in the imports of £202,931. The figures relating to the coal industry indicate a continued activity in the export trade, which cannot fail to be gratifying to those collieries situated at or near the sea board, and at which both proprietors and employés are reaping a rich harvest. To those connected with the iron and steel works of the country it will be no surprise to find from the published statistics a great diminution in the exports relating to those industries. The total amount of iron and steel exported for the month amounted to 287,422 tons, valued at £2,612,179, a falling off of 17 per cent. in quantity and 4 per cent. in value; for the four months the decrease is 21 per cent. in quantity, and 10 per cent. in value.

We append our usual tabular statement:—

	Month of April.		Four Months.	
	1891.	1890.	1891.	1890.
Pig and puddled	£165,308	£405,426	£518,978	£1,180,432
Bar, angle, &c.....	143,059	143,589	503,924	522,497
Railroad.....	337,646	477,555	1,219,876	2,112,897
Cast and wrought ...	452,273	533,477	1,639,684	2,055,633
Unwrought steel.....	324,737	272,172	1,135,703	1,182,889
Unwrought copper ...	204,506	179,854	754,508	749,165
Coals, &c.	1,674,513	1,460,978	5,799,157	5,620,664

Turning to the home markets, the experience of the trade for the past month has been far from encouraging. On the one hand, the cost of production has not been materially reduced, while on the other, prices have continued on a downward grade. Since January the price of pig iron has fallen about 5s. per ton, that of bar iron 10s. per ton. The relative position of cost and prices is actually worse than it was in 1888, when the depression in trade reached its lowest level. In many instances ironworks are being carried on at an absolute loss to the proprietors, and there are not wanting

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cases where works have been brought to a standstill. The immediate outlook cannot be regarded with any great amount of hopefulness. Though the "bulls" on the Glasgow warrant market are at present in the ascendant, and though stocks are being heavily drawn upon, there does not appear any substantial basis for the anticipation of a boom in prices. The abnormal continuance of cold weather during the last month has caused the demand for house coal to be maintained, but as the summer approaches less fuel will be used and prices will exhibit a weaker tendency. Already competition for the supply of manufacturing coals has become very keen in all land-locked centres, and prices are generally lower.

TIMBER PILING IN FOUNDATIONS AND OTHER WORKS.

A PAPER having the above title was read before the Society of Architects, on the 12th inst., by Mr. Henry Adams, M.Inst.C.E. The paper was divided into several heads, and was illustrated by many carefully drawn diagrams and well-selected specimens. First treating of the woods used in piling, the author described all the more commom forms: their weight, their method of growth, the manner in which they are imported, and their cost. Then, dealing with the preparation of the materials, he described the process of creosoting, and then, more particularly, the method of pointing and driving the piles for various works. A description of the different methods of pile driving was then given, and careful consideration was given to the supporting power of timber piles. This the author considers to depend upon three circumstances — (1) the resistance of the point to further penetration; (2) the friction of the earth against the sides of the pile; and (3) the strength of that portion of the pile rising above the ground considered as a column. The first two of these cases are generally combined into one formula, founded entirely upon experiments.

The author gave and compared the formulæ of Major Saunders, McAlpine, Weisbach, Rankine, W. K. Clark, Bidder, Brereton, and Lieutenant Sankey, and also a Dutch rule quoted by Molesworth and the results of experiments made by Kircaldy. Dobson's rule was then considered. The author drew attention to the fact that if the distance through which the head of the pile moves after being struck be considered as the criterion of the resulting force in pounds, this assumption is not true, as only part of the force is returnable as supporting power, some of it being expended in compressing the pile. The author concluded his paper by referring to some well-known examples of the use of piles in foundations, mainly taken from work on the banks of the Thames.

Letters to the Editor.

THE NICARAGUA CANAL.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Referring to my former letter on the subject of the Nicaragua Canal, it will interest your readers to know that Mr. Miller, the president of that undertaking, has returned from Nicaragua, and is thoroughly satisfied of the entire feasibility of the plans for the canal, and has no doubts about its ultimate success. He further believes that the cost will be less than estimated, all the work hitherto having been executed at prices below those estimated by the engineers.

The Suez Canal caused a revolution, not only in shipbuilding and marine engineering, but also in the methods and conditions of commerce. The completion of the Nicaraguan Canal will also have far-reaching effects. These, on the whole, will be felt in America to a greater extent than in this country, but it cannot be doubted that they will also be felt here to a very considerable extent. The length of the Nicaraguan route is somewhat greater than that of the other routes which have been proposed, but few now fail to see that, although it is burdened with locks, it is more practical, far less costly, and more useful than any of the others, and will accomplish the same object. The canal would practically double the present available coast line of North America by connecting the Eastern and Western States, and would again increase their trade by giving a shorter route to other countries. At present sailing vessels trading between San Francisco and New York are compelled to pass around Cape Horn, a distance of 19,000 miles. The immense produce of the Pacific coast can now only be transported to the Atlantic States by 3,000 miles of railway or by the long voyage round South America, so that the entire value of these productions is often consumed in the expense of the journey.

There cannot be the slightest doubt that the completion of the canal will give the manufacturers of the United States an immense hold on the trade of South America, and a great, or at least considerable, advantage over those of Britain, and it thus introduces a new factor in the ever-increasing competition of the world. American politicians recognise most distinctly that by the completion of the canal the community of interests between the American States would be enormously strengthened. Those of the United States say that the South American Republics are patterned after theirs, and that there can be no clashing of interests between them. For many years they are not likely to be manufacturing countries, but will be devoted mainly to agriculture and mining. They will naturally exchange their gold, silver, sugar, coffee, tropical fruits, grain, and other sources of wealth for the manufactures and productions of the United States.

The trade of this country, in its relations to the East especially, will be profoundly affected. A new and shorter route will be opened to China and Japan, and no doubt part of the traffic which at present goes by the Suez Canal will be diverted to the Nicaraguan, although the growth of the trade may be sufficient to prevent the change from resulting in any great degree in a financial loss.

I certainly think your journal is doing useful service in directing attention to some of the wider aspects of the questions under consideration. Very often questions connected with education, industry, and commerce are looked at in too restricted a manner, and the remote and indirect effects are often lost sight of in looking too closely at those immediately under consideration.

Yours, &c.,

Liverpool, 11th May, 1891. C.E.

SIMPSON'S TRAIN INDICATOR.

TO THE EDITOR OF "INDUSTRIES."

SIR,—In your issue of the 24th ult. you give an illustration of this indicator, and state that it can be made single or double faced, but from the details of the working arrangements I conclude that only the oscillating shutters can be made double-faced, and that the time of departure of the trains can only be shown on one side. If my conclusion be correct, then I say that the indicator falls far short in detail of those which I have seen on the Lancashire and Yorkshire Railway stations at Bolton, Wigan, and Southport (Patent No. 3935 of 1890), because the time of departure and stations are shown on both sides, and the departure times of three trains are shown on both sides in one frame at the Bolton Station, whereas, according to your description, the Simpson indicator does not accomplish this unless two of them are placed back to back, which would be very costly. Those I refer to are fitted with a glass-fronted case, in which the departures of all trains are recorded. In addition to this there are hands pointing to the departure platforms. Indicators are, as you state, very convenient for the public, especially as they render unnecessary many inquiries from the railway officials. I may state that I have no interest in the invention to which I refer, but it would be interesting if you or some of your readers would furnish some particulars of the working and arrangement of Patent 3935 of 1890 for the information of the travelling public.

Yours, &c.,

Leeds, 9th May, 1891. TRAVELLER.

FOUCAULT CURRENTS IN DYNAMOS.

TO THE EDITOR OF "INDUSTRIES."

SIR,—From the article on "Foucault Currents in Dynamos," which appeared in your issue of the 8th inst., it would be inferred that the method of analysing armature losses, published in the *Electrician*, and partly explained at the Institution of Electrical Engineers, claims to be a new *experimental* method of determining those losses. Now, it can hardly be necessary to say that it is only a graphic construction for analysing losses measured by perfectly well-known experimental methods. If Mr. Mordey had plotted the torque, as measured by his dynamometer, instead of the power, he would have obtained a straight-line diagram, and quadratic equations, &c., would have been unnecessary. Of course, no single pair of observations can give an accurate result by either method unless the experiments are absolutely exact, but the advantages of graphic analysis when a number of points of observation are distributed about a straight line are enormous.

It seems to be assumed that the losses in the winding and in bearing friction cannot be determined separately by this method. This, of course, is true if only the machine to be tested is used, but the use of a second motor is expressly mentioned, and this would take the place of Mr. Mordey's dynamometer. The second motor, however, should not be too small, otherwise its own losses are open to question. By this means friction may be observed at all speeds, or it may be eliminated entirely from the diagram. It is curious that Mr. Mordey shows it as constant, which, within the limits of speed generally used, seems to be very nearly true.

Variations of friction are sometimes troublesome with new bearings, but this is a difficulty which vanishes with patience.

With regard to the increased loss by Foucault currents on full load, this can hardly yet rank as an established fact; Dr. Hopkinson's classical experiments certainly show no indication of it. The neatest method of determining the point is to couple two similar machines Hopkinson-wise, and supply current directly to the pair in parallel. The power supplied then, of course, represents the sum of the losses in the two machines. I hope to be able to say more on this point shortly.

It may be mentioned that the graphic method of analysing armature losses was in use during the latter part of 1888, before Mr. Mordey had published his method.

Yours, &c,

R. H. HOUSMAN.

Birmingham, 12th May, 1891.

THE INSTITUTION OF CIVIL ENGINEERS.

AT a meeting of this Institution, held on the 5th inst., the President being in the chair, a paper was read on "Railway Train Lighting," by Mr. William Langdon.

The author said that the desirability of a better illumination of railway carriages had been long felt. The lamps originally provided were intended simply to enable passengers to enter and leave the carriages without inconvenience, but the exigencies of the present time called for the additional luxury of a reading light. The illuminants in use were rape oil, paraffin oil, compressed gas, and electricity, and the author dealt with the recent advances which had been made in connection with the last.

In October, 1881, a Pullman car, running between Victoria and Brighton, was lighted by electricity, and the experiment was so far successful that it was extended to the entire train, and at present there were sixteen trains so lighted belonging to the Brighton Company. Mr. Houghton, the Company's electrician, and the late Mr. Stroudley, were the pioneers of the application of electricity to this purpose. An interesting experiment, devised by Mr. W. H. Preece, F.R.S., was tried on the London and South-Western Railway in 1883-4. The movement of the train was employed to compress air into a chamber, and the air so compressed was used to drive a dynamo to furnish the current for the lamps. In July, 1886, the Great Northern Railway applied electric light to one of their metropolitan trains. The Taff Vale and Cheshire lines had also made experiments in the same direction. In all these cases the lighting was effected by means of a dynamo driven from the axle of the guard's van combined with accumulators stored in the same vehicle. In August, 1884, the London and North-Western Railway tried a different principle in fitting up a short train which was still running between Manchester and Liverpool. The current was produced by a dynamo driven by a Brotherhood engine fixed to the tender and supplied with steam from the boiler of the locomotive. In this, however, as in the previous cases, the lighting was effected from one point, and should the train be broken up the part severed from the source of current would be left in darkness. In 1888, the directors of the Midland Railway authorised the equipment of two trains to run between London, Manchester, and Liverpool, in which the following conditions were to be fulfilled, viz.:—(1.) Each vehicle was to carry its own lighting power. (2.) Each vehicle was to be capable of being coupled and uncoupled and turned about as needed, without the possibility of the connections being wrongly made. (3.) The coupling must readily draw apart when coaches were slipped *en route*. (4.) The act of drawing the coupling apart must make all the changes in the connections necessary to transfer the lamps from the dynamo circuit of the train to the accumulator circuit of the carriage itself. (5.) Each compartment was to carry not less than two lamps. (6.) The lighting throughout the train was to be capable of being turned on or off from any one of the guard's vans. For the sake of experiment, one of these trains was equipped on the "Parallel" system, the other on the "Series" system. The former, having proved the best, had been adopted by the Company, and there were now five trains leaving St. Pancras daily which were electrically lighted, and in which the dynamo was driven off the axle of the guard's van, each vehicle being provided with accumulators capable of supplying the necessary current without the assistance of the dynamo. There was also a local train travelling between Manchester and Stockport, lighted after the plan adopted by Mr. Houghton on the Brighton Line, but equipped with two sets of accumulators and two dynamos driven from the axle. In addition to the foregoing, there were two trains running between London and Bedford, the dynamos of which were driven by small high-speed engines placed on the locomotive.

Dynamos.—In all cases where accumulators were employed, it was necessary (*a*) that the dynamo should automatically come into circuit when the requisite speed to enable the electromotive force of the machine to overcome the back electromotive force of the batteries had been attained. (*b.*) That the electromotive force should remain practically constant whatever might be the speed of the train. (*c.*) That the current should always be in one direction, whichever way the vehicle was running. The first trains fitted on the Midland Railway were furnished with machines giving a practically constant output of current, no matter how few or how many were the carriages attached. Messrs. Holmes & Co., of Newcastle, had since succeeded in making a dynamo which afforded a current proportional to the resistance of the circuit, and these machines were employed on all main line trains in which the dynamos were driven from the axle. Automatic apparatus effected the stipulated requirements.

Accumulators.—These were of the "E.P.S." type. With main line trains, where each vehicle carried its own batteries, the type employed was C 15 for the larger, and C 11 for the smaller carriages. In all cases the electrical pressure was 35 volts, so that 18 cells were necessary for each.

Electrical Coupling.—Where trains were not broken up, the difficulty of providing an efficient electrical coupling was not so great, but where the marshalling of carriages had to be smartly dealt with at terminal

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or intermediate stations, the coupling must be such as not only to provide a good electrical connection, but to admit of easy handling. The form adopted by the Midland Company effected these objects in a perfectly satisfactory manner. On a coupling being separated, the lights were automatically turned on. If the lamps were not required, the coupling, instead of being allowed to hang down, was placed upon a "dummy," the effect of which was to turn the current off. For slip coaches special provision was made. By the insertion of a small resistance in each battery parallel, a fair distribution of the current throughout the different vehicles was attained, and in order to meet the increased pressure when the dynamo was in circuit, a sufficient additional resistance was automatically introduced. The lamps were of 8 candle-power, and there were two in each compartment, safety fuses being provided in connection with each group, as well as in connection with the dynamo itself. The circuits were arranged on the parallel system. With regard to the second mode of generating the current, namely, by dynamos placed on the locomotive, it was believed that at present no other trains save the three already referred to were equipped in that way. Mention should, however, be made of experiments conducted on the Lancashire and Yorkshire Railway in 1884, and also, in the same year, by Mr. W. H. Massey, on the Metropolitan District Railway. The extra staff required consisted, so far as the Midland Railway was concerned, of one senior officer and two train attendants at St. Pancras, one train attendant at Nottingham, Manchester, Bradford, and the services for about three hours per day of a man at Derby. The total number of electrically lighted vehicles now in operation on the Brighton, Great Northern, and Midland systems was 365 coaches and 57 vans.

In conclusion, the author pointed out that the main points to be determined were whether electricity was safe, reliable, and less costly than other illuminants. The fact that electrically lighted trains had now been running for a considerable period without accident would appear conclusive evidence of its safety, and experience had shown that there was no reason to doubt its reliability where efficient provision had been made; and the author believed that when the cost of applying any of the illuminants, whether oil, gas, or electricity, to a complete railway system was taken into account, that the latter would be found the most economical. The cost of oil was between ½d. and 1d. per lamp per hour. So far, compressed gas had never been employed for lighting the entire stock of any railway, with the exception of the Metropolitan Railway—which was specially adapted for its application. To consider the cost as applied to stock devoted to certain traffic would hardly afford a true basis of comparison. Where gas was used entirely, depôts must be established at each point at which trains were made up, whilst at busy centres it would probably have to be conveyed some distance by pipes laid down for the purpose. The cost of fitting coaches for gas varied from £4 8s. to £7 per lamp, while for electricity it was £50 for a six-bodied Midland main line coach, or £4 3s. 4d. per lamp. For trains running which were not broken up on the journey the cost per lamp amounted to £3 12s. or £18 per five-bodied coach. Vans with dynamos cost from £250 to £300 each. Statistics were given showing that the cost for maintenance in the case of gas was from ·045d. to ·250d. per light per hour. There was reason to believe that the total cost of compressed gas, when applied to an entire system, would exceed ½d. per lamp per hour, while the actual cost for electricity, as used on the Midland Railway, had not greatly exceeded ¼d. per lamp per hour.

Regarding electricity as the illuminant which would, at no distant date, be universally employed for train lighting, the author suggested the desirability of arriving at a common basis with regard to the following fundamental points:—(1.) Electrical system. (2.) Form and position of the electrical couplings. (3.) Pressure of current. Unless this was effected it was to be feared that unnecessary difficulties might be created by the diversity of the plans adopted.

THE INSTITUTE OF CHEMISTRY.

On Tuesday and Wednesday of this week the Fellows of the Institute of Chemistry held a conference at Burlington House, at which several Fellows had an opportunity of expressing their views as to the present position and future of their profession.

On Tuesday, Dr. Odling, F.R.S., of Oxford, opened the proceedings with an address "On the Relations of the Chemical Society to Professional Chemistry," in which he referred to the recent agitation as to the method of election to the Fellowship of the Chemical Society. He pointed out that the present system of admission being recommendatory it had been alleged that sparingly qualified and unsuitable candidates were elected by the present method of promiscuous election, and that this practice was objectionable on the grounds that it was derogatory to the Society, or detracting from the dignity of chemical science, and was also opposed to the interests of professional chemistry. He attached very little weight to the former of these objections, and proceeded to show that the function of the Chemical Society being the advancement of pure science it followed that it had no concern with the furtherance of professional interests. He pointed out, however, that the Council of the Society was composed of the most rising chemists, who were almost all either directly or indirectly interested in the profession, and that, therefore, although as a corporate body the Chemical Society could not recognise the profession, it was extremely unlikely that its policy was harmful to its interests. It must not be forgotten that there was a continuity in the policy of the Council, which had hitherto been conducive to the successful conduct of the affairs of the Society, and it must be admitted that the recent Jubilee celebrations were of such a character as to cause it to be patent that the Council of the Chemical Society had not failed to do its duty in emergencies. He proceeded to show that from a financial point of view it was expedient that the number of Fellows of the Chemical Society should be maintained, and that the remedy for the evil might consist of one of three measures—(1) A self-abnegatory announcement that Fellowship did not confer any attestation of scientific ability upon its holder; (2) The Council taking greater responsibility in the election of Fellows; (3) That the nominators should be responsible for the fitness of the candidates they propose. The first of these courses was impossible; the second would result in the Chemical Society's Fellowship being raised to a greater professional value, and would thus be antagonistic to the welfare of the Institute; whilst the last one he felt inclined to favour. He concluded by expressing his opinion that it was undesirable that the Fellowship of the Chemical Society should be considered tantamount in any degree to an attestation of scientific ability.

Several speakers followed, who defended the course of action of certain Fellows in their endeavour to induce the Council of the Chemical Society to take steps to secure that the Fellowship of the Chemical Society should be granted to those who would not derive a false position from such Fellowship, and who expressed regret that the foundation of the Institute had been found necessary, mainly owing to the neglect of the Chemical Society in the past to reconsider its position in respect to the chemical profession.

On Wednesday the proceedings were opened by Mr. Otto Hehner, who communicated a paper on "The Analytical Chemist in Relation to the Public, the Profession, and the Institute," in which he pointed out that chemists in this country might be divided into three groups, and that arranged in numerical order they stood as follows:—(1) Manufacturers; (2) analysts; (3) teachers. He contended that the Institute of Chemistry was founded for the second of these bodies, and that it was important for the public good that Fellows of the Institute should be recognised as qualified analytical chemists. Whereas long ago chemical analysis was practised as a branch of the science of chemistry it now afforded a means of livelihood to many men, and was of supreme public importance. In 1854 the London Directory contained the names of 11 analysts, in 1875 there were 20, and in the present year 98 names were inserted. The sudden growth between 1875 and 1881 was due to the passing of the Foods and Drugs Act, but sufficient time had now elapsed for the incompetent men to be weeded out from the profession by competition. The purely scientific chemist ignored commercial work in this country, but in Germany the two branches of the profession worked hand in hand, and had a similar status in the regard of the public. In early days analysis had been left to the tender mercies of microscopists, medical men, and agitators, but at the present time the exigencies of commerce required the modern analyst to be highly trained in his profession, and necessitated the utmost accuracy in all branches of commercial analysis. The subdivision of the work among specialists, who devoted their whole time to one branch of work, had further tended to increase the efficiency of the profession as a whole. Mr. Hehner then referred to the objects of the Institute as laid down in the charter, and pointed out, as we have already done in our recent articles on this subject, that the Institute was formed for maintaining the public efficiency of analysts and consulting chemists, and thus creating a body of men on whom the public can repose confidence and trust for reliable information on the purity or otherwise of articles of commerce. He then proceeded to show that hitherto the governing body of the Institute had consisted of men drawn from other branches of the profession than that for which he urged the Institute had primarily been founded, and advocated the admission to the Institute of all who could satisfy the examiners as to their analytical efficiency, irrespective of any enforced collegiate education. Professor Tilden, of Birmingham, the President of the Institute, expressed the opinion that it was erroneous to suppose that the professorial or teaching branch of the profession undervalued the analytical, and he believed that the majority of professors shared his view in this important matter.

Mr. Lloyd urged the desirability of taking the medical profession as a type of body which the Institute should try to imitate, and deprecated the unfortunate want of uniformity in the fees charged by analysts and chemical experts.

Mr. Blount, whilst agreeing with Mr. Hehner, suggested that the censors appointed by the Council had already the power to regulate and work towards the furtherance of many of the wishes expressed by previous speakers.

Mr. Allen pointed out that local authorities were unaware that Somerset House was, officially, only a referee as to matters included in the Foods and Drugs Act, and that, therefore, the competition of the Government in matters of reference with members of the profession was an anomaly. He felt sure that local authorities and public bodies would be willing to employ Fellows of the Institute as referees when it was known that the duties of Somerset House as referees were confined to the carrying out of this Act.

Dr. James Bell, F.R.S., announced that the sending of waters to Somerset House was being discontinued, and none were now received except those which had already been analysed by a Fellow of the Institute.

Dr. C. R. A. Wright, F.R.S., read a short paper on "The Training Requisite for Professional Chemists," in which he advocated that the Associateship of the Institute should be conferred on those who satisfied the examiners of their general chemical and scientific knowledge, which could best be obtained in one of the colleges. The full Fellowship should be given to those who, after having qualified for the Associateship, had further undergone a course of professional training in the laboratory of a Fellow, and produced satisfactory evidence that they had there acquired a special training in that branch of the profession they intended to adopt subsequently.

Mr. Lloyd's paper, on "The Best Training for an Analytical Chemist," was next taken, in which the author gave an outline of what he considered an ideal system of education for an analyst, and advocated, after a general education and experience in office and business work, a four years' training in chemistry, each year to be devoted to one particular branch, and the student's knowledge to be tested by an examination at the end of each session.

In the discussion which followed Messrs. Thomson, Norman Tate, Hehner, Allen, and Cassal expressed their several views in favour of some regular and systematic training in the laboratory of a Fellow engaged in an analytical practice before a student should be considered qualified for the Fellowship of the Institute, and Mr. Groves, Dr. Stevenson, Professor Smithells, of Leeds, and Professor Clowes, of Nottingham, supported the view of the Council that the requisite training should be partly acquired in a recognised teaching institution.

MAGNOLIA-LINED BEARING PEDESTALS.

Improved metal pedestal bearings have been recently introduced by Messrs. Allen & Robson, Newcastle-on-Tyne, especially adapted for pit tubs and waggons, which we illustrate herewith. It will be seen they are of ordinary construction, but are lined with magnolia anti-friction metal, which is carefully fitted in. Under the usual system of steel axles running in steel bearings, both the axle and the bearing deteriorate, and thus

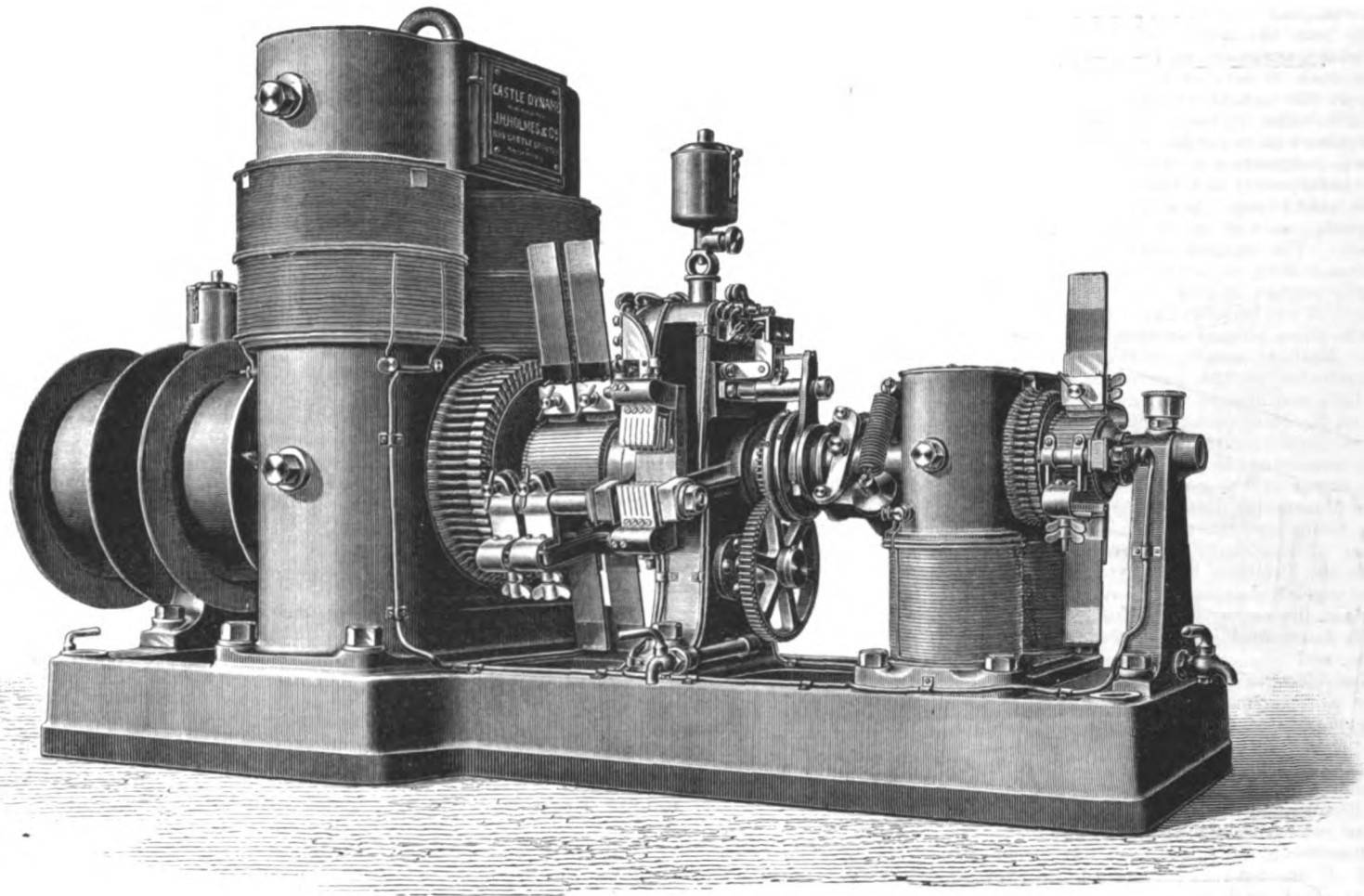


frequent renewals are necessitated. It is found that, with these improved bearings, the axles do not appreciably wear away, and while, owing to the anti-frictional properties of the magnolia metal, less lubrication is required, the cost of repairing colliery tubs and waggons is materially decreased, as the iron or steel body of the bearing will last almost indefinitely, without serious accidents occasion a breakage. Any ordinary mechanic can refit the lining of magnolia when it is required because of wearing down, and it is evident that this arrangement should prove productive of real economy.

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TRAIN LIGHTING DYNAMO.

CONSTRUCTED BY MESSRS. J. H. HOLMES & CO., ELECTRICAL ENGINEERS, NEWCASTLE-ON-TYNE.



GENERAL VIEW.

HOLMES' TRAIN LIGHTING DYNAMO.

MANY attempts have been made to light trains electrically. The chief difficulty is in the variation of speed of driving the dynamos. Separate engines have been used, but have been found unsatisfactory. We illustrate above a solution of the problem, due to the ingenuity of Mr. J. Holmes, of Newcastle. The inventor explains his dynamo as follows:—

Practically the e.m.f. of an ordinary separately excited dynamo varies directly as the speed, so if the speed be increased, say, from 500 revolutions per minute to 1,000 revolutions per minute, the electromotive force will be doubled. The electromotive force varies directly as the strength of the magnetic field, so that, if the strength of field of a separately excited dynamo be reduced in the same proportion as the speed at which its armature revolves be increased, the electromotive force of the armature will remain practically constant.

To produce this result two dynamos are arranged having their armatures upon the same shaft, so as to revolve together, but influenced by separate magnetic fields. One is the main generating machine, the other is for regulating the strength of its magnetic field. The magnets of the machines are separately excited from an external source, such as a set of accumulators, and the magnets of the generating armature are provided with two distinct exciting circuits. One circuit is an ordinary high resistance shunt circuit, and the other is of less resistance, and is coupled up to the source of current so as to have the small regulating armature in series with it. The regulating armature is so coupled up that its electromotive force opposes the electromotive force of the regulating armature and external source of supply. The high resistance shunt circuit is so proportioned that, at the highest speed at which it is intended to run the generating armature, it, without the aid of the regulating circuit, will give a magnetic field of an intensity proper for the required e.m.f. in the generating armature. When thus driven the second exciting circuit ought to have no current passing through it, and this is secured by making the e.m.f. of the regulating armature at its highest speed equal and opposite to the external source of e.m.f. produced in the second coil of the generating machine. If, however, the speed falls, the e.m.f. of the regulating armature is reduced in the same proportion, and is no longer equal to the external e.m.f., and a current will flow through the second exciting circuit of the magnets of the generating dynamo, thus increasing the intensity of the magnetic field to make up for reduction of speed, maintaining a practically uniform e.m.f.

The armature is driven by belting from the axle of the guard's van, and a set of accumulators excite the field magnets. A centrifugal governor automatically switches the storage batteries in or out. The brushes which collect the current from the two armatures are made of wire gauze, and are placed radially, the "lead" being automatically altered to suit the direction of rotation. The connections to the armatures are changed at the same time.

This dynamo is used by the Midland Railway Company for their express trains, and has also been applied to French, German, and Russian railways.

THE ROYAL SOCIETY CONVERSAZIONE.

WE referred briefly last week to the conversazione held by the Royal Society in their rooms at Burlington House on the 6th inst.

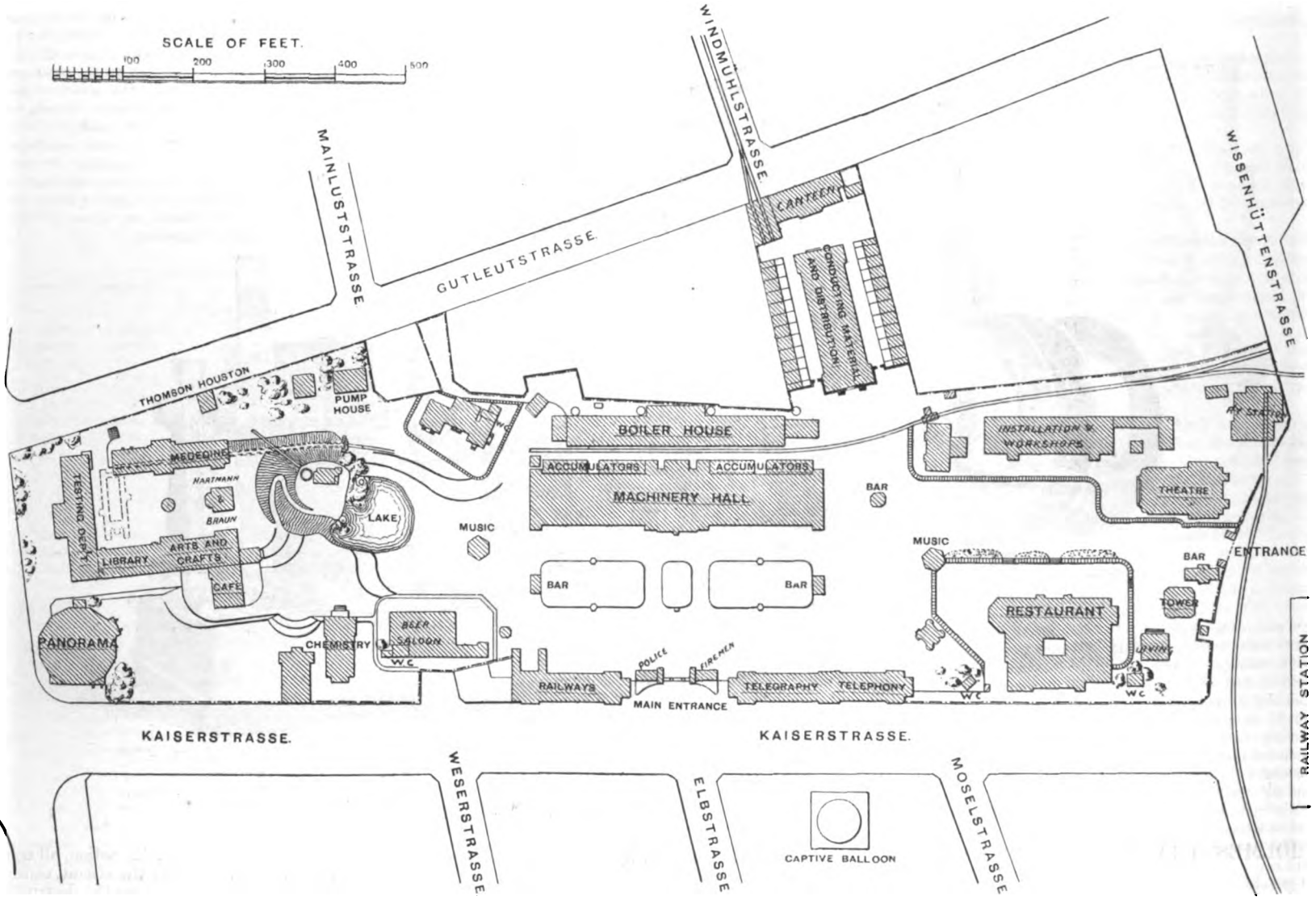
As usual, a large number of exhibits were on view, all more or less interesting, but we shall confine our attention to the more noteworthy from an engineering point of view. Mr. Wimshurst exhibited his new alternating influence machine, which excites electrical oscillations without giving any continuous current. The machine by which the phenomenon was exhibited was ingeniously constructed in such a manner as to allow, by means of interchanges of various portions, which could be easily and expeditiously effected, of its being transformed into an influence machine of any one of the numerous types which have been devised. An exhibit of considerable interest to electrical engineers was the "Tomlinson Regulator for Electric Light Mains," shown by the manufacturers, Messrs. J. E. H. Gordon & Co. The regulator is intended for use at transformer sub-stations, and is so contrived that, if anything goes wrong with the apparatus, which is automatic in its action, all transformers are immediately thrown into the circuit, causing merely a waste of coal in place of risking the destruction of the station by fire. A very striking illustration of electrical resonance was exhibited by Professor O. Lodge. The arrangement consisted of a pair of similar and independent Leyden jar circuits at a short distance apart. One jar was charged and discharged successively by means of an influence machine included in its circuit, and the other jar, which had the two coatings nearly connected by a slip of tinfoil, so as to provide an easy overflow path, had the length of wire in circuit with it adjusted by means of a slider, until it was seen to overflow at each discharge of the jar in the exciting circuit. Messrs. Richard Frères, of Paris, exhibited a number of delicate specimens of continuous recording apparatus, among which we may mention an aneroid barometer showing variations as small as $\frac{1}{10}$mm., and an ingeniously contrived wattmeter, together with continuously recording voltmeters and ammeters.

Professor Roberts-Austen showed illustrations of a method of photographically recording pyrometric measurements at temperatures between 600° C. and 1,200° C. The measurements were obtained from the indications of a galvanometer in circuit with a platinum-rhodium thermo-couple. The ordinary spot of light was replaced by the image of a fine vertical slit, which, as the current varied, due to changing temperature, travelled along a fine horizontal slit, below which, and perpendicularly to it, a sensitised plate was carried along at a uniform speed by means of clockwork. A number of curves obtained in this way, and showing the rates of cooling of various pure metals and alloys, were shown.

One of the most interesting of the exhibits on view was Professor W. C. Unwin's new length-measuring instrument devised to measure lengths to within $\frac{1}{10000}$ of an inch. A gauge bar, the length of which is accurately known, and not differing greatly from that of the length to be measured, is first placed in the instrument, and the contact pieces which rest against the end of the standard bar are adjusted by means of delicate levels attached to each, and when the adjustment is made the pressure against each end of the bar is a very small but perfectly definite quantity. A micrometer screw, with a play of about 2in., allows of a bar being compared with a standard which does not differ from it by more than that

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THE FRANKFORT ELECTRICAL EXHIBITION.



General Plan of Buildings and Grounds.

length. Owing to the complete absence of indefinite strains the instrument can be made to take in objects of considerable diameter, and the measurements can be made for any length for which a gauge bar of accurately known length can be obtained. Professor S. P. Thompson exhibited a focameter for determining the true focal length of any compound system of lenses, such as a microscope objective or a photographic camera lens; and Mr. Shelford Bidwell showed some of the selenium cells which aroused so much interest when exhibited to the Physical Society last year. He also exhibited contrivances, in which they were employed for automatically lighting an incandescent lamp on the advent of darkness, and for giving an audible alarm if a ship's light or railway lamp were accidentally extinguished. A good deal of interest was attracted by some colour photographs of the spectrum exhibited by M. Lippmann. The colours are produced by interference, due to the structure imparted to the film by the stationary waves of incident light during exposure in the camera. It may be noted that similar phenomena were sometimes exhibited by the old daguerreotype films. The explanation of this phenomenon is certainly of considerable interest; the results do not give any indication of progress in the direction of colour photography, as the expression is usually understood. Professor Schuster exhibited several forms of Clark's standard cells. The most noteworthy point about them was the employment of indiarubber valves to allow the hydrogen generated to escape, also preserving the cells from destruction from its gradual accumulation.

THE FRANKFORT EXHIBITION.

The great event of the year to electricians will be the Exhibition at Frankfort-on-the-Main. An exhibition like this must be regarded from two points of view, those of the exhibitor who wishes to further his trade, and of the electrical engineer who wants to study the progress of the industry.

We do not yet know how far our electrical firms will exhibit, but there is little doubt that there will be a fairly representative display of English manufactures. There is, however, a feeling that both the French and Germans prefer to use their own machinery, on Protection principles. There is a very good reason why it is sometimes of little use trying to push English goods in Germany, and that is because the cheapness of German labour enables the Germans to undersell us, especially in their own country; and we have no reason to complain of this. So far we have only heard of one English engine maker and one English dynamo maker exhibiting, and do not know if there are any large French exhibits at all. From the point of view of the electrical engineer who wants to learn, the Exhibition will be exceedingly valuable. Frankfort is a long way off in miles, but it can be reached both quickly and cheaply. Moreover, many people can take it on their way to Switzerland or Italy, for it is on the high road to the districts where people flock in holiday time.

We have recently had a splendid opportunity of comparing French practice with our own at Paris, and a more intimate acquaintance with German design will do no harm.

There will probably be no striking novelties, unless the so-called rotary field motors, which are receiving so much attention just now, can be considered new. There will, however, probably be a good display of large multipolar central station machines and station engines. About 4,000 h.p. in steam engines is already arranged, and there are over 200 h.p. in gas engines.

There is little doubt that, with the talent for organisation for which the Germans are so well known, the Exhibition will be a great success. A glance at the accompanying plan will show that the main engine and machine house is a building close upon 500ft. long, and the rest of the Exhibition is on a correspondingly large scale.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

VIII.

(*Continued from page* 451.)

Manufacturers' Soap.—The best qualities of soap, for manufacturers' use, are made from the nigres of ordinary pale or brown soaps, together with currier's grease or bone fat, and rosin, and the soap fitted without the addition of too much water. Large quantities of manufacturers' soap are, however, made as a curd, from bone grease, kitchen and ship fats, crude recovered fatty acids, and, indeed, almost any kind of fat or grease. This kind of soap, which is sometimes hardened by soaking the bars in strong brine, has a mottled appearance, owing to the dark-coloured impurities present, and it is generally strongly caustic. The presence of a considerable amount of free caustic soda is, however, not only unobjectionable, but is a necessity for the kind of work for which this soap is generally employed.

Palm oil, in conjunction with rosin, is also largely used in the fabrication of this class of soap, but cocoanut, palmnut, and some other oils do not give good results. A certain amount is also made by the so-called "cold process," in a very crude manner, by melting impure tallow or other solid fat at a low temperature in a jacketed pan, which is fitted with a rotary mixer, shown in Fig. 14, and crutching in strong caustic soda solution to effect saponification. The product is then run out into a frame to cool and set. Soap made in this way always contains a large quantity of free caustic soda, and, not infrequently, a considerable proportion of unsaponified tallow or fat.

The olive oil soap manufactured expressly for calico printers, silk dressers, &c., is an entirely different product from the manufacturers' soaps mentioned above, being, as a rule, made from purer materials, and con-

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taining very little or no free alkali. It usually contains from 60 per cent. to 70 per cent. of fatty anhydrides, and from 6·5 per cent. to 7 per cent. of combined soda.

Soft Soap.—The soda salts of the fatty acids are, as a rule, hard, opaque, and not appreciably affected by the addition of a moderate quantity of water. Potash soaps, on the other hand, especially if made from neutral oils,

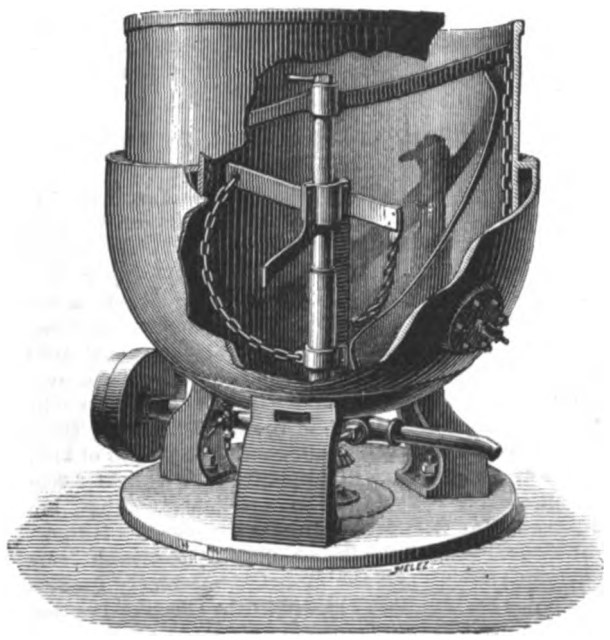


Fig. 14.

are soft, deliquescent, and transparent, and are rendered more soft by the addition of even a small quantity of extra water. Unlike most of the hard soda soaps described, soft soap contains the whole of the extraneous matters of the original oils, as well as the glycerine produced by their saponification. The process of manufacture is very similar to that described for marine or common mottled soap, and is prepared in a similar pan, generally from linseed and cottonseed oils. Hempseed and sometimes crude or green olive oils are also used, while Scotch soft soap is said to be made mainly from cod or whale oil and tallow.

The potash lye for the saponification of these oils is still commonly prepared by acting on a boiling solution of potassium carbonate with hot slacked lime, and allowing the precipitated calcium carbonate (chalk) to settle. The clear liquid is then drawn or siphoned off and diluted to the required specific gravity to form the lye. Other manufacturers prepare their lye from the solid caustic potash obtained in drums similar to those containing the solid caustic soda, and in this case the saponification of the oil is more easily controlled and the result is better, if a certain proportion of carbonate of potash be added to the caustic lye. This fact may account for the preference many soapboilers have for lye prepared from quicklime and pearl ashes, as such almost invariably contains a notable quantity of unacted-upon potassium carbonate.

The device of having a gauge on the lye tank, for the purpose of showing when the requisite quantity of caustic has been run into the pan, is of special value in the boiling of soft soap, as the saponification proceeds rapidly when once commenced, and the lye must therefore be allowed to run in more freely than with most soda soaps, to avoid the risk of the mass becoming thick. The operation is commenced with moderately weak alkali, and finished with strong lye of from 1·15 to 1·20 sp. gr., and the boiling is either begun with open steam and finished by fire, or effected throughout by fire alone. The saponification is materially assisted by vigorous beating with the spade, which is also necessary to prevent the undue swelling up of the boiling and frothy mass.

When finished, the soap boils in a peculiar manner, and has a dark, transparent appearance, the surface being free, or practically so, from "fob"; whilst a small sample, taken from the pan and cooled, has no stringiness, but is "short" and can be "balled" in the hand. The operator also tests the state of the product by its appearance on the knife or trowel, and small samples are allowed to cool on a glass plate. If the result of these observations be satisfactory, the fire is withdrawn from under the pan, and the soap shortly afterwards filled into casks and firkins, in which it is allowed to set.

Soft soap, so made, usually contains about ·5 per cent. of free caustic potash, and from 40 per cent. to 50 per cent. of water. If made from cottonseed or linseed oil, or both, it has a fine golden, sometimes greenish colour, and, on standing for some time, becomes filled with small stellate granules of potassium stearate, a condition which is technically called "figged." This figging is usually, but quite mistakenly, regarded as a sign or proof of good quality, and to produce it a small quantity of tallow is often added to the oils employed. It is also sometimes imitated by the addition of unboiled starch, and other substances, to the made soap.

Hempseed oil soft soap is green in colour and very soft in consistency, as also is soap made from fish oil, the latter retaining an unmistakable and unpleasant fishy smell.

Soft soap is often filled or adulterated with various substances, such as potassium chloride, potassium silicate, dextrin, Irish moss, and starch, some samples containing as much as 10 per cent. of a solution of the latter, which sometimes actually gives a better and brighter appearance to the soap, although, when adulterated in this way, it has little or no tendency to "fig."

(To be continued.)

NOTES ON ALLOYS.

X.

The recent work by Mr. Veley on the action of nitric acid on the metals has shown that foreign impurities in either the acid or the metal determines the solution of the metal, and in his recent paper before the Society of Chemical Industry it was suggested that these experiments might throw some light upon the solvent action of the weak acid upon the lead of vitrol chambers. M. Hochstetter has recently presented to the Société Industrielle du Nord de la France an exhaustive paper on this very question, in which he has shown that the action of sulphuric acid upon lead is protected by the presence of certain impurities such as copper and antimony in the metal. By adding quantities of copper, varying from ·01 to ·04 per cent. of the commercial lead used, he showed that such alloys were not acted upon by acid at 66°, and the same was true when antimony varying from ·1 to ·2 per cent. was added. When the two metals were added to the lead together, much smaller quantities of each were sufficient to protect the lead from dissolution, so that the minimum quantity of foreign metals which must be present to afford protection is a mixture of ·005 per cent. copper and ·05 per cent. of antimony. From some nine trials he further found that this alloy resisted the action of the acid considerably longer than that of lead alloyed with the small quantities of antimony or copper above mentioned.

Mr. Fred. C. Weld has made an interesting addition to Heycock & Neville's work noticed in our last article, which confirms their results in the case of the tin lead alloy, but shows, as is already known in working Raolt's method for determining the molecular weight of organic substances, that the lowering of the melting point of the tin by the addition of the lead is only true when the quantity of lead added is less than in the proportion of 15 atoms of lead to 100 of tin. The following table shows the results obtained:—

Melting Point of Tin (Fine Bar).		Atoms of Lead.		Factor for Lead.		Calculated Melting Point.	Actual Melting Point.
227°	minus	3·28	×	2·22°	=	219·72°	218°–219°
,,	,,	11·24	×	2·22°	=	202·05°	201·5°
,,	,,	15·13	×	2·22°	=	193·41°	194°
,,	,,	17·19	×	2·22°	=	188·84°	193°
,,	,,	19·47	×	2·22°	=	183·78°	188°–190°
,,	,,	38·18	×	2·22°	=	142·24°	180°
,,	,,	57·28	×	2·22°	=	99·84°	180°
,,	,,	85·12	×	2·22°	=	38·03°	209°

It is interesting further to note that the lowest melting point possible is obtained from 38 atoms of added lead, but the author is unable at present to advance any theory to account for these phenomena. He further points out that the effects of this reduction of the melting point are not cumulative, so that at present the law does not hold for the addition of two or more foreign metals. The following table is also given by the author as showing the atomic proportions of some compounds alloys whose melting points he has determined:—

Tin (atoms).	Lead (atoms).	Mercury (atoms).	Zinc (atoms).	Bismuth (atoms).	Melting Points.
100	57·28	12·58	7·04	3·3	145°–150°
100	57·28	8·41	—	2·24	166°–167°
100	57·28	10·58	13·02	4·03	148°
100	57·28	12·82	5·63	2·66	145°

The composition of the alloys for resistance coils is now receiving considerable attention, and here again the influence of small quantities of added metal to the alloy gives very marked differences in their specific resistances and temperature coefficients. Obermaier's nickelin is one of these new alloys which is practically German silver with a somewhat large per centage of nickel. Geitner's rheotan contains about 4 per cent. of iron in place of a corresponding quantity of zinc in the nickelin. Basse and Selve of Altena are also selling for the same purpose an alloy which they term "patent nickel," which practically consists of a mixture of three parts copper and one part nickel, with small fractions of a per cent. of zinc, iron, and manganese. It is difficult at present to connote the physical properties of these alloys with their chemical composition, and until some investigator undertakes the preparation of, say, the series of pure copper-nickel alloys, and then adds thereto varying percentages of the several elements in order, most of this knowledge must remain in its present empirical condition.

The following table is a summary of Feussner and St. Lindeck's determination of the chemical composition and electrical properties of some of these alloys. The manganese alloys examined are those produced at the Isabellen factory at Dillenburg:—

—	German Silver.	Obermaier's Nickelin. A diam. 1·0 mm.	Obermaier's Nickelin. B diam. 0·1 mm.	Rheotan.
Copper	60·10	61·63	54·57	53·38
Zinc	25·37	19·67	20·44	16·89
Tin	—	—	—	—
Nickel	14·03	18·46	24·48	25·31
Iron	0·30	0·24	0·64	4·46
Cobalt	Trace.	0·19	—	—
Manganese	Trace.	0·18	0·27	0·37
	99·86	100·37	100·40	100·31
Spec. resistance	30·0	33·2	44·8	52·5
Temp. co-effic't.	0·00036	0·00030	0·00033	0·00041

—	Patent Nickel. A diam. 0·6 mm.	Patent Nickel. B diam. 1·0 mm.	Manganese Copper.	Nickel Manganese Copper.
Copper	74·41	74·71	70	73
Zinc	0·23	0·52	—	—
Tin	—	Trace.	—	—
Nickel	25·10	25·14	—	3
Iron	0·42	0·70	—	—
Cobalt	Trace.	Trace.	—	—
Manganese	0·18	0·17	30	24
	100·29	100·24	100·00	100·00
Spec. resistance	34·2	32·8	100·6	47·7
Temp. co-effic't.	0·00019	0·00021	0·00004	−0·00003

The negative temperature coefficient of the nickel-manganese-copper alloy is especially noteworthy as well as the high specific resistance of the manganese-copper alloy given in the above table. We hope that further experiments will soon be forthcoming on these interesting alloys, and that they may be found useful in electrical work, for which they seem to be admirably adapted.

SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

At a meeting of this Section, held on the 1st inst., Mr. Ivan Levinstein presided, and spoke at some length respecting reports which had been circulating with regard to the pollution of Manchester air by smoke and fumes from chemical works. He said that a good deal of sensational talk had been indulged in. Every one knew that the air of Manchester was not as pure as at the seaside, but as long as Manchester maintained its position as a great industrial and densely populated centre, and as long as coal was employed as the direct producer of heat, the inhabitants would have to put up with smoke. He wished to point out that the factories and chemical works with their tall chimneys were not such great sinners in respect of smoke as were the thousands of household fires. Chemical and kindred works had lately been denounced by some philanthropists as the chief cause of the pollution of the air, and owners and managers had been put to considerable annoyance and vexatious interference. Such gentlemen forgot that by hampering the works they were inflicting injury on the working classes, whose cause they professed to have at heart. Mr. Levinstein referred to a report on Manchester air recently made by Mr. William Thomson to the Noxious Vapour Abatement Association, which closed with the statement that the greater pollution of the rain water collected in the east of Manchester was no doubt due to chemical works. These reports, he contended, should

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not be made at random or without the strongest possible evidence of their truth, as they were calculated to do harm and injustice to those who were already labouring under sufficient difficulties and disadvantages. He would suggest the formation of an association for the protection of the chemical and allied industries.

In the discussion which followed, Mr. Thomson justified his report, and Dr. Bailey said that, having spent a good deal of time lately on the air pollution question, he had come to the conclusion that the greater part of the evil was due to domestic fires. Observations which had been taken at Leeds for three years showed that three-fourths of the smoke was due to domestic fires. In an orchid house at Chelsea he had found that, owing to the smoke, no perfect blooms could be grown, while in one in the north of England, near a chemical works, there were perfect plants. Mr. Irvine quoted figures he had obtained from rain collected at Miles Platting—a manufacturing centre—showing that the general condition of the air was as good as in the centre of Manchester.

A discussion adjourned from the last meeting then took place on Mr. W. Thomson's paper, on the "Methods for Determining the Value of Rival Sewage Processes." Dr. Burghardt was present, and met the criticism to which he had been subjected in the paper. Representatives of the International Sewage Process Company were also present and criticised Dr. Burghardt's analyses. As Dr. Burghardt referred to the report recently submitted to the Salford Corporation by the chemists and engineers of the sewage trials, the Chairman said that any one else would be in order in criticising this report. The proceedings were at times of a somewhat lively and personal character, and it was fortunate for the patience of the members that all the defeated sewage process companies were not represented by orators. The discussion is scarcely likely to appear in the Society's Journal, and we shall only refer to two important points on which opinions differed.

With regard to sampling sewage, Dr. Burghardt and Mr. Carter Bell held that a perfectly average sample was obtained by collecting a portion every half-hour for twenty-four hours, and then mixing all together.

Mr. Thomson, however, disapproved of this method, and contended that the fact of more albumenoid ammonia being found in the effluent than in the original sample showed that the analysis of the sewage could not be considered trustworthy. Dr. Burghardt explained this anomaly by saying that the sewage had probably taken up something left at the bottom of the tank, but Mr. Thomson thought that very improbable.

The discussion next turned on "loss on ignition," different opinions being expressed. Figures given in the sewage report showed that in some cases the organic matter in solution was higher in the effluent than in the raw sewage. Mr. Thomson contended that this was due to putting down the loss on ignition as organic matter, whereas he had shown it to contain also combined water, ammonia salts, chlorine from chloride of magnesium, and common salt. Combined water would be found when any of the processes employing hydrated oxide of iron, sulphate of lime, &c., were adopted. Dr. Burghardt, on the other hand, said that he had proved the loss on ignition to be almost all organic matter; combined water did not form more than 1 per cent. of the direct residue. With regard to this organic matter in solution, he attached no importance to it whatever from a sanitary point of view, as it was stable and did not undergo further decomposition. A speaker, representing the "International" process, observed that as Dr. Burghardt had found the loss on ignition to be organic matter containing nitrogen, it was strange that it should not decompose. He himself had found that the loss on ignition represented a good deal besides organic matter.

It was announced that these sewage trials were the largest and most comprehensive that had ever been made, and it was intended that the report should be widely circulated. At present it had been suppressed owing to one or two inaccuracies which had crept in, but it was intended to re-issue it at an early date.

Notes.

PUBLIC WORKS IN THE MOZAMBIQUE DISTRICT.

A WHARF of timber and masonry is to be constructed at Puilimane. This wharf will extend into water having a minimum depth of 6½ft. A concession has been granted for the construction of a light railway, for goods and passenger traffic, between Morguirumba, on the Quaqua River to a place to be chosen on the banks of the Zambesi, near Mopea. The line will have a length of 63 kilometres, and has to be completed within twelve months of the approval of the plans. In the latter part of last year a party of eight Portuguese engineers were sent to the Pungue River to make a survey and report on the advisability of constructing a line of railway from Beira, on the coast, at the mouth of the Pungue River, to Manica or Massi-Kesse, on the Revue branch of the Busi River. The proposed route has been found to run through most difficult country. At Beira the line will have to be built on bridges for many miles, as all the country round the mouth of the Pungue River is very swampy. On the other side of the swampy district the country becomes rocky and full of rivers and small streams, yet, notwithstanding all these difficulties, the proposed route has been favourably reported on.

THE CHIGNECTO SHIP RAILWAY.

MORE or less work was carried on during the latter part of the winter at the Tidnish end of this project. Blasting was done in the bottom of the basin under the ice. No less than 1,330 holes were cut through the ice, which formed a platform and admitted of the work being prosecuted much more advantageously than it could be in summer, though its rise and fall with the tide added to the difficulty. The rock, states the *Railroad Gazette*, lay 10ft. to 15ft. under water. Between two and three tons of dynamite was used.

TRAFFIC OF THE SUEZ AND SAULT STE. MARIE CANALS.

THE traffic of the Suez Canal for 1890 was 3,389 vessels registering 6,890,014 net tons, as against 3,425 vessels and 6,783,187 tons for 1889. The traffic of the Sault Ste. Marie Canal, at the foot of Lake Superior, during the 234 days navigation was open in 1889, was 9,576 vessels and 7,221,935 net tons, and in 1890 it was 10,557 vessels and 8,454,435 net tons—that is to say, in 1889 the lock at the "Soo" passed 11 per cent. more tonnage than the Suez Canal, and, in the 228 days that the canal was open last year, 22·8 per cent. more tonnage passed through it than passed through the Suez Canal.

RICE CLEANING IN RUSSIA.

A MILL has been established at Baku by the enterprise of Mr. Hume and Mr. Lister, both Englishmen, where the uncleaned rice supplied from Persia undergoes a process of cleaning and polishing during which the breakage is almost *nil*, owing to special improvements in the system of the works. The yearly output of cleaned rice is about 3,000 tons. This is one of the new industries that have recently sprung up in Russia, and may be said to be a most promising undertaking, considering the great quantities of uncleaned rice procurable in Persia and the proximity of rice-growing districts of Baku and Elizavetopol, which, if properly irrigated, would be capable of yielding over and above the home requirements a considerable surplus for export purposes.

STEAMERS WANTED IN CHINA.

As almost the whole carrying trade at Ichang is done during the winter months, when the water is often less than 5ft. deep, some powerful stern-wheel steamers are required, with a draught of not more than 4ft., but capable of carrying 1,000 packages of merchandise, and with good passenger accommodation, as the passenger traffic is steadily increasing. A recent official report states that the steamers should be provided with a small steam launch, in order that soundings may be taken in places where the water is low, and to mark out a safe passage. The steamers suggested should be able to make the trip from Hankow in four days, in place of the eight to twelve days that are now often taken.

PUBLIC WORKS AT BORDEAUX IN 1890.

THE construction of the new vertical stone quays on the left bank of the river in the harbour of Bordeaux has proceeded somewhat slowly, and will hardly be finished within the appointed three years. The many difficulties attending the discharging and loading the largest class of vessels at Bordeaux, and the great inconvenience and discomfort to which passengers using the large steamers running between Bordeaux and transatlantic countries are frequently subjected now on landing or embarking in the River Gironde, have led one of the most important French steamship companies to apply to the Government for permission to construct extensive landing stages at Pauillac, the outport of Bordeaux, and situated about twenty-five miles from the latter town. The Bordeaux Chamber of Commerce, which for some time opposed this project, on the alleged ground of its being prejudicial to the interests of Bordeaux has now, it appears, itself asked for authority to carry out the work, and establish landing stages at Pauillac for general use. A large naval medical college erected in the town by the municipal authorities for the French Government was inaugurated at the end of last year, the other college of this kind, situated at Lyons, having become too small for existing demands. A work, which is of considerable importance for vessels arriving in the River Gironde with petroleum from America, has lately been completed at Laroque, a few miles below Bordeaux, and consists of a large iron reservoir capable of holding 5,000 cubic metres of petroleum.

THE ELECTRICAL UTILISATION OF WATER-POWER

AN important work, according to the *New York Electrical Engineer*, has been undertaken by the South-Western Electric Light and Water Power Company for the utilisation of water-power situated near the city of Joplin, Mo., U.S.A., for electrical purposes. The scheme includes a fine natural water-power about 5½ miles from Joplin, and when the present installation is completed will cause about 2,000 effective horse-power to be available. A large concrete dam has been constructed, and the turbines have been built by Messrs. Jas. Leffel & Co., of Springfield, Ohio. These turbines have 66in. wheels and work under a head of 21ft. The electrical equipment consists of one 1,500-light 2,000-volt alternating dynamo and two 50-light 2,000 c.p. arc machines. The electric light from these machines is transmitted to the city of Joplin, which is 5½ to 6 miles away from the station. All the electrical machinery for this installation has been been supplied by the Thomson-Houston Company.

INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.

THE Engineering Section of the International Congress of Hygiene and Demography have adopted the following as their programme, and have already been fortunate enough to secure promises of a good supply of papers:—I.—Sewerage and Sewage Disposal—(A) Water-carriage System; (B) Other Systems. II.—Water Supply. III.—Pollution of Rivers. IV.—Town Refuse. Such subjects as street paving, street subways, heating and ventilation, and house drainage, subjects which by many will be thought to belong to the Engineering Section, are absent from its programme. This is due to the fact that the Architectural Section have undertaken to deal with those subjects. The Committee of the Section are of opinion that the subjects they have undertaken should be dealt with as thoroughly as time will permit, and if sufficient funds should be placed at the disposal of the Central Committee the papers and discussions will be printed *in extenso*. The acting honorary secretary, Mr. R. E. Middleton, of 35, Parliament Street, S.W., will be glad to receive any information which may be considered to be of service to the Section, and trusts that the objects of the Congress, which are to diffuse knowledge of hygiene, may be widely published.

BOILERS REGISTRATION BILL.

THE Engineering Trade Section of the London Chamber of Commerce, at their meeting held on the 22nd ult., after considering the provisions of this Bill, adopted the appended memorandum embodying the conditions which they consider should be observed in any legislation affecting the registration of boilers and designed to reduce the number of explosions arising from various causes. The Committee were of opinion that the Bill, if amended in accordance with their suggestions, would better effect the object which its promoters have in view:—1. That every boiler owner shall register his boiler or boilers at the Board of Trade, with particulars (as per the schedule to the Bill) of every boiler owned by him, together with full data and the name of his engineer or other person directly responsible for the condition and management of the boiler or boilers. 2. That the Board of Trade shall keep a register of all boilers and their owners, and of the managers responsible for the same, and shall take proceedings against boiler owners who neglect to have them registered in due course. 3. That the Board of Trade may cause an examination to be made in the case of all explosions, and shall make such an examination in every case where explosion causes damage externally to the boiler or injury to life or limb, or both, and the Board of Trade shall prosecute the party or parties whom they consider to blame. 4. That the boiler owner shall pay a small fee to the Board of Trade to meet the expenses of registration and prosecution.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

27th April, 1891.

7205. The Gaseous and Liquid Fuel Supply Company, Ld., & Thwaite — Injecting and spraying gaseous and liquid fluids.
7208. Elcoate, T. — Valve gearing and valves for steam engines.
7212. Alley & MacLellan — Steam steering machinery.
7218. Williams, H. — Gas motor and similar engines.
7218. Bradley & Black — Machinery for drilling the holes in circles, fallers, and the like.
7219. Riley, R. — Foundry spindle for moulding purposes.
7220. Wilkinson & Wilkinson — Signalling apparatus.
7224. Washington, S. — Weighing machines.
7232. Whitehead, J. — Apparatus for supplying fuel to steam boiler furnaces.
7233. Brampton, C. H. — The manufacture of driving chains.
7245. Haddan, R. — Rotary air engines (*Müller*).
7250. Hoare, W. — Circular saws.
7256. Alder, V. — Priming caps or exploders.
7257. Johnson, J. Y. — Apparatus for producing an artificial draught in furnace flues and the like (*La Société Geneste, Herscher et Cie.*).
7263. Collier, J. — Motive power apparatus.
7267. Murrie, J. — Apparatus for feeding water into steam boilers or evaporators and alarms connected therewith.
7269. Ephraim, A. — Spreading disc for petroleum and gas burners.
7270. Klein, T. — Brake apparatus for railway waggons, &c.
7275. Boult, A. J. — Pitch or driving chains (*Moxon*).

28th April, 1891.

7293. Marks, R. G. — Locking railway signals.
7295. Suydam, J. — Automatic pipe-couplers for railway cars.
7297. Sibley, D. E. — Machine for scouring grain. (27th October, 1890.)
7298. Gerdom & Reynolds — Breechloading ordnance.
7299. De Baere, P. — Rock drills.
7301. Tozer, Stanton, & Stanton — Apparatus for transferring mails to and from trains in motion.
7302. Jarkovski, I. O. — Steam boilers.
7303. Maxon, Boyer, & Staniland — Lifting jacks.
7307. Newton, H. E. — Direct-acting engines (*Worthington*).
7309. Bishop, A. — Means for presenting metal work to the action of emery wheels.
7313. Pinkney, C. W. — Gas engines.
7316. Buckman, S. Y. — Apparatus for joining, coating, and treating sheet metal plates.
7317. Lake, H. H. — Axle boxes for railway vehicles (*Godley*).
7325. Fell, J. C. — Locks of firearms and safety devices combined therewith (*Whitney*).
7329. Wicks, F. — Type composing machines.
7338. Dixon, F. N. — Travelling cranes.
7344. Jensen, C. A. — Mechanical movements (*Edleblute & Mueller*).
7352. Conolly, H. — Air-tight manhole covers.

29th April, 1891.

7354. Brett, E. S. — Steam stamps.
7365. Nance, W. — Apparatus for dressing or separating ores of tin or other metals or minerals.
7366. Wormald & Washington — Shedding motion of looms.
7375. Sharp, T. — Cogging mills.
7384. Marsland, Coldwell, & Coldwell — Heating water by exhaust steam.
7385. Miles, H. A. — Circular saw table for use in lathes.
7386. Roberts, L. — Brake mechanism of vehicles mounted on bogie wheels.
7387. Speight, Jarvis, & Sellers — Rollers for carding machines.
7390. Schofield, J. W. — Method of fixing wheels on the axles of railway, tramway, or other rolling stock.
7395. Adams, J. A. P. — Lathes.
7401. Hartmann & Thomson — Leather paring machines.
7407. Hills, G. — Mechanical time and percussion fuses for projectiles.
7413. Seward, T. — Safety brake or locking device for lifts.
7415. Kummer, Fischinger, & Leck — Centrifugal governors for engines.
7418. Bousfield, J. E. — Mountings for quick-firing guns (*Ternstrom & Widell*).
7425. Horn, W. W. — Appliance for moving railroad switches (*Washington & Roberts*).
7426. Horn, W. W. — Railway track (*Kendall, Hunt, & Fay*).
7432. Breething, E. — Machinery for moulding bricks.
7436. Wills, J. — Construction of screw propelled boats.

30th April, 1891.

7444. Ulrich, F. — Drilling machines.
7455. Hall, H. R. — Engine governors.
7472. Swindells & Peel — Apparatus for transferring mail bags or similar articles to or from trains in motion.
7477. Hundleby, R. — Metallic sleepers, chairs, and rail joints.
7482. Comings, W. R. — Mechanism for applying, exerting, and controlling band friction.
7491. McGrath, Jones, & Carter — Combined supply, cut-off, expansion, and exhaust valves with automatic variable gear for steam engines.
7499. Bousfield, J. E. — Breech mechanism for quick-firing guns (*Bergman*).
7500. Marc, E. C. — Ramie machinery.
7510. Marshall & FitzGerald — Air propelling or ventilating.
7511. Decock, E. — Machinery for dyeing textile materials in hanks.
7512. Lane, F. R. — The valve gear of engines.
7517. Farrer, F. T. — Cocks or valves.
7519. Barlow, W. A. — Hydraulic motor (*Guignet & Bloemendaal*).
7520. Wright, P. — Engine slide valves.
7521. Preston & Nelson — Compressed air or gas motor.
7525. Bertram, D. N. — Paper-making machines.

1st May, 1891.

7530. Miller, A. — Heating feed-water of steam boilers.
7538. Rylands & Emmet — Machinery for making bottles.
7545. Tattersall, W. — Apparatus for humidifying air.
7551. Murrell, S. — Flues for marine boilers.
7556. Willoughby, Ackroyd, & Ackroyd — Apparatus for utilising the waste heat of marine boilers.
7557. Pirnie, G. — Method of or means for propelling vessels.
7559. Scott & Fenley — Steam engines.
7561. Giblis, H. — Charging retorts.
7566. Gray, A. — Vaporisers for petroleum engines.
7579. Edwards, E. — Apparatus for ejecting or withdrawing vapours and gases from pipes (*Rohrmann*).
7580. Bell & Welsby — Lifts, elevators, and similar machinery.
7581. Roberts, H. P. — Vaporisers.
7587. Robinson, A. S. F. — Thrashing machines, traction engines, and other road locomotives.
7588. Thomas, H. M. — Governors for motive power engines (*Sainsbury*).

2nd May, 1891.

7600. Noble, A. — Apparatus for working guns.
7602. Langfield & Sharples — The consumption of smoke and apparatus therefor.
7611. Fraser, P. — Screw-tapping mechanism.
7612. Semmler, A. — Straight bar knitting machines.
7625. Tropenas, A. — The manufacture of steel, steel castings, or ingot iron, and apparatus employed therein.
7626. Barker, R. L. — Spiral springs for pistons and air pump buckets.
7632. Mowat, J. G. — Securing the foundation fabric of card clothing to the bars of flat carding engines.
7643. Anderson, R. — The bending of metal tubes.
7644. Lane & Ashford — Apparatus used in the soldering of the seams or joints of metallic tubes.

ELECTRICITY.

27th April, 1891.

7204. Kingsland, W. — Electric alarms.
7210. Jarvis, G. A. — Incandescent lamps.
7225. Nussbaum, G. A. — Telephonic transmitters.

28th April, 1891.

7278. Percival, G. — Electric switches and circuit closing and opening devices.
7283. Bennett, A. R. — System of telegraphy and telephony.
7331. Abel, C. D. — Telephones (*Société Générale des Téléphones—Reseaux Téléphoniques et Constructions Electriques*).
7333. Thompson, W. P. — Dynamo-electric machines (*Tischendorfer*).

29th April, 1891.

7353. Bayly, J. P. — Electric railway systems (*Weems*).
7355. Atkins & Atkins — Electrical fittings.
7372. Bolton & Mountain — Apparatus for actuating hammering, caulking, rock-boring, or like percussive machinery by electricity.
7427. Horn, W. W. — Electric time locks (*Flowers, Jones, & Price*).
7430. Heaviside, Jackson, & Richardson — Equalising motion pulley for alternating current dynamos.
7433. Salomons, Sir D. L. — A leakage detector for electric lighting conductors.

30th April, 1891.

7479. Keller, E. E. — Underground conduits for electric railways.
7493. Sperry, E. A. — Mounting dynamos and motors upon rotating axles.
7529. Shann, G. — Dynamo-electric machine.

1st May, 1891.

7531. Cuthbert, A. — An insulation cutter.

2nd May, 1891.

7603. Yule & Stewart — Electric signalling apparatus for passenger trains.
7614. Walker, T. P. — Regulating the brilliancy of incandescent lights.
7661. Thomson & Foyster — Putting transformers in or out of circuit.

CHEMISTRY.

27th April, 1891.

7258. Johnson, J. Y. — Production of dyes belonging to the rhodamine series (*Badische Anilin & Soda Fabrik*).

28th April, 1891.

7282. Claus, W. H. — Process for the manufacture of pyrogallic acid.

29th April, 1891.

7362. Kellner, C. — Apparatus for recovering sulphurous acid used in the manufacture of paper pulp from wood.
7434. Nodon, A. — The electrolysis of chlorides and the utilisation of the liberated chlorine for the manufacture of chlorates and hypochlorites.
7437. Fleischer, E. — Manufacture of alkali aluminates.

30th April, 1891.

7464. Hop, A. — Carburating or carbonising apparatus.

2nd May, 1891.

7654. Brindley, G. F. — The production of solid compounds of sulphuric acid and acid sulphate of sodium or potassium.

MISCELLANEOUS.

27th April, 1891.

7223. Charlopin, C. — A solution or fluid for motive power or heating purposes.
7228. Nagel, E. — Leather belting with steel facing.

28th April, 1891.

7284. Cruikshank, G. M. — Gas burners (*Bergeon*).

29th April, 1891.

7396. Prosser, H. W. — Spanners.
7400. Rizzoni, P. — Axle journals.

30th April, 1891.

7445. Shepard, J. W. — Instruments for obtaining angles, levels, perpendiculars, and gradients.
7450. Cuttler, Cuttler, & Cook — Life guards for tramway and other engines.
7487. Haddan, R. — Magnesium flash lights (*Engel*).
7513. Crang & Harris — Hooks for disengaging boats.

1st May, 1891.

7558. Loewenthal, L. — Production of gas.
7583. Bourân, J. D. — Coal gas retorts.
7590. Brewster, F. W. — Connecting and disconnecting ships' boats.

2nd May, 1891.

7593. Jones, T. W. — Railway chairs.
7607. Walker, J. — Rod packing.
7619. Falconer, R. — Miners' lamps.
7624. Armour, A. — Packing for water-gauge glass tubes (*Armour*).
7628. Walton & Walton — Washer.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

1578. Jewell.
5010. Hartmann & Thomson.
6374. Ives & Barker.
6521. Hookham.
6685. Willoughby & Horsfield.
7031. Weiss.
4784. Faulds.
6325. Bilbie & Gooch.
6470. Horn (*Beatty*).
6607. Taylor.
6747. Elliott.
6798. Bottcher.
7068. Foster.

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7198. Hitchcock-Spencer.
7826. Skinner & Chatterton.
7667. Kingsford.
7830. Sykes & Blamires.
8276. Wooster.
8632. Commons.
8659. J. Crossley & Sons, Ld., & Siret.
8945. Turck.
9019. Shaw.
9083. Hough.
9112. Ellershausen.
9191. Sandino.
9413. Brooks.
9435. Bayly (*Shearer*).
9489. Duckett & Duckett.
9542. Koch.
9729. Wise (*Piron*).
9768. Dawson & Hirsch.
9888. Watson & Watson.
9909. Newman.
9935. Woodward.
9958. Gray.
9972. Hinton & Hinton.
9984. Watson.
9992. Cooper.
10006. Hindle, Hindle, & Isherwood.
10021. Jepson.
10034. Bayly (*Gehring*).
10036. Bayly (*Lenderoth*).
10046. Moffat.
10058. Foster.
10087. Hamilton.
10095. Johnson (*Badische Anilin & Soda Fabrik*).
10140. Cockroft & Farmer.
10154. Priestman & Priestman.
10163. Raworth.
10177. Breiner.
10220. Wormald & Washington.
10231. Atherton & Battersby.
10257. Tiffin (*Wenstrom*).
10263. Karl Kuno Malmström.
10283. Clay.
10326. Hutchinson.
10415. Lee.
10422. Murden.
10456. Wallace.
10613. Robertson & Wedgwood.
10682. Bay.
10788. Saint-Denis.
11030. Palmer.
11217. Lawson & Hodgetts.
11552. Herrburger.
11709. The Adamant Railing Company, Ld., & Hetherington.
12398. Peterson.
13320. Heeley.
13600. Taylor.
16757. Just, Weiler, & Heidepriem.
17168. Edwards (*Kentnowski*).
18549. Gehre.
19669. Thode.
20070. Martin.
20503. Tillinghast.
21043. Essick.
7271. Willmott.
7603. Capel & Ladd.
7827. Fox.
8261. Wright & Wright.
8609. Fyfe.
8651. Smith.
8668. Piffard.
8752. Cryer.
8958. Finby.
9060. Vialet-Chabrand.
9107. Eckardt.
9152. Rodges.
9218. Brunton & Statter.
9434. Bayly (*Holmes*).
9482. Sloan.
9514. Gairdner & Ramsay.
9631. Cowan.
9758. Marshall.
9875. Bayly (*Terman*).
9890. Horton.
9910. Boullanger & Schneubert.
9967. Fowler.
9977. Hickes.
9991. Parker.
9999. Hatschek.
10011. Mills (*Michalot-Sirot*).
10012. Sershall.
10030. Whittaker & Parker.
10035. Bayly (*Brandon*).
10038. Watt.
10051. Wilkinson.
10065. Taylor.
10089. Beechey.
10107. Holland.
10138. Harrison & Sheard.
10152. Hollingworth.
10159. Hahlo, Lieberich, & Hanson.
10164. Brooke.
10198. Waring.
10225. Jones.
10228. Chambers.
10249. Bayly (*Kingsland*).
10259. Simons & Smith.
10264. Castelnau.
10276. Allison (*Ward*).
10325. Hutchinson.
10340. Townsend.
10416. Gibbs.
10487. Margetts.
10599. Lake (*Oehler*).
10635. Smith.
10662. Puskas & Schlenker.
10735. Pemberton.
10860. Jelf-Petit.
11095. Smith.
11392. Kirschbaum & Schnitzer.
11894. Baker.
12212. Chance & Chance Bros. & Co., Ld.
12613. Von Kalchberg.
13534. Parkinson.
15906. Haagen.
16805. Scott.
17078. Radford.
17417. Lewin.
19081. Kerr.
19688. Prescott.
20490. Attock.
21005A. Fairweather (*Pratt & The Babcock and Wilcox Company*). (24th December, 1890.)

1891.

48. Link & Avenarius.
1027. Grant.
1437. Wilcox.
1715. Vassie.
1988. Imray (*The Writing Telegraph Company*).
2443. Westinghouse & Schreuder.
2895. Karsten (*Kasten*).
3621. Andersen & Kaas.
3787. Harris.
3851. Sponsel.
3996. Lake (*Copeland*).
4079. Fleming, Ferguson, & Dixon.
4244. Clarke.
4302. Boult (*Pifre*).
4464. Schuster.
4545. Jermy.
4629. Aschendorf.
4715. Amstutz.
4769. Wheatley.
4863. Lake (*Stafford*).
5046. Von Skoda.
5238. Cook.
5254. Lake (*Hill*).
5272. Trost.
5418. Schaffer.
5453. Ashberry & Barnes.
5470. Taylor.
5514. Stelling (*Henkel*).
5548. Bishop.
5562. Thompson (*Dodge*).
5571. Ross.
5584. Thompson (*Wade*).
5596. Hunter.
5622. Thompson (*Prall*).
5625. Davey.
5661. Malfait.
5686. Russell & Downing.
209. Löbel & Liebman.
1286. Edwards (*Held*).
1440. Hibling & Jeffery.
1882. Mezzetti.
2356. Morris. (5th September, 1890.)
2873. Burdon.
2887. Thompson (*Sanford*).
3088. Downie.
3675. Edwards (*Kunhardt*).
3839. Wolfe.
3859. Bockmühl & Karthaus.
3997. Smith (*De Kunwald*).
4131. Greninger.
4218. Richards & Cooley.
4293. Boult (*Cote*).
4870. Kruger.
4540. Boult (*Raftery*).
4574. Milnes.
4676. Bowker & Williams.
4749. Briggs.
4790. Johnson (*Koyl*).
4939. Boult (*Milburn*).
5223. Sagendorph.
5242. Hinsdale.
5257. Koch.
5366. Nolte (*Kleinpeter*).
5450. Smith.
5464. Shuttleworth, Shuttleworth, & Gamble.
5543. Klatte.
5555. Haddan (*Evans*).
5570. Goldsmith.
5577. Perkins.
5588. Seck.
5597. Selkirk.
5623. Thompson (*Schönleber & Knauss*).
5662. Horn (*Marlow*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Boiler Furnaces.—*E. Broadhead, W. Beesley, & D. Evans, Barrow.*—The generation of heat in steam boiler furnaces constructed according to this invention is effected by assisting the combustion of inflammable gas introduced into a furnace, by directing streams of air upon the burning gas. Inflammable gas (preferably "producer gas") is introduced into the furnace through a pipe or tube, and two or more currents of air heated in an air pipe and led through the flue in a zigzag fashion are caused to meet the incoming gas at a point immediately above the grate, the branched and perforated ends of the air pipe and the end of the gas pipe over the fire being protected by refractory material. The air is forced through the zigzag tube by a steam blower. A furnace grate of ordinary construction is provided, but of somewhat less length than usual, and a bright coal or coke fire is kept up, the flame of which ignites the incoming gas, and warms the air admitted through the bars into a combustion chamber formed by a brick lining in the flue, over the grate, the heat of the lining serving to continue the ignition of the gas while fresh charges of fuel are burning up. Claims: Causing heated air to be directed upon inflammable gas as it enters the furnace over the fire; the conducting pipe for air, arranged within the flue, and the steam jet.—No. 8510. June 2nd, 1890. 8*d*.

Die Stocks and Dies.—*W. P. Thompson, Liverpool.* (*J. S. Fletcher & J. S. Emmert, Chicago, U.S.A.*)—This arrangement is designed for accurately varying and determining the gauge of the die with reference to the bolt or article to be operated upon, to provide a separable die stock and die with a guide adapted to be held therein by the means employed for holding the die; to adjust the

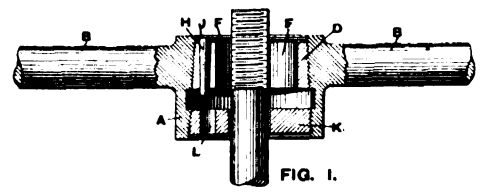


FIG. 1.

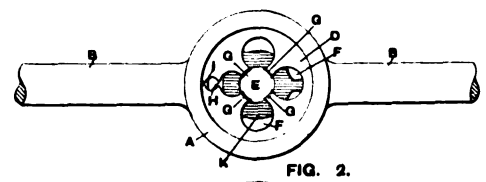


FIG. 2.

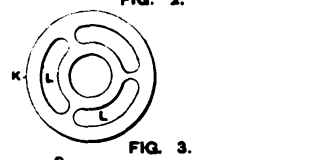


FIG. 3.

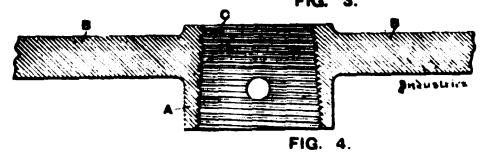
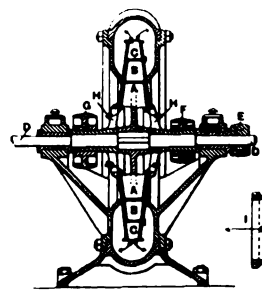


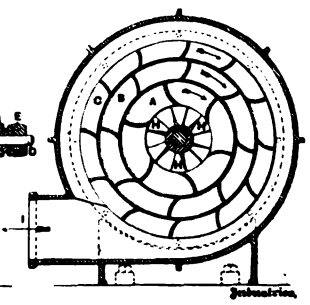
FIG. 4.

die with nicety and hold it firmly; and it is claimed that the arrangement here described constitutes a simple and cheap tool. Fig. 1 is a central section through a die stock and die showing a bolt in the die, Fig. 2 is a plan of the same without the bolt, Fig. 3 is a plan of the guide, and Fig. 4 shows a stock having its bore threaded from end to end. The die stock is formed with a hub A having one or more arms or handles B; the hub is provided with a tapered bore C preferably threaded from end to end as in Fig. 4, or, if desired, the bore, as in Fig. 1, need not be threaded throughout its whole length. The cutter D is tapered and externally threaded to screw into the hub, taking up a position within its smaller end. The central opening E in the die is preferably formed with recesses F passing through the die, which recesses receive the cuttings, the wall portions G of the die between the recesses being provided with cutters for threading the bolt. The die is split through at H, the split permitting the die to expand and contract in conformity with the diameter of the tapered bore; thus the location of the die within the bore can be changed to determine or vary its gauge. The walls of the split or gap H are provided with notches or recesses I for the reception of a pin J to jam the die within the bore. A guide K is located within the other end of the tapered bore and is provided with a central opening L to fit the bolt or rod to be threaded, which guide is provided with several slots as shown, which serve to receive a wrench for turning the guide or a tool to act upon the pin J, and also serve to pass the cuttings. The inventors desire to cover any equivalent arrangement in which, broadly considered, a hub or holder having a tapered bore and a die adapted to wedge within the said bore are provided. Claims: The combination referred to in the last preceding sentence, and the combination fully described above.—No. 3327. February 24th, 1891. 8*d*.

Steel Manufacture.—*W. Hodge, Yatton, Somerset.*—The method described in this specification is similar to the cementation process, but differs therefrom by the employment of a material for producing carbonisation, which, while effecting the desired result in a single process, does not blister the surface nor affect the grain or the internal structure of the iron as does the wood charcoal employed in the cementation process. The substance employed is spent tan, which, having been partially or wholly charred, is put into the box or crucible with the wrought-iron goods, as is customary. The boxes or crucibles are well luted, and exposed to a moderate furnace heat for such time as is necessary for the amount of conversion required, and the furnace is afterwards allowed to cool down. Claims: The steelification of wrought iron in a manufactured or partially manufactured state by the application of carbonised spent tan as described.—No. 7253. May 9th, 1890. 6*d*.

Centrifugal Fans.—*Carl Wenner, Zurich.*—A compound centrifugal fan for delivering a high-pressure blast is illustrated herewith, in cross section in Fig. 1, and in longitudinal section in Fig. 2. It consists of three fans A B and C, each provided with an annular series of vanes and being mounted so that each


FIG. 1.


FIG. 2.

series revolves independently of the other and in the same direction about a common axis, but the different series rotate with different angular velocities which are so related that their circumferential or peripheral speeds are about equal. With reference to Fig. 1 it will be seen that the series A is fixed on the central shaft D, and is driven by the pulley E which is keyed thereto, the series B being formed upon the right hand disc, seen in section, secured to the long boss carrying a driving pulley F and turning freely upon the right hand end of the shaft D, and the series C forming part of the left hand disc turns freely with the left hand boss and its driving pulley G upon the opposite end of the shaft. Portions of the arms carrying the series B and C are formed as screw surfaces at H, to allow the air to enter the fans freely at the centre. Air drawn in and brought to a certain pressure by the first fan would be delivered to the second fan (see also Fig. 2), which would impart to it additional pressure, thus the air would enter the third fan C at a still higher pressure, which by the action of the last fan is still further augmented, so that the air can be brought to a pressure approximately double or triple (according to the number of fans) of that pressure which would correspond to the circumferential speed of only one of the fans. On leaving the last fan C the air passes into the annular casing and leaves it by the outlet I. Claims: A compound fan composed of two or more single fans running at different speeds substantially as described; forming the spokes or arms carrying the series B and C as screw blades, for the reason stated above.—No. 17607. November 3rd, 1890. 8*d*.

Band Saw Guides.—*J. & J. Plumridge, High Wycombe, Bucks, & S. Jackson, Chinnor, Oxford.*—The arrangements illustrated are designed to provide a support for the back of the saw and for the sides thereof, in such a manner that the alignment of the saw will be preserved, the thrust of the back of the saw being taken by the face (and not by the periphery) of a disc arranged to turn freely on its axis, and supported by anti-friction balls, or by backing-rollers, in order that the pressure of the saw on the disc may not cause it to cant and the position of the axis thereof to be sensibly displaced, as has been the case where an unsupported disc has been employed, and also where the saw has been given a bearing upon the periphery of a roller. To keep the saw in adjustment laterally a pair of wooden guides or rubbing faces are arranged, one on each side of the blade, one block being clamped in position and the other being adjustable to admit the

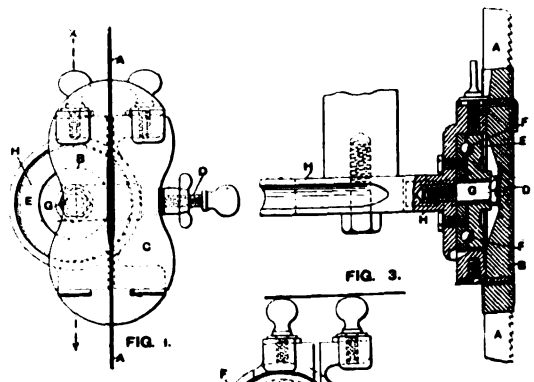
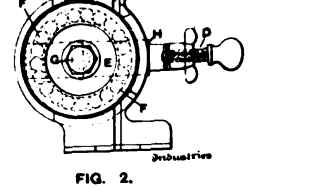

FIG. 1.

FIG. 3.


FIG. 2.

passage of saws of different thickness. A front view of one modification is given in Fig. 1 herewith, Fig. 2 being a like view with the saw and the wooden guide blocks removed, and Fig. 3 being a section on the line X Y of Fig. 1. In these views A is the saw, B the fixed wooden guide, C the moveable one with its adjusting screw D, E is the disc taking the thrust of the rear of the saw, F the supporting rollers, and G the pin on which the disc rotates, the whole arrangement being carried by a bracket or arm H adjustable upon the machine to suit variations in the work. Claims: The combination of the revolving disc with an anti-frictional supporting device.—No. 5129. April 2nd, 1890. 8*d*.

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MARINE ENGINE GOVERNORS.—*J. D. Churchill, London.*—This invention relates to the governing of compound engines and consists of an arrangement wherein the governor, which may be of any suitable kind, operates the throttle valve and also operates what are termed compound attachment valves, these latter affecting the low-pressure cylinder. Two compound attachment valves are employed, one placed near each end of the low-pressure cylinder, to avoid loss by clearance. Stop valves in connection

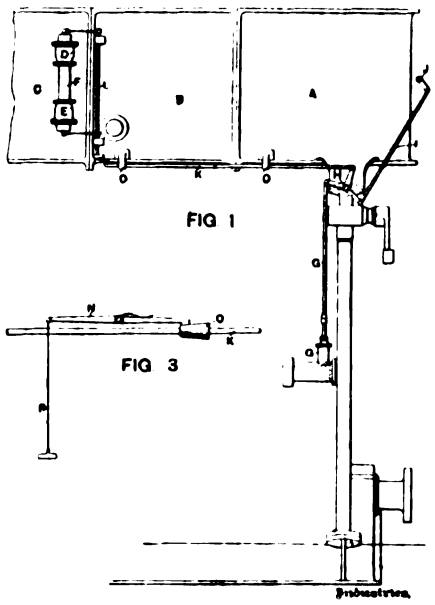


FIG 1

FIG 3

with the attachment valves are dispensed with. Fig. 1 illustrates in side elevation a view of part of a triple-expansion engine to which the apparatus above referred to is attached, A, B, and C being the high, intermediate, and low-pressure cylinders respectively, D and E being the two compound attachment valves attached to a connecting pipe F, so that when both valves are opened they place the upper and lower ends of the low-pressure cylinder in communication and the low-pressure piston in equilibrium. G is the governor, preferably of the inventor's own construction, operating the three-armed lever H, a rod I from one of the arms controlling the throttle valve at J, another arm operating the rod K, which, by the vertical shaft L, controls the compound attachment valves. From Fig. 2 it may be seen that one end of the rod K is provided with a pin working in a specially formed slot, in order that the governor, which actuates the rod K simultaneously with the actuation of the rod I by which the throttle-valve is closed, may not open the compound attachment valves until the throttle-valve has been closed to a predetermined extent; consequently steam will not be lost in the low-pressure cylinder unless the speed of the engine rises excessively; moreover, the speed of the engine will not be too suddenly checked. When the governor acts in the opposite direction, the valves D and E, if these have been previously opened, will be closed by the action of the pin of the rod K upon the shoulder M and the upper portion of the slot shown in Fig. 2, and thus the low-pressure cylinder resumes work simultaneously with the high-pressure cylinder, and the engine resumes work smoothly. Other forms of apparatus for effecting similar results are described.

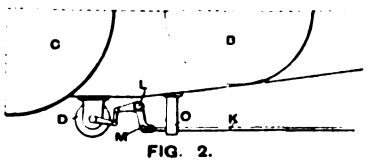


FIG. 2.

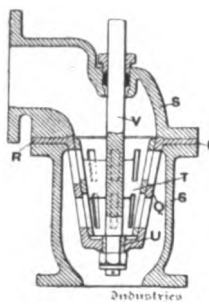


FIG. 4.

Fig. 3 shows a detent N which turns upon a pivot carried by the framing of the engine; this detent engages with a collar O carried by the rod K, and is stated to lock the valves D and E in their closed position in the event of the engine racing excessively or breaking down. The collar O may be released by pulling the wire P. Fig. 4 shows one of the compound attachment valves in vertical section, in which Q is a tapered slotted valve seat formed with a flange R, by which it is secured between the upper and lower parts of the valve case S. A correspondingly tapered slotted valve T is adjustable for wear by a screw nut U, journaled on a reduced part of the valve spindle V, and able to work through a screw-threaded hole in the lower end of the valve seat. In another modification a collar on the valve spindle keeps the spindle in place by bearing in a recess in the stuffing-box, which itself may be adjusted by screwing it into or out from the valve casing, so keeping the valve down to its seating. Claims: The compound attachment valves (or valve) on the low-pressure cylinder operated by slotted connection from the governor as described; also the provision of two compound attachment valves located as described and operated by the governor, the device illustrated in Fig. 3, and a method (not shown above) of controlling the governing valves by an arrangement of levers and flexible connections; and the two modifications of the compound attachment valve.—No. 6590. April 29th, 1890. 11*d.*

SMOKE PREVENTION.—*S. K. Barnes, London.*—This specification describes an apparatus intended for application to boiler or other furnaces for the prevention of smoke where slack or small bituminous coal is used as fuel, and the appliance consists of an induction apparatus whereby heated air is injected into the furnace above the fire by means of a jet of dry steam. To the inner side of the furnace front is applied a pipe, arched to lie close up against the crown of the flue; the two ends of this pipe are brought through the dead plate and turned out below it, as air supply inlets. At the top of the arched pipe are introduced one or more steam pipes, taken from any convenient part of the boiler into an injector jet piece placed horizontally under the furnace crown and forcing a combined jet of air and steam over the fire towards the bridge. Owing to the air inlet pipe being placed inside the furnace front the air will have become considerably heated by passing through the hot pipe before mixing with the jet of steam, and the steam will thus be well dried before admission to the furnace. The action of this jet also induces a better flow of air through the fire-bars in addition to the natural draught, which will consequently tend to raise the rate of combustion per square foot of fire grate, and so keep up a better evaporation. Claims: The combination with induction air tubes placed within the furnace front of an injection nozzle or nozzles fed with dry steam and controlled by a regulating valve; the specific arrangements described.—No. 8418. May 30th, 1890. 6*d.*

PIPE CUTTING AND SCREWING.—*A. Göbel, Ems, Germany.*—The piece of apparatus shown in longitudinal vertical section in Fig. 2, and in end elevation in Fig. 1, is one in which the pipe to be cut or screwed is introduced into the central or axial opening from the right hand, automatically gripped and centred by a clamp at that end, whilst a cutter is rotated, or rotated and advanced, about the opposite end. A support A is provided with a horizontal hollow shaft, about which the headstock and hollow sleeve B are rotated by a worm C operated by the handle D and gearing into the worm-wheel E, which is integral with the headstock and sleeve. The headstock carries a cutter-head F, of known construction, which rotates with it, and which may receive motion in the direction of its axis, but is prevented from

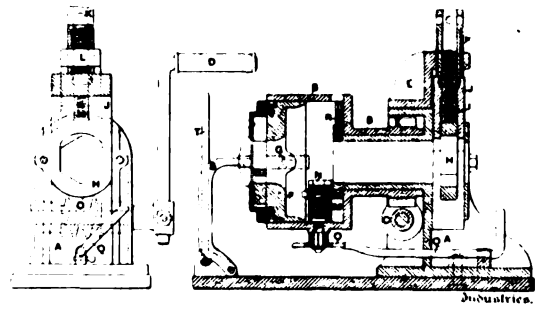


FIG. 1. FIG. 2.

receiving independent rotation by two stops G, which work in slots provided for that purpose in the headstock. The automatic centreing clamp is at the opposite end of the machine, and is thus arranged:—A ring H carrying a screwed spindle I is adjustable vertically within a jaw J, the lower edges of which are cut out at an angle of 120 degrees, as shown, the lower internal edge of the ring H being similarly cut out, so that a cylinder or pipe inserted in the opening between the two comes into contact with four points on the four inclined faces, both ring and jaw sliding in ribs on the support A to prevent lateral displacement. A hollow stud K passes through a lug L on the support A, and is threaded externally for the purpose of raising and lowering the jaw J, to which its lower end is attached; it is also threaded internally with another screw of double the pitch of the external screw for the purpose of receiving the screwed spindle I of the ring H; thus the motion of the jaw J and ring H relatively to each other is such that any circles inscribed in the space between the jaws will have a common centre concentric with the axis of the sleeve B and head F. Screw-cutting discs are fitted in the headstock and operate in the usual and well-known manner. For cutting off lengths of pipe a piece M is secured in the headstock, and carries a cutter N on a moveable slide, which is fed forward by the star wheel O on the screw P, the wheel being rotated by contact with the end of the rod Q, which may be moved into or out of the path of the star wheel. Screws R assist in holding the pipe in position whilst being cut. A presser arm S is held by the lever T against the cutter head to keep it up to its work when cutting screws, and the lever T may be withdrawn from its bearings to allow the arm S to fall and the cutter-head to be removed if required. Claims: The screwing and cutting device as aforesaid; the presser arm and accessories.—No. 15553. October 1st, 1890. 6*d.*

ANCHORS.—*W. L. Byers, Sunderland.*—An anchor designed in the manner described below is intended to be equally trustworthy in mud or slime as in hard ground. To increase the holding power of a stockless anchor the inventor forms a partial cylindrical or curved surface on the inner face or front of the cross-head towards the flukes, the said surface, when embedded in soft ground, affording a firm hold. The curved surface extends longitudinally along the inner part of the cross-head from arm to arm, being partially interrupted at the centre by the double eye which is to receive the shank. The cross-head and spurs are also strengthened by longitudinal and transverse webs formed in one with them, on the underside thereof. Claims: An anchor cross-head, the inner face of which is curved to form a dish or scoop, the underside of the cross-head being strengthened by longitudinal and transverse ribs.—No. 7846. May 20th, 1890. 6*d.*

AIR COMPRESSOR.—*Wm. Tattersall, Bradford.*—The apparatus herein described is for the purpose of supplying compressed air, and is of simple form, consisting of a vibrating compressor blade or vane operated in any convenient manner, and enclosed within a segmental or vee-shaped case provided with suitable valves and a receiver. The blade or vane is pivoted in the narrow end of the case, and the free end of the blade fits against the opposite end of the said case which is formed to a curve struck from the centre of the blade pivot. The inclined sides of the case approach one another at the narrow end, and the parallel sides are the same distance apart as the width of said blade. Admission valves are provided in the casing, at opposite sides of the blade, and emission valves lead from each side into a receiver. In operation, the blade is vibrated within the case by means of connecting rods which are driven from a crank-shaft and vibrate arms, secured, outside the casing, upon the shaft to which the blade is fixed. During each stroke air is admitted to one of the sides of the blade, and expelled from the opposite side, each side serving alternately for suction and for delivery. Claims: The air compressor or blower constructed with a vibrating blade within a vee-shaped chamber, and delivering into a receiver, substantially as described above.—No. 5429. April 10th, 1890. 6*d.*

HIGH SPEED ENGINES.—*W. P. Thompson, Liverpool.* (*Geo. C. Pyle, Indianapolis, Ind., U.S.A.*)—The inventor's object is to construct high speed engines which will automatically maintain an unvarying speed, and which will be compact in structure. Fig. 1 illustrates one of these engines in longitudinal section and coupled

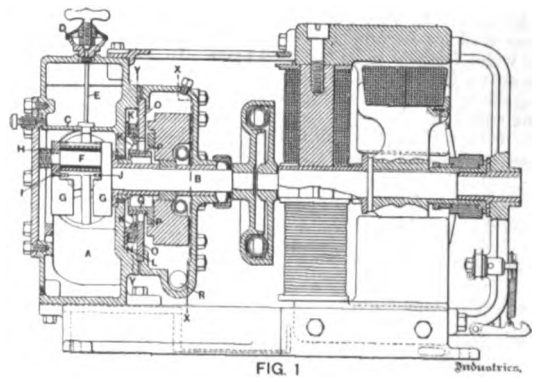


FIG. 1.

to a dynamo, Fig. 2 being a cross section through the cylinders, Figs. 3 and 4 being cross sections on the lines X X and Y Y respectively of Fig. 1. The cylinders A of four single-acting engines are formed in one casting which encases them and carries the bearings for the main shaft B. The two upper cylinders are connected by a web C, the space thus enclosed between them forming a chamber into which oil is introduced at D. The open space around the other cylinders receives the exhaust steam, some of which will find its way up a pipe E and will condense in the oil chamber, displacing some of the oil therein and causing it to overflow down the walls of the pipe E, which will discharge it immediately above the crank pin F; automatic and continuous lubrication is thus ensured, and the chamber is said to act as a steam jacket. The outer web of the crank G is secured to the crank pin F, the latter having its outer end threaded as shown, and being fitted with two bushings H and I, one of which is preferably of a metal which will run without lubrication, this precaution being observed because of the inaccessibility and high speed of the pin. It is considered desirable that there should be three

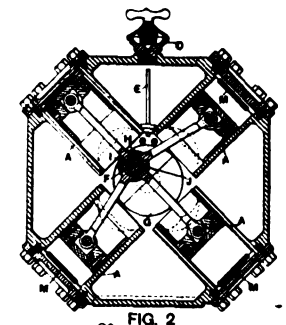


FIG. 2

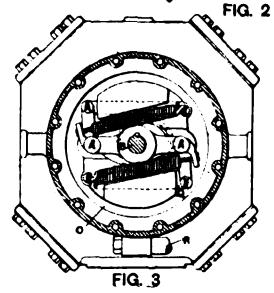


FIG. 3

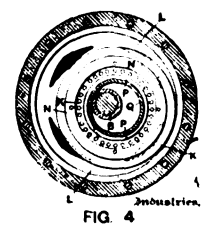


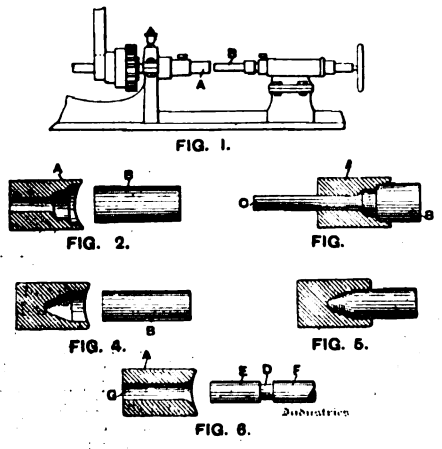
FIG. 4

bearing surfaces here—the crank to bear against the first bushing, that against the second bushing, and the latter against the bored big-ends of the piston rods. A ring J embraces the piston rod ends to prevent displacement of same. The valve K is circular in form, and a flat annular portion thereof bears directly against the turned surface L of the bottom of the valve chest and adjacent to the port openings (see Fig. 3); the steam proceeds from these openings along within the thickness of the casting to each cylinder at M; a packing ring N forms the back of the valve, and bears against a stationary ring O which forms a division between the live steam space and the exhaust space. The annular space around the valve and between L and O is the space into which live steam is introduced by a passage (not shown), and the exhaust steam from within the annular valve passes through holes in a flange P into the valve chest, and away by the pipe R. The

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flange P of the valve encircles a similar flange Q, this latter being held eccentrically to the shaft by a centrifugal governor, shown in Fig. 3, operating against the resistance of spiral springs, and carried by the main shaft within the casing; the governor, by varying the eccentricity of the flange Q, lessens the eccentricity of the annular valve, and, the valve and governor revolving with the main shaft and relatively to the port face, variation of the the eccentricity of the valve will vary the point of cut-off and the period of expansion. Claims: The various combinations constituting the high-speed engine as described above, and including the oil chamber and steam jacket, and the valve formed and operated as described.—No. 961. January 20th, 1891. 8*d*.

METAL TUBES.—*J. G. Bohl, Peoria, U.S.A.*—This invention consists in forming tubes and like articles, reducing or increasing their diameter, closing them at their ends, or welding or joining two or more tubes together, as will be described. A hard metal die or former is mounted on the spindle of a lathe and is provided with a smooth recessed face or with a smooth perforation through the die or former in the line of its axis, or with both, as may be required. This recess or perforation receives the tube or other article to be formed, and when the die or former is revolved at a sufficient velocity the article forced thereinto becomes intensely heated by frictional contact, and is thereby softened and made susceptible of being reduced, closed, or otherwise formed. As an alternative the article may be revolved while the die remains at rest, or both may be revolved in opposite directions. Fig. 1 is a side elevation of a lathe for spinning tubes, A being the die or former and B the tube about to be forced thereinto by the tail-stocks crew. In Fig. 2 A is a longitudinal section of a die or former used for forming tubes with small termini, B being the tube which is about to be operated upon. In Fig. 3, the former A is shown in section with the partially reduced tube B therein, C being the reduced portion. Fig. 4 represents in section a die wherein the ends of a tube may be securely closed and welded by means of the tube striking the wall of the recess therein, which heads, closes, and securely welds the ends of the tube, the tube B

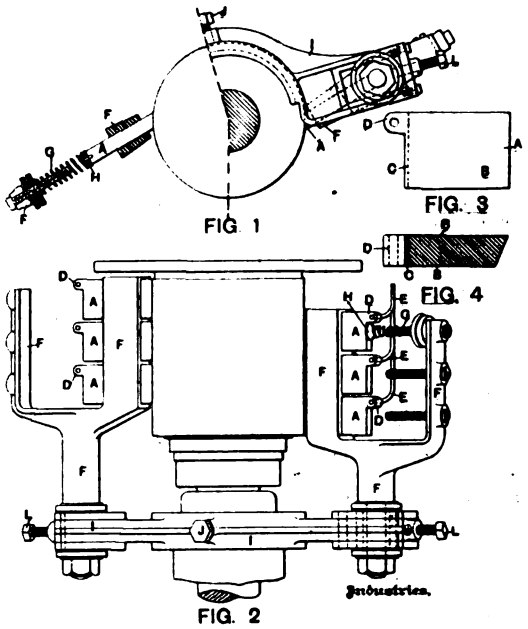


being shown in elevation, and in Fig. 5 the die and completed tube are illustrated. In Fig. 6 a die A is shown in which two tubes E F may be welded together. The tube F is represented as slightly larger than the tube E, and as having its end D reduced in order that it may be introduced into the latter as shown. The tubes are now forced into the die A, and the moment the tube F comes into contact therewith it becomes reduced in diameter, and, by reason of the intense heat generated by the frictional contact of the rapidly revolving die is immediately welded to the tube E, and passes out at the opening G reduced to the same size and thickness as the tube E. Claims: The method of spinning and welding tubes and the like substantially as described.—No. 3122. February 20th, 1891. 6*d*.

ELECTRICITY.

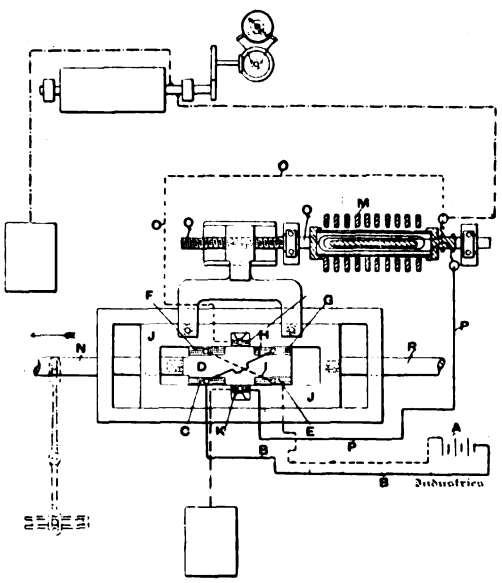
SECONDARY BATTERY ELECTRODES. — *Dr. Schoop, Oerlikon, Switzerland.*—According to this specification, electrodes of high capacity for secondary batteries may be produced in a short time at a moderate cost with a minimum expenditure of energy, and without the use of paste or of any material mechanically applied to the body intended to form an electrode. For this purpose one or other of certain electro-negative substances containing one or other of the halogen elements, chlorine, fluorine, bromine, or iodine, are used in a bath in which two series of lead plates are immersed, one set of plates being connected to the positive pole and the other to the negative pole of an electric generator, current being passed through the bath for, say, 36 to 100 hours, in accordance with the strength of current used and the depth of porous lead required. For a plate having a surface of 100 square centimetres, a current of ½ of an ampere may be used, the temperature of the bath being maintained at 50° Fahr., but it is evident that these data are variable with circumstances. An example is given where the composition of the bath is one hundred parts by weight of water, five of bisulphate of sodium, and two-thirds of one part of chlorate of potassium, or an equivalent composed of water, sulphate of sodium, chlorate of potassium, and sulphuric acid; with this bath, there is probably formed on the plate constituting the anode chloric acid, part of which combines with the lead, whilst the other part is decomposed by the current without combining with the lead plate. The result is that oxide of lead is formed upon the anode, and the cathode plate appears to be scarcely altered, hydrogen escaping freely from its surface. After this treatment the direction of the current is reversed, so that the plate which was formerly the anode is now the cathode, and becomes reduced by the oxygen liberated thereon, and is finally covered with spongy or porous lead. When this is effected the bath is removed, the plates washed, and the vessel re-charged with dilute (10 per cent.) sulphuric acid, and another reversal of current is continued until gases are abundantly evolved from each plate, and the two series of electrodes resulting are ready for use. Examples of the use of the fluorine, iodine, and bromine compounds are given. Claims: The electro-chemical treatment above indicated, and involving the use of an electro-negative halogen compound, a salt of sulphuric acid and water, with or without the addition of free sulphuric acid; also the use of a sulphate or bisulphate in this connection.—No. 7518. May 14th, 1890. 6*d*.

BRUSH FOR DYNAMOS.—*M. Immisch, London.*—This is a new form of carbon brush, in which the current is not taken from the frame or holder of the brush, but directly from the carbon block itself, by attaching thereto a flexible conductor. The nature of the invention may readily be gathered from Fig. 1, which is an



elevation, partly in section, of the commutator and brushes, from Fig. 2 a plan of the same, and Figs. 3 and 4 a plan and longitudinal section, respectively, of one of the brushes. The carbon brushes A are coated with copper B, except at the contact surface with the commutator, and have a plate of copper C secured at the rear end of the carbon block, this plate being provided with an ear or lug D, in which the flexible conductors E are secured to convey the current directly to or from the brushes. The brushes A are inserted in a holder F, through which they can work freely, and adjustable springs G insulated from the brushes by blocks of insulating material H (Fig. 1) enable the pressure of the brushes upon the commutator to be regulated, and allow for the wear of the brushes. Each brush holder F is carried at one end of a frame I, the position of which can be shifted for lead, relative to the end-bearing of the dynamo, and secured by the set screw J, the stems of each of the brush holders F, being, of course, insulated from the frame I, and the brush holders are carried in guides K in the frame I, being adjustable by the screw L towards or from the commutator when the brushes are adjusted for wear or when new ones are inserted. Claims: The brush as described; the insulated spring adjustment for same; and the combination of brushes, holders, and frame.—No. 7511. May 14th, 1890. 8*d*.

SERVO-MOTOR.—*C. W. Sleeman, London.*—This is a combination of sliding contacts carried by two slides, and operated as a "hunting" arrangement for opening and closing a circuit from a



battery through electromotors used to operate signalling devices, such as engine-room telegraphs, or operated by a pendulum for controlling the propulsion of submerged torpedoes, or for other purposes, and the principle of the device is such that, to any amount of movement imparted to the apparatus by the operator, corresponds a certain and predetermined amount of motion of the driven mechanism, correspondence between the two movements being automatically ensured. In the illustration, A is a battery, from one pole of which connection is made by the wire B with a contact C carried by a sliding-block D, which carries also a contact E, and, at its opposite sides contacts F and G. The contacts C and G are electrically connected together by a wire H, as also are the contacts E and F by the wire I. The sliding frame J carries at its opposite sides spring contacts K and L, which are connected to the opposite terminals of a motor M, a wire from the spring contact K going to earth. The operator moves the central slide to any distance to the left of its present position—for example, by means of the screw N, thereby closing the battery circuit through the contact C, wire H, contacts G L, and wire O, to the motor, the return circuit from the motor being closed to earth through the wire P and contacts K. The frame J is operated by a screw Q driven by the motor, which will immediately move the contacts on the frame J away from and ultimately out of connection with the contacts on the block D, which remains stationary. Should the motor over-run, the slide J operated thereby will also over-run (being always operated by the screw Q to follow up the block D), and thus will break the first circuit, bringing the second pair of contacts E and F into position to close a reversed circuit through the motor, which will therefore be rotated reversely, and finally be brought to rest at a position properly corresponding to the completion of the range of motion desired by the operator. The motor M may not itself directly operate the signalling device, which may be arranged in parallel with it as shown in the upper part of the illustration. When used to control a torpedo, the frame J is operated by a pendulum, which acts upon the rod R. Claims: The servo-motor substantially as described for general purposes, and particularly for controlling the propulsion of torpedoes; the use of the apparatus as a relay for connecting an intermediate station with the transmitting and receiving station.—No. 5923. April 18th, 1890. 8*d*.

ZINCS FOR BATTERIES.—*J. Moseley, Manchester.*—The zincs consist of a series of layers or sheets of wrought or rolled sheet zinc, each sheet (when the zinc has to be amalgamated) being separately amalgamated before being made up into the element. In the case of flat and similar elements the several sheets are secured together by zinc fasteners; or, to obviate the possibility of local action arising from differences in the quality of the plates and fastenings, pins or studs of ebonite, celluloid, or similar insoluble non-conductors are employed. In one example, short tubes of ebonite are used, which pass through perforations in the plates, and are slightly longer than the thickness of the element. A warmed conical tool may be inserted in the ends of the tubes to splay or open them outwards and thus secure the plates together. Cylindrical and tubular forms of the elements are shown, in which each of the concentric layers is formed from a tube drawn from a strip of sheet zinc. The edges of the sheet nearly meet, and in placing the tubes one within the other the spaces at such meeting edges should preferably alternately break joint, and in preparing these tubular elements each tube is made of slightly different diameter to that which it will possess when in the element, and the edges are not quite closed up. By this arrangement the tubes may be extended or spring into one another, and will be secured without the necessity for any special fastening. Claims: Battery zincs formed of separate sheets as described, secured by zinc or by non-conducting fasteners; also the tubular and cylindrical battery zincs as described—No. 13463. August 27th, 1890. 8*d*.

CHEMISTRY.

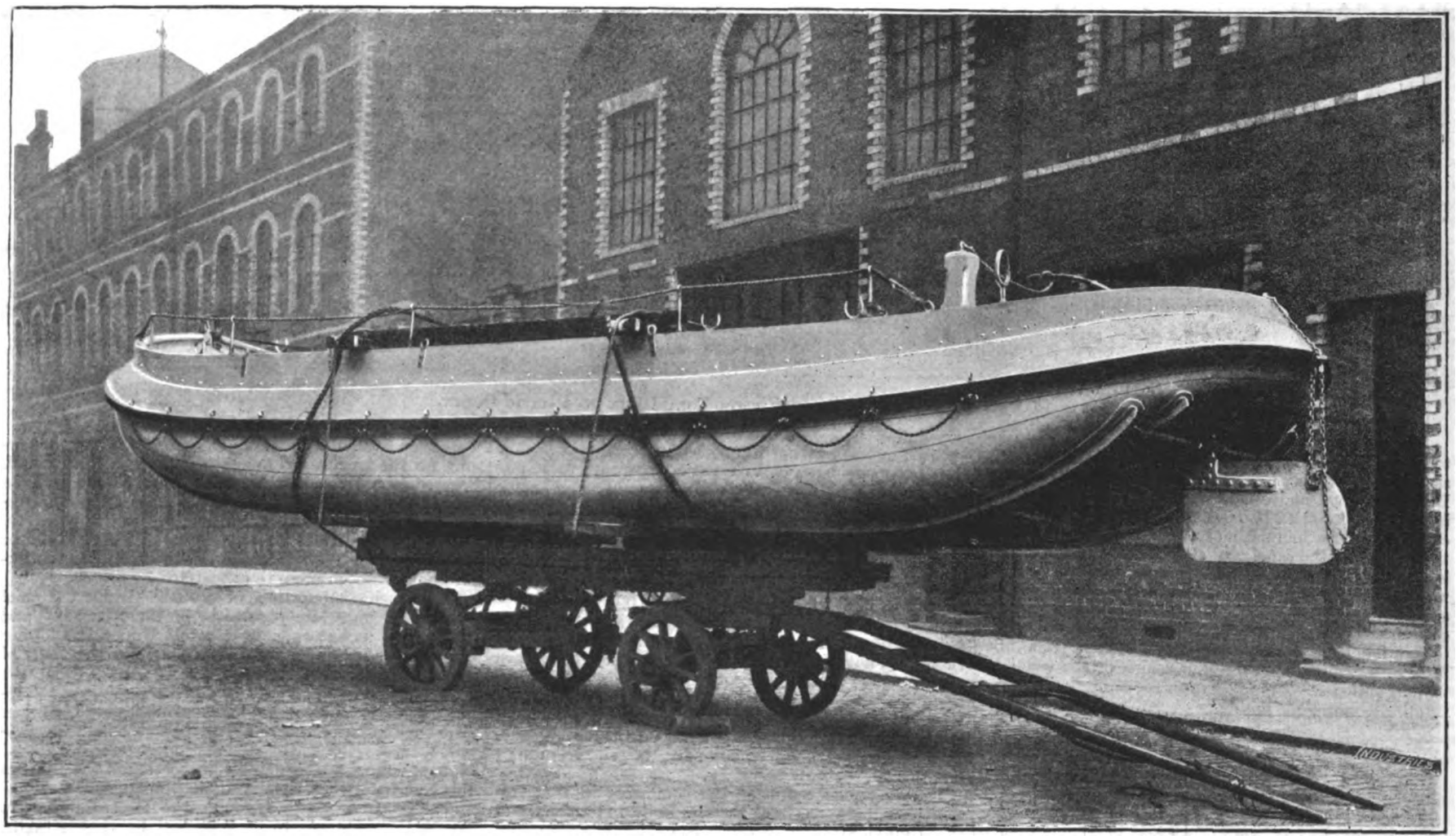
CHROMIUM COMPOUNDS.—*H. H. Lake, London.* (*Jules Massignon & E. Watel, Paris.*)—For the production of the above the inventor, after finely pulverising the ore, mixes it with calcium chloride and lime in such quantities that the entire base obtained from the caustic lime or the calcium carbonate shall be somewhat greater than the quantity necessary for forming a calcium chromate, when all the chromate sesquioxide of the ore will be transformed into chromic acid by the oxidation. The calcium chloride is used in the proportion of one part to three parts of the total lime. The mixture is conveyed to a furnace, wherein it is first heated moderately for effecting desiccation, and is then raised to a temperature sufficient to reduce the calcium carbonate to form caustic lime. If the material burned at the temperature adapted for the reduction of the calcium carbonate is removed from the furnace, it will be sufficient to allow the pieces of material to be exposed to the air at the ordinary temperature in order that the complete oxidation of the chromium sesquioxide shall without any manipulation be gradually effected by the action of the atmospheric air, as the material is porous enough for enabling the latter to pass to the interior of the pieces. For manufacturing chromates and bichromates of potash and soda the above-mentioned mixture is lixiviated in hot water by washing so as to enable a concentrated solution to be produced which contains all the calcium chloride and only a small quantity of calcium chromate by reason of the great difference in the solubility of these two substances. For the purpose of recovering or utilising the calcium chromate entering into this solution, the latter can be concentrated and then serve for preparing a fresh mixture of the material; the calcium chromate which it contains will thus be extracted by the following operation. This solution can be utilised for manufacturing lead chromate (chrome-yellow) by precipitating the calcium chromate by a salt of lead. In this manner will be obtained a solution of calcium chloride deprived of chromate and ready to be used in the operation, and the chrome-yellow is produced very economically, whilst heretofore it has been necessary to obtain the same from potassium or sodium bichromate. After this washing operation the mixture is treated by a solution of sulphate or carbonate of potash or soda and yields potassium or sodium chromate, and if, moreover, sulphuric acid is employed, potassium or sodium bichromate in solution. These solutions are filtered for separating them from the insoluble deposits, concentrated and crystallised in order to extract from them the salts formed. When the mixture of dry oxidised material is treated by sulphuric acid, or by dry gaseous hydrochloric acid, chlorochromic acid can be economically obtained. By treating the mixture with sulphuric acid, and after the calcium chloride has been removed therefrom by lixiviation and after drying, chromic acid can be economically produced without first forming potassium or sodium bichromate as heretofore. The inventor makes six claims for the above-described processes.—No. 2224. February 6th, 1891. 6*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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GENERAL VIEW.

STEEL TUBULAR LIFEBOAT FOR PWLLHELI.

We give above a general view of a lifeboat of a novel design built by Messrs. Mechan & Sons, of the Neptune Works, Glasgow. This boat has been built to the order of the Royal National Lifeboat Institution, from designs prepared by Mr. Charles H. Bloe, M.Inst.C.E., the Honorary Secretary of the Institution at Liverpool. The length of the boat is 35ft.; breadth, 10ft.; depth amidships, 4ft. The hull is formed of two tubes as shown, which taper gradually to a circular section towards the stem and stern, where they turn inwards and upwards toward each other above the water level, thus forming one homogeneous structure. As this boat will require to depend entirely upon oars and sails for propulsion, lightness and strength are essential qualities. With these points in view steel has been adopted for its construction. The hulls are constructed of mild steel plates of $\frac{1}{16}$in. thickness, formed to the required shape and thereafter galvanised. The framing consists of steel angle bars 1½in. by 1½in. by ⅛in., spaced at 21in. centre to centre. The two hulls are securely braced together at intervals under the thwarts by means of girders formed of tee bars of steel. Between those girders and the two hulls the deck is fitted, being supported on the bottom tee bar, while the thwart beams are secured to the upper one of the girder. The tee bars are bound together by struts and ties of steel angle bars. Besides those girders there are three stays 1½in. in diameter, secured to the inside bilge, extending across between the tubes to give additional rigidity to the structure. The deck has a height of about 7in. above the water level, and in it thirty automatic relieving valves are fitted for the purpose of freeing the deck from water as quickly as possible. Around the outside top corner of the tubes, there is secured the gunwale boarding, which is 11in. deep amidships, tapering to 4in. at stem and stern, thus giving the required freeboard of 2ft. 4in. Around the inside of this is fitted the sparred side seats. A central fore and aft beam of red pine is secured along the tops of the thwarts, and a flat steel bar is fastened in the centre line along the bottom of the girders extending from stem to stern. Around the outside of the boat, just above the water level, is fitted an elm rubbing piece to prevent excessive shocks when the boat is alongside of vessels.

The boat is divided by bulkheads into eighteen separate water-tight compartments, so that in the event of several of these being injured, the floating capacity would not be much affected thereby; and for the purpose of cleaning and painting the interior of the hull, a water-tight manhole is fitted to each compartment. In order that the trim of the boat may be under command, a water-ballast tank has been formed on each side, each tank being provided with valves for filling, and a 4in. pump, by which the compartments may be emptied in a few minutes. As the draught of the boat is only 18in., four centre boards, 5ft. long by 2ft. 9in. deep, have been fitted, which will improve considerably the sailing qualities of the boat. Two are inserted into each hull.

It will be evident that a boat having the form described will have very great stability at small angles of inclination, the displacements being divided and removed to a distance from each other. Although, by so doing, the surface friction is increased, this is compensated for by the more important quality of stability.

The boat is fitted with two masts carrying lug sails and one jib sail, and is fitted with accommodation for pulling seven oars on each side. A carriage is provided, which the boat will be launched from, or conveyed by, on land, to within the shortest distance by sea to a shipwreck, thus avoiding danger and enabling the crew to arrive at their destination without being unduly fatigued.

THE NICARAGUA CANAL

IV.

(*Continued from page* 420.)

WATER SUPPLY.

As we have already mentioned, one of the leading points in favour of the Nicaraguan Canal route is the abundance of the water supply at all seasons, in which respect it compares favourably with the Panama route. According to Mr. Menocal's estimate, the water required for thirty-two lockages per diem, corresponding to the passage of 11,680 vessels per annum, would be 127,400,000 cubic feet. The minimum flow from Lake Nicaragua at its outlet by the San Juan River was found, by gauging, to be 11,390 cubic feet per second, or 984,096,000 cubic feet per diem. This gives a surplus of 856,696,000 cubic feet daily over the quantity required, and all from the lake supply only, during the driest season. In the wet season the discharge was estimated by Colonel Childs at 18,059 cubic feet per second, and, taking the mean between the two values, a flow of 14,724 cubic feet per second is arrived at, equivalent to 1,272,530,600 cubic feet daily. On this basis the mean excess of supply over demand would be no less than 1,144,753,600 cubic feet. In addition to this comes the flow of the various tributaries of the San Juan River, and also those of the various basins, which, it is calculated, will amply compensate for leakage and evaporation. The surface area of Lake Nicaragua is about 2,600 square miles, with a watershed of at least 8,000 square miles.

DIMENSIONS OF CANAL.

Out of the 26 miles of excavated channel, over 18 miles of the excavation will be of sufficiently large section to allow vessels travelling in opposite directions

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THE NICARAGUA CANAL.

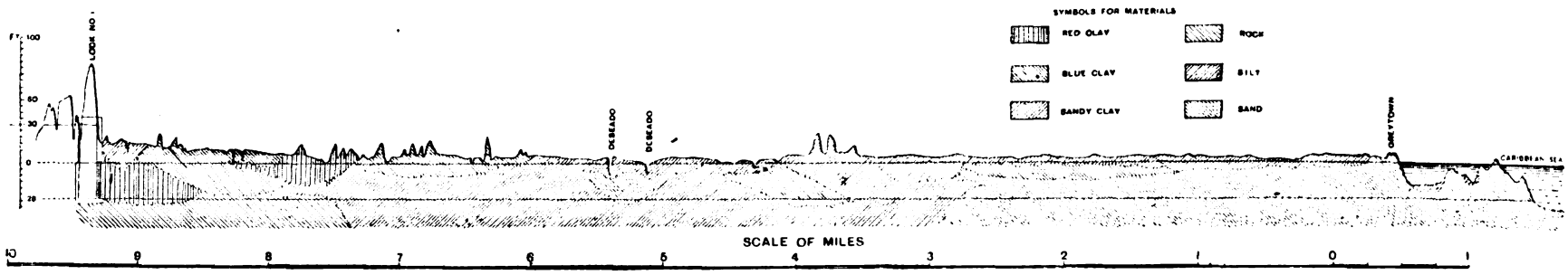


FIG. 7.—GEOLOGICAL PROFILE FROM GREYTOWN TO LOCK NO. 1.

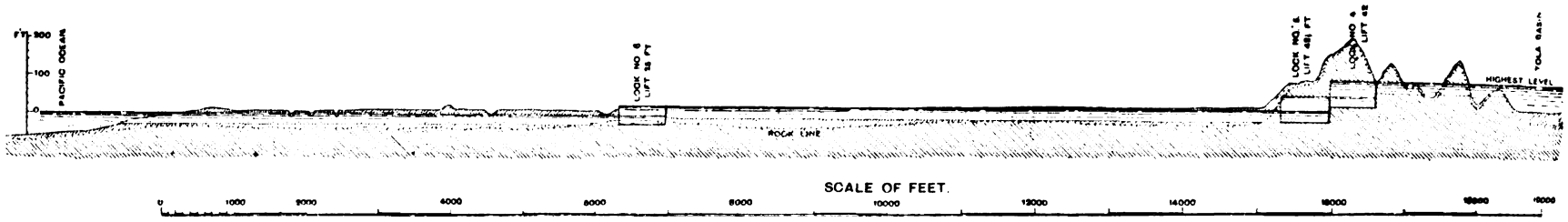


FIG. 8.—GEOLOGICAL PROFILE FROM TOLA BASIN TO PACIFIC OCEAN.

to pass each other. Those parts in which the dimensions will be reduced are in the Eastern and Western Divide cuttings, and consist of a length of 2·917 miles in the former and 4·924 miles in the latter. Here the cuttings will be in rock, and, as they are situated near the termini of the canal, and close to the upper locks, it is considered that the slight gain in speed of transit which would be secured by making the channel of larger sectional area would be outweighed by the increased cost of excavation.

The following tabular statement, taken from Mr. Menocal's report, shows the dimensions of the canal in various parts:—

Portion of Canal.	Length. Miles.	Width, Top. Feet	Width, Bottom. Feet.	Mean Depth. Feet.
Greytown to Lock No. 1	9·297	288	120	28
Lock No. 1 to Lock No. 2 (canal)	1·258	210	120	30
Lock No. 2 to Lock No. 3 (canal)	1·650	210	120	30
Lock No. 2 to Lock No. 3 (basin)	1·762	—	—	30
Lock No. 3 to Western End of Eastern Divide Cut (canal)	2·917	80	80	30
Lock No. 3 to Western End of Eastern Divide Cut (Deseado Basin)	3·086	—	—	45
Western End of Divide Cut to Ochoa (canal)	1·233	184	80	30
Western End of Divide Cut to Ochoa (San Francisco Basin)	11·267	—	—	40
River San Juan to Toro Rapids	37·040	—	—	52
River San Juan, where dredging is needed	27·500	—	125	28
Lake Nicaragua	56·500	—	150	50
Lake to Western Divide Cut (canal)	1·565	210	120	30
Western Divide Cut (canal)	4·924	80	80	30
Divide Cut to East End of Tola Basin (canal)	2·519	184	80	30
East End of Tola Basin to Lock No. 4 (basin)	5·504	—	—	50
Lock No. 5 to Lock No. 6 (canal)	1·582	184	80	30
Lock No. 6 to Harbour of Brito (canal)	·570	288	120	28

A geological profile along part of the canal is shown above in Figs. 7 and 8, and will, in conjunction with the preceding table, assist in giving a clear idea of the kind and amount of excavation required on the various parts of the canal route.

PROSPECTIVE TRAFFIC.

Last year an elaborate report on the traffic expected to pass through the canal was issued by the Nicaragua Canal Construction Company, compiled by Mr. Thos. B. Atkins, the secretary and treasurer of the Maritime Canal Company of Nicaragua. As the author of this report very truly remarks, the problem is an intricate one, and allows room for a considerable diversity of opinion. The question was very carefully studied by a Statistical Commission for the information of the International Congress which assembled in Paris in 1879 to consider the various projects for an interoceanic canal between the Atlantic and Pacific then before the public. The conclusion was arrived at and embodied in the report presented to the Congress by M. Levasseur, the president of the Commission, "that the tonnage of traffic existing in 1876, within the zone of attraction of such a canal, upon the basis of an estimated average value per ton, was 5,268,000 tons." According to another estimate, based upon statistics partly furnished from American sources, the traffic was calculated at 4,833,000 tons. Finally, 5,250,000 tons was accepted by the Commission as a "very moderate" estimate of the tonnage existing in 1878 within the zone of attraction, while the probable amount in 1888 was calculated at 7,250,000 tons.

In framing a new estimate Mr. Atkins has, in so far as possible, based his calculations on official statistics of value, and not of bulk or weight, since the former are more reliable; where accessible, local statistics have been made use of, otherwise the figures of our own Board of Trade are accepted. The traffic coming within the influence of the canal is divided into three classes—First, entirely tributary; secondly, largely tributary; and thirdly, partially tributary.

The aggregate value of the commerce in 1888, respectively, between Great Britain, France, Germany, and the United States, and other countries, likely to contribute in a greater or less degree to the traffic through the canal, is then given in a tabular form. The total value is estimated at $825,110,167. From the official returns of exports and imports for some of the leading countries of the world an average value of each ton of freight carried can be arrived at, and by applying this value to the whole of the commerce in question—with the exception of nitrates, wheat, &c., which are carried almost exclusively from South American ports to Europe—an estimate is obtained of the equivalent tonnage, which amounts to 18,785,350 tons. The question then has to be answered, as to what proportion of this tonnage will pass through the canal.

As *entirely* tributary, the author of the report in question characterises the trade between the following places:—

	Tons.
Atlantic with Pacific ports, United States, &c. (not included elsewhere)	275,000
Pacific ports with Great Britain, France, Germany, Belgium, Cuba, and Brazil	1,032,247
Atlantic ports of United States with Hong Kong, China, Japan, British Australasia, Philippine Islands, Hawaii, Peru, Equador, and Chili	1,263,399
Coal oil to British, French, and Dutch East Indies from Atlantic ports	519,863
Great Britain with Equador, Peru, and Bolivia	2,137,317
Belgium with Peru	105,589
Total	5,333,415

The trade classified as "largely tributary" is estimated to furnish 2,526,542 tons to the business of the canal, while from "partially tributary" commerce 262,136 tons are expected.

We have therefore:—

	Tons.
Entirely tributary traffic	5,333,415
Largely " "	2,526,542
Partially " "	262,136
Total	8,122,093

This is an estimate for 1889-90, and includes an allowance for the ascertained increase of the trade in coal oil, between the United States and China, Japan, and the East Indies, as compared with the year 1888-89. According to M. Levasseur's report, previously referred to, the anticipated traffic for 1888-89 was 7,250,000 tons, so that it will be seen that the expectations therein expressed have been more than justified by events.

In all such computations of probable traffic the chief element of uncertainty consists in the "largely" and "partially" tributary contingents. Under the former heading, for instance, Mr. Atkins classifies the trade of Great Britain with Hong Kong, Japan, China, the Australian Colonies, New Zealand, Tasmania, the Philippine Islands, Chili, and Central America, and assumes that one-fourth of the total will pass through the proposed canal, being "attracted in proportion to distances." Now, of course, a considerable proportion of the trade of this country with Australia, China, Japan, New Zealand, and Tasmania passes through the Suez Canal. In giving the distances to be traversed by vessels taking different routes between given points, Mr. Atkins states the distances *viâ* the Cape of Good Hope, but not those *viâ* the Suez Canal, and the traffic to the countries above enumerated passing through the Suez Canal is not separated from that carried round the Cape of Good Hope. We think it would be more satisfactory if this had been done, although we have no reason to suppose that Mr. Atkins' estimate is exaggerated, since he expressly disclaims any expectation that any appreciable proportion of British trade with the East and Australia now carried on by way of the Suez Canal will be diverted to the proposed new route.

Generally speaking, it is calculated that where the saving in distance approaches 2,800 miles for a 2,000 ton vessel, with a cargo worth $150,000 or over, there will be an advantage to both shipper and shipowner in using the new waterway at a toll of $2·50 per registered ton. The possible developments of new business resulting from the opening of the canal offer a wide and varied field for speculation, in which Mr. Atkins indulges at some length.

The lumber trade of the North-Western Pacific coast is one of those industries which, it is anticipated, will be greatly increased by the additional facilities for transport to a favourable market afforded by the canal, more especially as the forests of the Eastern States no longer yield an adequate supply of large timber. Another expected result of the construction of the Nicaragua Canal, not altogether so pleasant for this country to contemplate, is the increase of the commerce between the Eastern States of America and South America. "To-day," as Mr. Atkins remarks, "England is practically as near the markets of Western South America as we; to-morrow we shall be 7,000 miles nearer than she is to-day in a distance of 10,600 miles by existing routes. We shall still have the advantage over her of the Atlantic's width when the canal is opened, nearer by so many miles to a market for our cotton goods and manufactures of every kind, with machinery, agricultural implements, furniture, woollen goods, carpets, and coals to sell, and the needs of 75,000,000 of people at home to furnish a reciprocal market for the products which they have to offer us."

(To be continued.)

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RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.

TABLE I.—Trials of the s.s. "Iona."

Analyses of Funnel Gases by Volume.						Analyses of Funnel Gases by Weight.					
No. of Sample.	Carbonic Acid.	Carbonic Oxide.	Oxygen.	Nitrogen.	Time of Collecting.	Duration of Collecting.	Carbonic Acid.	Carbonic Oxide.	Oxygen	Nitrogen.	No. of Sample.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	p.m.	Minutes.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	6·43	0·00	13·11	80·46	6·34–7·20	46	9·57	0·00	14·20	76·23	1
2	8·71	0·00	10·51	80·78	7·30–8·10	40	12·85	0·00	11·28	75·87	2
3	8·64	0·00	10·61	80·75	8·30–9·30	60	12·75	0·00	11·39	75·86	3
4	7·79	0·00	11·63	80·58	9·30–10·30	60	11·54	0·00	12·52	75·94	4
5	8·86	0·00	10·79	80·35	10·30	2	13·06	0·00	11·57	75·37	5
*					a.m.						*
9	8·93	0·00	9·67	81·40	2·30–3·20	50	13·18	0·00	10·38	76·44	9
10	8·15	0·00	11·17	80·68	3·30	2	12·05	0·00	12·01	75·94	10
11	7·15	0·00	11·70	81·15	4·30–5·30	60	10·62	0·00	12·64	76·74	11
12	7·06	0·00	12·51	80·43	5·30–6·30	60	10·48	0·00	13·51	76·01	12
13	8·91	0·00	10·80	80·29	6·30–7·30	60	13·13	0·00	11·57	75·30	13
14	8·85	0·00	10·87	80·28	8·0–8·30	30	13·05	0·00	11·65	75·30	14
15	8·82	0·00	10·78	80·40	9·0–9·30	30	13·00	0·00	11·56	75·44	15
16	8·28	0·00	11·07	80·65	9·40–10·15	35	12·24	0·00	11·90	75·86	16
Mean.	8·20	0·00	11·17	80·63		Mean.	12·12	0·00	12·01	75·87	

* Samples 6, 7, and 8 were not properly taken, and were therefore rejected as being unreliable.

FIG. 4. *Total Coal, Water, and Revolutions; and Temperatures of Chimney Gases and of Feed-Water.*

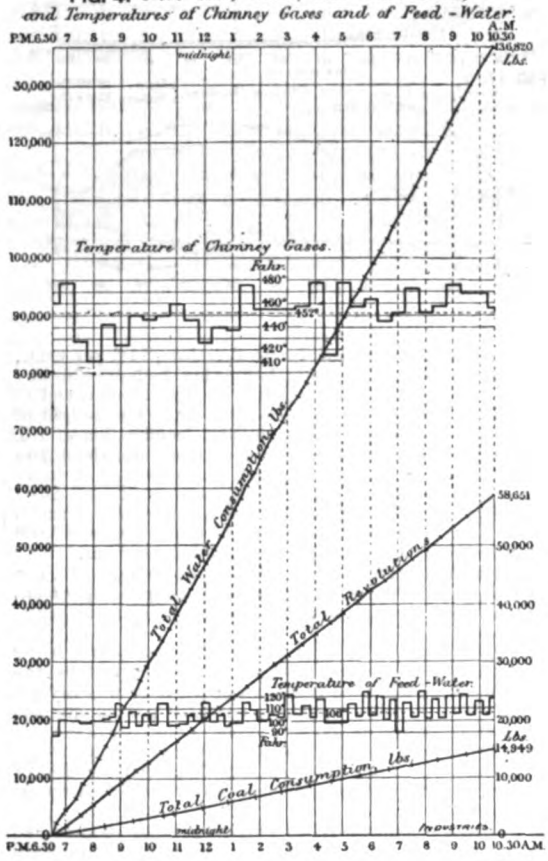


FIG. 5. *Total Indicated Horse-Power.*



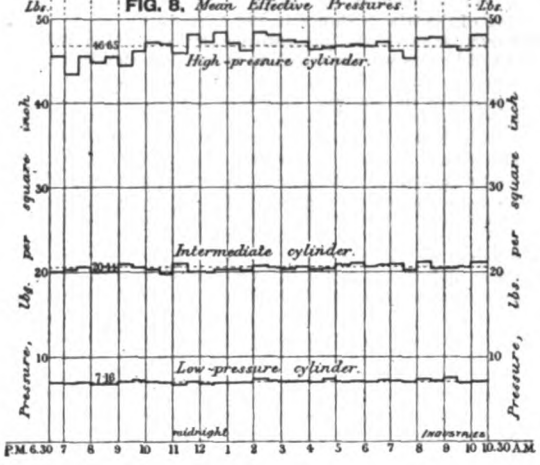
FIG. 6. *Boiler Pressure above atmosphere.*



FIG. 7. *Revolutions per minute.*



FIG. 8. *Mean Effective Pressures.*



RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

(*Continued from page* 449.)

REPORT UPON TRIALS OF THE S.S. "IONA."

Duration of Trial.—The duration of the trial from start to finish was exactly 16 hours, or 960 minutes.

Coal Measurement.—The coal was weighed in baskets by means of a spring balance in the stoke-hold, as in the former trials (see *Proceedings*, 1889, page 237; and 1890, pages 205, 214, and 226), about 450lb. at a time being put down on the floor beside each boiler. The trial was started with clean floors, and the time of first stoking from each weighed lot of coal was noted, as well as the time when each weighed lot was completely put on the grates. The line of coal consumption plots out as shown in Fig. 4. As an additional check upon the coal measurement, a particular bunker was emptied beforehand, and coal enough for the trial was weighed into it off the trucks. The amount of coal so weighed amounted to 9·61 tons. At the end of the trial the quantity of coal still left in the bunker was taken out and weighed, and amounted to 2·82 tons, which, deducted from the whole quantity weighed into the bunker, gives 6·79 tons as the quantity used. As the coal weighed in detail during the trial was 6·67 tons, the difference between the two methods of measurement was less than 1¼ per cent. of the whole quantity in the bunker. The fires were cleaned once during the trial. The total amount of ash, weighed after the trial, amounted to 430lb., which is about 2·9 per cent. of the whole fuel used. The coal used throughout was Tyne coal from Walbottle Colliery. Coal samples were taken from the weighed lots frequently during the trial; and after a thorough mixture of all these samples, the final analyses, which have again been kindly made by Mr. C. J. Wilson, are as follows:—

	Coal as used.	Dry Coal.
Carbon	82·34 per cent.	83·97 per cent.
Hydrogen	5·47 ,,	5·58 ,,
Moisture	1·94 ,,	0·00 ,,
Ash	2·90 ,,	2·96 ,,
Nitrogen, sulphur, oxygen, &c., by difference	7·35 ,,	7·49 ,,
	100·00	100·00

A sample of the ash was also collected, and has been analysed by Mr. Wilson as follows:—

Loss on ignition (= carbon)	56·19 per cent.
Mineral matter	43·81 ,,
	100·00

The calculated calorific value of the fuel is 14,830 thermal units per pound, which corresponds to the evaporation of 15·35lb. of water from and at 212° Fahr., and to an equivalent carbon-value of 1·02lb. per lb. of coal. A portion of the coal sample was also tested by Mr. L. A. Legros with a Thomson calorimeter of which gave a calorific value of 14,890 thermal units per lb. as the mean of two separate determinations; the difference between this and the value calculated from the analyses is less than half of one per cent. The total coal used was as follows:—

Port boiler	7,248lb.
Starboard boiler	7,701lb.
	14,949lb.

This amounts to 15·71b. per minute, or 942lb. per hour, making a total time for coal consumption of 15 hours 53 minutes, or 953 minutes, which was arrived at as follows:—The last firing with unweighed coal before the trial began was at 6.25 p.m. upon the 13th July, and the last firing with weighed coal during the trial was at 10.21 a.m. upon the 14th, or an interval of 956 minutes. The first firing with weighed coal during the trial was at 6.38 p.m. upon the 13th, and the weighed coal was all burnt at 10.28 p.m. upon the 14th, which was the time of first firing with unweighed coal after the trial was over, or an interval of 950 minutes. A mean between these two intervals, or 953 minutes, has therefore been taken as the total time for coal consumption.

Furnace Gases.—Thirteen samples of the furnace gases were obtained, being collected over mercury by Mr. Wilson as the trial went on. Some of these, it will be seen, were collected quickly, as, for instance, Nos. 5 and 10. The others were collected slowly over periods varying from half an hour to an hour. The differences between the specimens collected quickly and slowly, it will be seen, are not at all so great as those between different samples collected at about the same rate. The analyses of the samples are given in Table I. The chimney temperatures were read every half-hour with a mercury thermometer of the same description as that used in former trials (see *Proceedings*, 1890, page 218). Two Murrie pyrometers were also used alongside of the thermometer to indicate the chimney temperatures, and the readings of the three instruments agreed. The height of the thermometer above the furnace bars was about 30ft. The average reading was 452° Fahr., the minimum being 410°, and the maximum 478°. The variations in chimney temperature are shown in Fig. 4. Trial was made to see whether any alteration of temperature reading followed a change in the position of the thermometer bulb from the side to the centre of the chimney, but none could be detected. The mean air-temperature on deck was 62° Fahr. The mean chimney-draught, which was measured by a U gauge-glass at the place where the furnace gases were collected, or about 13ft. above the damper, was 0·25in. of water. The funnel damper was only one-sixth open throughout the whole of the trial.

Feed-water Measurement.—The feed water was measured in the tanks which had been previously used in the "Colchester" and the "Tartar" trials (see *Proceedings*, 1890, page 219, and Plate 87). In the present trial each tank lasted about 15½ minutes. As already mentioned, separate tanks were used for measuring the jacket water and the water from the steam pipe and high-pressure valve chest drains, and a third separate tank was used for measuring the supplementary feed water. The water from the hot well was pumped into the measuring tanks by a donkey pump which was supplied with steam from the donkey boiler. This arrangement was adopted in order to prevent the additional load which would have been thrown upon the air pump if it had had to deliver into the measuring tanks. The feeding of the main boilers was done entirely by the engine pumps, which drew the water from the measuring tanks. The glands of the feed pumps leaked considerably during the first hour and a half of the trial; but the leakage was then so far stopped that it could be neglected during the rest of the trial. Steam was kept up in the donkey boiler for the fan engine, the donkey pump already mentioned, and the ballast donkey. The total amount of water used was 136,820lb. during a total time of 953 minutes. This amounts to 143·6lb. per minute, or 8,616lb. per hour. The rate at which the feed water was supplied and the variations of its temperature are shown in Fig. 4. Both at the commencement and at the end of the trial the boiler pressure was falling, as will be noticed from the diagram Fig. 6, and the water level was as nearly as possible the same; but the motion of the vessel at the end of the trial made the last observation of water level a little uncertain. An error of ½in., however, which is certainly more than could have occurred, would make a difference of less than 0·4 per cent. in the total feed, and might therefore be practically neglected. At 5 a.m. on 14th July samples of water were taken from both boilers, and at the same time a quantity of steam from the main steam pipe was condensed and collected. These samples were analysed by Mr. Wilson to determine the percentage of salt present in each, and gave the following results:—

Sample.	Percentage of Salt Present.
From steam pipe	0·00758 per cent.
,, starboard boiler	0·351 ,,
,, port boiler	0·177 ,,
Mean of both boilers	0·264 ,,

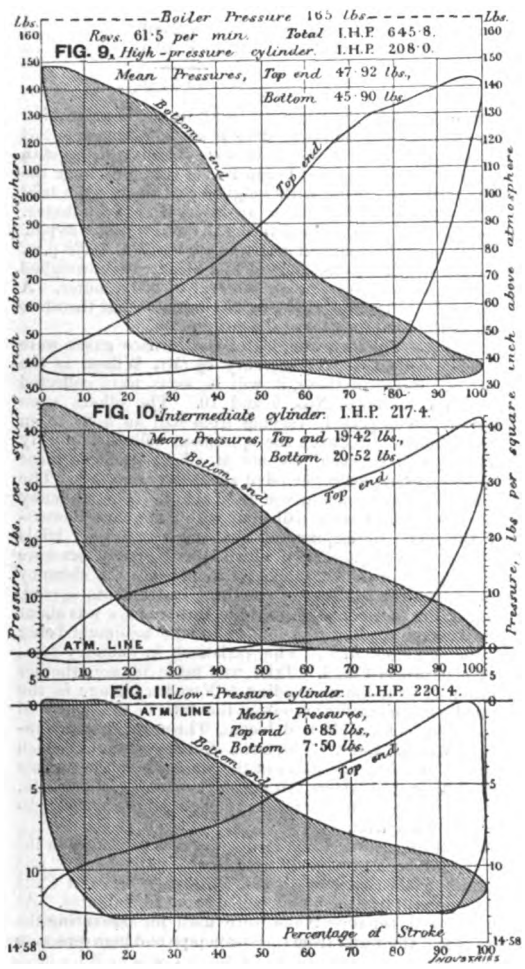
Taking the average saltness of the water in the two boilers this shows that the above sample of condensed steam contained 2·87 per cent. of boiler water, which figure therefore represents the amount of priming at the time when the sample was collected. It was intended to have taken a series of these samples throughout the trial; but unfortunately the condensing apparatus broke down, and the above sample was the only reliable one that was obtained. The temperatures of the circulating water and of the discharge water were measured at about half-hourly intervals throughout the trial. Calculating from these observations, the mean temperature of the circulating water was 55·8° Fahr., and of the discharge water 75·5° Fahr.

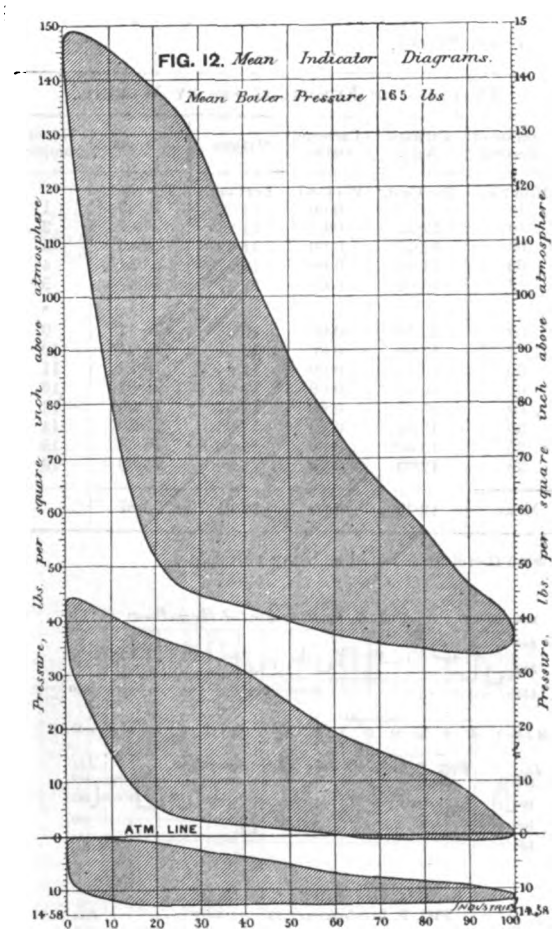
Additional Water Measurements.—The total water taken from the high-pressure jacket over a period of 910 minutes was 5,600lb., being at the rate of 6·15lb. per minute, or 4·3 per cent. of the total feed. The total water from the steam-pipe and high-pressure valve chest drains during 910 minutes was 800lb., or 0·88lb. per minute, which is 0·61 per cent. of the total feed. The total amount of supplementary water was 8,302lb. in 953 minutes, being 8·7lb. per minute, or 6·1 per cent. of the total feed. Practically the whole of the water from the jacket and cylinder drains was returned into the feed measuring tanks, and therefore repumped into the boilers.

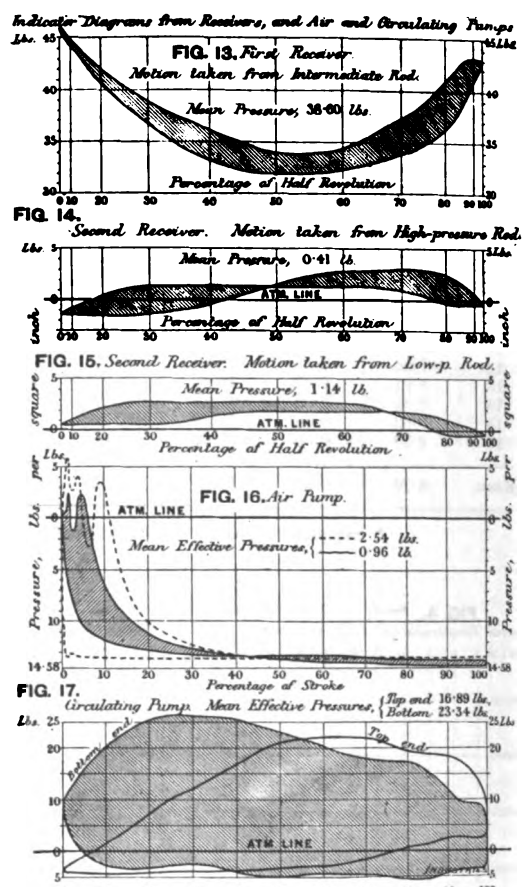
* Report prepared by Professor Alexander B. W. Kennedy, F.R.S., Chairman of the Committee, for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 31st ult.

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RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.







Power Measurement.—Indicator diagrams were taken every half-hour from each end of each cylinder, as in the former trials. There were thus 32 complete sets of diagrams, or 192 single diagrams, taken in all. The indicators used were again kindly lent by Messrs. T. S. M'Innes & Co., of Glasgow, and were the same that had been in use in the trials of the "Colchester" and "Tartar" (see *Proceedings*, 1890, pages 219 and 231). The springs used were in most cases new, and had all been carefully tested before the trial. The following are the mean effective pressures in the cylinders in lbs. per square inch:—

Cylinder.	Top.	Bottom.	Mean.
High-pressure...	47·98 ...	45·32 ...	46·65
Intermediate ...	20·52 ...	20·36 ...	20·44
Low-pressure ...	6·80 ...	7·52 ...	7·16

These pressures correspond with the following indicated horse-powers:—

High-pressure cylinder.....	205·6
Intermediate cylinder	221·2
Low-pressure cylinder.....	218·6
Total indicated horse-power	645·4

The maximum indicated horse-power given by any one set of diagrams was 667·9, which occurred at 8.15 a.m. on 14th July, with 61·3 revolutions per minute, and boiler pressure of 163lb. per square inch. The minimum indicated horse-power by any one set of diagrams was 627·5, at 7.15 p.m. on 13th July, with 61·4 revolutions per minute, and boiler pressure of 162lb. per square inch. In Figs. 9, 10, 11 is given the set of diagrams nearest to the mean, which was taken at 10.45 p.m. on 13th July, with 61·5 revolutions per minute, and boiler pressure of 165lb. per square inch. From the 192 diagrams which were taken during the trial a mean diagram has been plotted for each of the three cylinders, and these are given in Fig. 12. Eight diagrams were taken from the circulating pump during the trial, four from each end, and examples of these are shown in Fig. 17. The average power given by these diagrams is 12·4 i.h.p. at the mean speed of 61·1 revolutions per minute. Six diagrams were taken from the air pump, which is single-acting, and examples of these are shown in Fig. 16. The average power given by these diagrams is 1·2 i.h.p. at the mean speed of 61·1 revolutions per minute. Several diagrams were also taken during the trial from the first receiver, the indicator barrel being actuated from the cross-head of the intermediate cylinder; from the second receiver when the barrel was actuated from the low-pressure cross-head, and again when it was actuated from the high-pressure cross-head; and also from both ends of the condenser. Examples of the receiver diagrams are shown in Figs. 13, 14, and 15; the condenser diagrams are merely horizontal straight lines showing a mean absolute back-pressure of 1·2lb. per square inch. The continuous variations of boiler pressure are shown in Fig. 6, of cylinder mean effective pressures in Fig. 8, of horse-power in Fig. 5, and of speed in Fig. 7.

Speed.—The counter was read every half-hour. The total number of revolutions made was 58,651 in sixteen hours, giving an average speed of 61·1 revolutions per minute throughout the trial. The maximum number of revolutions per minute for any half-hour during the trial was 61·8, and the minimum 59·7 revolutions. The continuous increase of total revolutions from the beginning of the trial is shown in Fig 4.

Pressures, &c.—All the pressure gauges connected with the engines and boilers were checked by means of a standard gauge, and a correction allowed for where necessary. The mean barometric pressure during the trial was 29·67in. of mercury, or 14·58lb. per square inch. The mean boiler pressure was 165·0lb. per square inch above the atmosphere by the pressure gauges in the engine-room. The mean pressures in the high-pressure valve-chest, first receiver, and second receiver were respectively 160·0lb. and 41·7lb. and 2·4lb. per square inch above the atmosphere. The mean vacuum in the condenser was 28·25in. of mercury by gauge, which corresponds with a mean absolute back pressure in the condenser of 0·70lb. per square inch. The mean pressures in the first and second receivers, as measured from the indicator diagrams taken, were respectively 38·0lb. and 0·6lb. per square inch above the atmosphere; and the mean absolute back pressure in the condenser, as measured from the diagrams, was 1·0 forward and 1·4 aft, or a mean of 1·2lb. per square inch. The mean initial pressure in the high-pressure cylinder, as measured from the diagrams, was 142·5lb. per square inch above the atmosphere; and the mean vacuum in the low-pressure cylinder, as measured from the diagrams, was 12·74lb. per square inch, which corresponds with a mean absolute back-pressure of 1·84lb. per square inch in the cylinder.

Boiler Efficiencies.—The mean rate of combustion in the furnace was 22·4lb. of coal per square foot of actual gratesurface per hour, or 0·30lb. per square foot of total heating surface per hour. The total amount of feed-water pumped into the boilers, as given in an earlier paragraph, corresponds with 9·15lb. per lb. of coal. The average temperature of the feed was 106° Fahr., and the temperature corresponding with the mean boiler pressure was 373° Fahr.; so that each lb. of steam must have taken up (212 − 106) + 966 + 0·305 (373 − 212) = 1,122 thermal units. The equivalent evaporation from and at 212° Fahr. was therefore 10·63lb. of water per lb. of coal, or 10·42lb. per lb. of carbon-value in the coal. The equivalent amount of heat utilised per lb. of coal would be 10,265 thermal units, or 69·8 per cent. of the thermal value of the fuel. This figure of course represents the actual boiler efficiency. The series of analyses of chimney gases given in Table I. enable the weight of the air used per pound of coal to be calculated. The weight of dry air per lb. of coal thus worked out amounts to 24·51b., so that the total weight of furnace gases per lb. of coal would be about 25·4lb. These gases have been raised in temperature from 62° Fahr., the temperature of the outer air, to 452° Fahr., the mean chimney temperature. Taking the mean specific heat of the gases as 0·243, this corresponds to a loss of 2,407 thermal units per lb. of coal, or 16·2 per cent. of the whole calorific value of the fuel. In estimating the weight and specific heat of the gases, it has been assumed that the whole of the hydrogen in the fuel was burnt. No doubt this is not an entirely correct assumption, but the error due to it is very small. The loss due to the evaporation of the moisture in the fuel is so small that it may be neglected; and in no one of the thirteen analyses was any carbonic oxide found to be present in the gases. The quantity of heat not accounted for is, therefore, 14·6 per cent., which is mainly covered by the radiation, but includes also any losses due to unburnt carbon passing up the chimney, and to imperfect combustion of the hydrocarbons, &c. The weight of air theoretically necessary for the complete combustion of 1lb. of coal is 11·4lb. The air actually used is, therefore, about 2·15 times the amount theoretically required. The weight of water evaporated from and at 212° Fahr. per square foot of total heating surface was 3·171b. per hour. The average rate of transmission of heat through the material of the boiler was 3,059 thermal units per square foot of heating surface per hour.

Coal Consumption.—The total coal burnt—namely, 942lb. per hour—corresponds to 1·381b. per indicated horse-power per hour. This is equivalent to 1·491b. of carbon-value per indicated horse-power per hour.

Engine Efficiencies.—The total indicated horse-power being 645·4, and the total feed-water used per hour being 8,616lb., the feed-water used per indicated horse-power per hour was 13·351b. The actual heat received by the feed-water per minute was 161,100 thermal units, or 249·6 thermal units per indicated horse-power per minute, which is 69·2 per cent. of the whole heat of combustion. The absolute engine efficiency, or ratio of the heat turned into work to the heat given to the feed-water, was 18 per cent.

Total Efficiency.—The combined efficiency of the boilers and engines, or ratio of the heat turned into work to the total heat of combustion of the fuel, was 0·74 × 0·171, which is equivalent to 12·55 per cent.

Steam from Indicator Diagrams.—The following are the results of measurements made upon the indicator diagrams taken to ascertain the proportion of steam accounted for by them. The actual weight of feed-water used per revolution was 235lb.:—

Proportion of Steam accounted for by Indicator Diagrams.	Lbs. per Revolution.	Percentage of Total Feed.	Percentage in Jacket or present in Cylinder as Water.
	Lbs.	Per Cent.	Per Cent.
Steam present in high pressure cylinder after cut-off, when the pressure was 125·4lb. per square inch above the atmosphere.....	1·49	63·4	36·6
Steam present in intermediate cylinder, when the pressure was 19·4lb. per square inch above the atmosphere	1·76	74·9	25·1
Steam present in low-pressure cylinder near end of expansion, when the pressure was 8·6lb. per square inch below the atmosphere..... ...	1·39	59·1	40·9

(To be continued.)

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SHAW'S "PNEUMATIC BRIDGE."

THE pneumatic bridge is an instrument invented by Mr. W. N. Shaw, of Emmanuel College, Cambridge, for comparing the capacity which different orifices and tubes possess for transmitting air. It was described in a paper read at the recent meeting of the Physical Society at Cambridge. By its means it is possible to study the relative advantages of systems of ventilation and other questions connected with currents of air, for the readings of the instrument are directly and accurately proportional to the quantities of air delivered. Such an instrument has long been desired in the scientific study of ventilation, where the measurements have been generally made with anemometers.

Those of our readers who are acquainted with the Wheatstone bridge method of comparing the resistances offered by wires to the electrical current will readily follow the theory and working of this new bridge, for it bears a strict analogy to that instrument. It, as at present constructed, consists of three air-tight boxes, one of the size of 4ft. by 1½ft. by 1½ft., and two of the size of 3ft. by 1½ft. by 1½ft., arranged and fastened together in a manner shown in Fig. 1. In the middle of the upper side of the transverse box is a metal chimney containing a gas flame, by means of which the necessary draught is obtained. This flame can be altered in size so that the head of air may be made greater or less. It has been found that in this particular instrument the head can be varied in the ratio of 4 to 1. To obtain a greater draught a revolving fan can be used. Between the transverse and the two lateral boxes are two equal openings C and D of about 1½in. diameter, and it is through them that the air is drawn from the side boxes. They are circular openings cut in the thinnest possible sheets of mica, and represent in the electrical analogue two equal resistances. At a point 1ft. distant from the far ends of the side boxes is a glass tube about 1·1in. in diameter, connecting them, and in it at its centre is a small magnetic vane G (Fig. 1). As the sensitiveness of the apparatus depends on the indicator employed, we shall quote Mr. Shaw's description of it. "The one tried and found to work well consists of two very small parallel sewing needles, stuck through a cap of elder pith, supported on a small agate compass centre. The needles carry very light mica vanes on one side of the centre, counterpoised by a small quantity of platinum wire. The whole is balanced on the point of a fine needle, and forms a very delicate wind vane." The needles are magnetised and maintained in a fixed direction by an external control magnet, so that their points are opposite a fiducial mark in the glass tube. The sensitiveness can be altered as desired by the external control magnet just as that of a galvanometer needle can be.

One foot nearer are two other orifices A and B (Fig. 1), one of which is a graduated and adjustable slit shown in Fig. 2, and the other is the particular orifice or tube of which the air transmitting capacity is required. F is an additional aperture for other experiments. The two openings A and B are analogous to the other two resistances in Wheatstone's bridge, one of which is a known variable, and the other the resistance to be determined.

Let us trace now the passage of air through the instrument due to the draught in the chimney. It will enter by the orifices A and B in proportion to their capacities, and if they are exactly equivalent to one another in exactly equal quantities. It will then pass through the side boxes to the two orifices C and D, and through them pass into the transverse chamber to the chimney, since C and D have equal transmitting capacities. But if the quantities entering A and B are not the same, then part of the air from that side on which more is admitted will find its way by the glass tube to the side where less enters, and in doing so will deflect the vane in the opposite direction to its motion like a weathercock. If the experimenter now alters the adjustable slit A until the vane returns to its position of rest, he will have restored equilibrium between the currents. The orifice at B can now be changed for another, and the adjustment again made. In this way the comparisons we are about to describe have been made.

At the meeting of the Physical Society at Cambridge, on the 9th inst., Mr. Shaw exhibited a piece of ordinary sheet zinc with a circular hole cut in it, having a slight bevel on one edge. He explained that it was some 10 per cent. better as an air transmitter when placed with the bevel outwards. This same result was shown in another way: two equal sized tubes of wood, shown in section in Fig. 3, were compared, one ending with a flush edge and the other ending in a trumpet. The latter was nearly a half again as efficient as the former. This advantage of trumpet-shaped orifices is used on steamships where the ventilators for the engine-rooms are expanded into large trumpets which can be turned towards the wind. The explanation of the increased capacity depends on the prevention of small vortices which occur just inside a tube with a flush end, there being the same formation of

SHAW'S "PNEUMATIC BRIDGE."

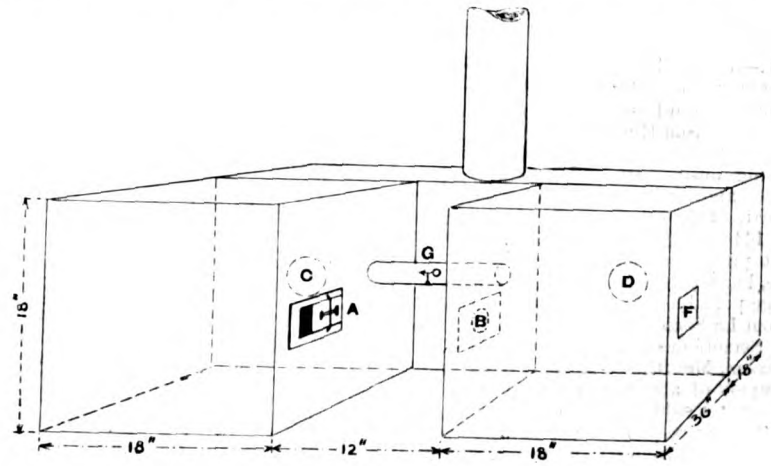
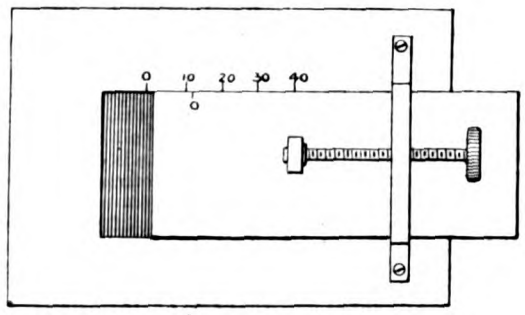
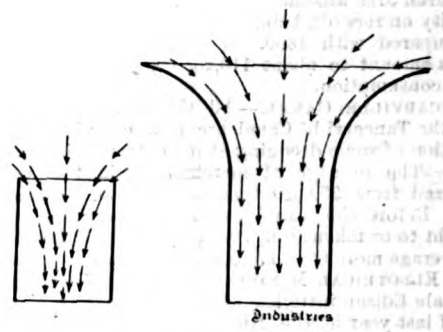


FIG. 1.



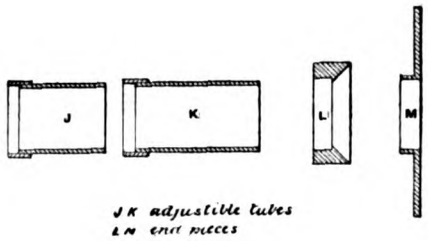
Shutter with Tangent Screw & Scale

FIG. 2.



Arrows show Course of Stream.

FIG. 3.



J K adjustible tubes
L M end pieces

FIG. 4.

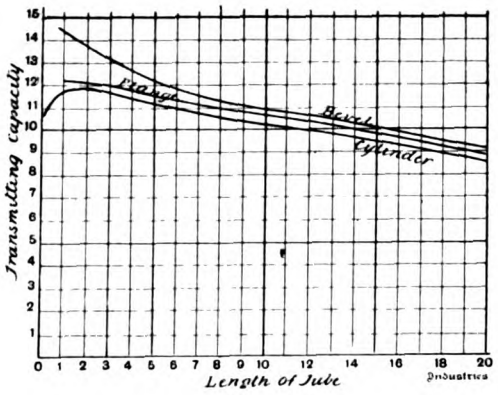


FIG. 5.

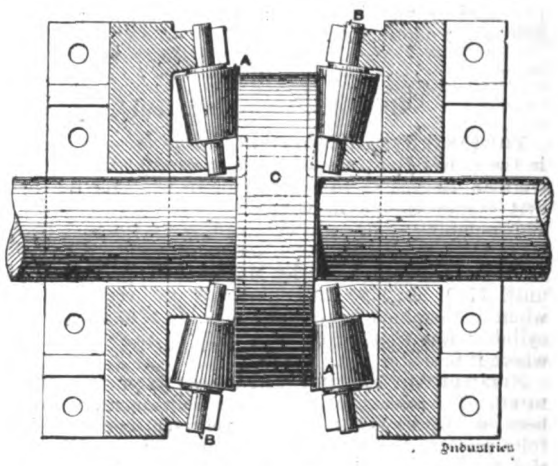
a contracted vein with air as there is in an ordinary water jet.

The comparative efficiency of different lengths of a cylindrical tube ending flush, with a flange and with a bevel, is exhibited in the diagram Fig. 5, where horizontal distances represent increasing lengths of tube and vertical distances represent transmitting capacity. It will be noticed that, with the adjustable cylindrical tube represented in Fig. 4, the first small length placed in front of a circular aperture has the effect of increasing the quantity of air admitted. Further increase of length of the tube reduces by friction the capacity for transmitting air. Another result which has been established by experiments with the bridge is that two circular apertures in a thin plate of mica are precisely equivalent to one circular aperture whose area is equal to the combined area of the two.

Many useful applications for this instrument will suggest themselves. Various ventilators might be compared by attaching small models to the bridge, and the friction in chimneys and cowls might be determined. It would also be serviceable in directly comparing gas meters. If water were the fluid used in place of the air, many other applications may be found. Plumbers would find it useful in comparing the effect of bends, stops, and cocks; whilst the hydraulic engineer could test the efficiency of waterways. For this purpose Mr. Shaw has suggested the use of two canal locks connected by a cross channel.

THRUST BEARING FOR PROPELLER SHAFTS.

WE illustrate herewith in section a thrust bearing for propeller shafts, which is designed to overcome some of the difficulties arising from the ordinary type. It consists of two series of rollers A, one on each side of a collar C, formed on the propeller shaft. The rollers are made from hardened steel, and are fixed on spindles B, which revolve in bearings formed in the thrust-block.



It will be noticed that the rollers are frustra of cones, and are so carried in the thrust-block that their surfaces are in a plane coincident with that of the face of the collar against which they press. It is claimed for this bearing that it overcomes entirely the objections to the use of spheres, and that rollers of the shape shown are very readily and accurately obtained. There is, moreover, no contact between adjacent rollers, and the only frictional surface is that of the spindles.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 19th May, 1891.

The Iron Market.—The Paris market is still very firm, with a strong tendency to a still further rise in prices. The state of affairs in Belgium has a certain influence on quotations here, but apart from this cause the iron trade in France is, at all events for the moment, fast gaining strength. The building business in and around Paris is very active, and the demand for iron work for constructive purposes is very great. Prices are very firm at 136s. 6d. per ton for bars, and 144s. 6d. per ton for joists. There is a healthy tone in the provincial markets generally. Mr. Jules Weitz, of Lyons, has received an order for 7 kilometres of 50 centimetre gauge portable railway, with 40 turntables and 400 waggons, from La Société Française des Charbonnages du Tonkin. La Société des Fonderies et Hauts Fourneaux de Pont-à-Mousson, Meurthe-et-Moselle, has secured a contract for the supply of about 3,000 tons of cast-iron piping for the Paris water supply, to be delivered within three years, at an average price of 130s. per ton.

Champagne Annual Statistics.—Messrs. J. R. Parkington & Co. state that the total quantity of champagne forwarded from the champagne districts for the year ending March 31st amounted to 25,776,194 bottles (the largest quantity on record), being an increase of 2,451,623 bottles, as compared with 1890. Present stocks in cask and bottles amount to about 110,256,000 bottles, or about five years' consumption.

Tancarville Canal.—All the works in connection with the Tancarville Canal are now completed, with the exception of some dredging at its entrance into the River Seine. The tonnage of merchandise in this canal has increased from 239,009 tons in 1888 to 302,120 tons in 1890. Before this canal was made the amount of goods brought to or taken from Havre by the river in barges did not average more than 170,000 tons a year.

An Electrical Mining Plant.—The Compagnie Continentale Edison installed an electric haulage plant at the end of last year in the Mines de Marles, and it has given such satisfaction that the original plant is now about to be considerably enlarged. The generator is a 26 unit Edison machine, giving 400 volts at 900 revolutions. The pit is nearly 1,000ft. deep, and the line runs along a gallery 1¼ miles in length. The locomotive is 7ft. 3in. long, 2ft. 4in. broad, 4ft. 11in. high, and weighs 2 tons 6 cwt. The motor is a 10 unit machine, and is arranged lengthwise. A speed of over 9 miles an hour is attained, and 10 b.h.p. is developed when hauling a train of twenty-five fully loaded skips, each weighing 14 cwt. The conductors in the gallery are two suspended Vignoles rails having porcelain insulators fixed in the roof, and the current is taken off by travelling carriages fitted with brushes and connected to the locomotive by flexible conductors.

Extended Use of the Telephone.—A company has been formed in Paris to organise a telephonic theatrical service. The company has erected in various public places, such as cafés, clubs, restaurants, &c., a certain number of automatic telephone receivers, by which, on introducing a fifty centime piece, one is placed in communication for five minutes with the theatres or concerts indicated on the apparatus. At present the Opéra Comique, the Bouffes, and the Nouveautés are the only theatres in connection with the system, but the number will be soon increased.

Launch.—On the 9th inst. the "Forges et Chantiers de la Méditerranée" launched a steel twin-screw steamer of about 4,000 i.h.p. for the Channel service between Newhaven and Dieppe, in connection with the Western Railway Company. The vessel is designed for passenger service only, and will make the passage in about 3¼ hours. Her principal dimensions are:—Length, 269ft.; breadth, 29ft. 6in.; depth, 15ft.

BERLIN, 18th May, 1891.

The First Steam Engine in Germany.—At Hettstedt, in the Lower Harz, a monument, erected by the Society of German Engineers to commemorate the erection of the first steam engine in Germany, was recently unveiled. This pumping engine was obtained by the Prussian Government from England in 1788, and continued to be used for raising the water from the Mansfeld copper shale mines until 1789. In 1795 the engine was removed to Löbejün, where it remained in use until 1848. In 1867 the old steam cylinder was transferred to a mine in the same district, where it is still in use.

Electrical Testing Establishment at Magdeburg.—The electrical testing establishment, which has been in operation for nearly a year, has continued to be fully employed up to the present time. Like the association for the inspection of boilers, it undertakes to make for its members yearly inspections of electrical installations. In this way it has accomplished very useful work for the owners of electrical works. Its influence has been the more powerful in consequence of the fact that it is entirely independent of electrical firms, and can therefore give an unbiassed opinion. The activity of this establishment is felt throughout the whole of Germany. Its work consists in examining and reporting on the estimates for electrical installations. It affords advice and information concerning electrical apparatus, and gives its members by means of circulars the benefits of the experience which it has gained in carrying out the inspections.

Electrical Elevators and Cranes.—The Allgemeine Electricitäts Gesellschaft has obtained good results by the use of motors for elevators and cranes. For some time past the company has worked an electrical elevator for raising coal. The waggons when filled are pushed on to the cage. A full load of a ton can be raised 30ft. in about forty seconds. As the cage rises it automatically shuts the safety gates which the waggon had opened on its way down. The winding engine is automatically put out of gear when the cage reaches either end of its course. The waggon on coming to the surface is received by a powerful crane, which is put into connection with the current as soon as the winding engine stops. The electromotor is not used in the return journey, as the waggon runs back by its own weight with a regular speed. The installation is provided with safety apparatus in the event of the breaking of the rope or of the pulley, and the cage on breaking away can only attain a speed of one metre per second. Electromotors are specially useful for working cranes, as it often is difficult to apply steam power where the cranes are to be used. Electromotors can be advantageously used for travelling cranes in workshops, as their control is very simple. The same company has had two travelling 1-ton cranes at work for some time now.

VIENNA, 18th May, 1891.

The Iron Market.—No important change has taken place in the iron market since my report of last week. There are, however, many signs that an improvement of the situation may be looked for. Building operations are in very active progress in the two principal towns of Austria-Hungary, and a revival of all the building trades and industries connected therewith is expected. The property of all the mining and iron companies shows a continual rise in value, which may be attributed to the fact that the profits of working are more favourable than those of the previous year. Last week the balance-sheet of the Alpine Mining Company, which had been awaited with some interest, was published. The net profits for the past year amounted to £284,631. It was decided to pay a dividend of 5½ per cent., and to assign the balance, £155,000, partly to the tontines, and partly to next year's account.

The Coal Market.—Notwithstanding the advanced season there is no alteration in the state of the coal market. Last week the market was affected by the strikes, which began on the 1st inst. in the Bohemian brown coal works and in the Ostrau district. About 8,000 men went out on strike.—The Rossitz Mining Company has had a larger output last year than in any previous year. The dividend was equal in value to 27,200 waggons of 10 tons each, and the net profit amounted to £26,157, which allows the payment of a dividend of 5½ per cent.

Electrical Engineering.—The electrical railway, projected by Messrs. Ganz & Co., and having a speed of 28 miles per hour, is to be worked by means of a distribution of current, which has been specially devised by Mr. Zipernowski. The current is sent from the alternating machines at the central station to the secondary stations at a pressure of 10,000 volts, where there are machines consisting of a combination of alternate current motors and continuous current dynamos. The alternating current motor at the secondary station drives the dynamo, which produces a continuous current for working the motors in the carriages. By means of this combination the alternate current motor of the secondary stations is at first driven by the continuous current dynamo, until it attains synchronism, when the motor drives the dynamo. Since the alternating current motors work at some loss with full load, Mr. Zipernowski has devised this ingenious means of utilising both systems of current for distant portions of the line.

Silk Culture.—Recently published statistics show that the expansion of silk culture in Hungary during the last decade has been very great. In the year 1880 there were 1,059 silk growers in 172 towns, who produced 10,132 kgr. of fresh cocoons. This number has increased to 66,525 growers in 1,942 towns, with an aggregate production of 1,043,906 kgr. These magnificent results were brought about by establishing mulberry tree plantations, by distributing trees and plants, and by careful selections of seed in specially sericultural stations.

BRUSSELS, 19th May, 1891.

Iron and Steel.—A very large number of industrial establishments are stopped, some on account of the strike and others for want of coal, a supply of which is expected in a few days. In the battery of Liège, in the iron manufactory the blast furnaces are stopped, and the want of coal impedes labour. The workmen of this city continue to strike, and certain works will be awkwardly fixed, as they have deliveries to make at fixed terms. There is therefore nothing particular to report in the way of progress, the prices of iron remaining feeble.

Coal Trade.—The strike is general in the coal trade, but there is a tendency to relax. The country is visited by a large number of agents, who offer English, German, and French coals. The question is, therefore, for the Belgian coal owners to decide whether or not the fuel is to be brought from foreign countries.

Electric Lighting.—This branch of industry is also suffering by reason of the strike, the most important cafés and theatres having to cease the use of electricity for lighting purposes.

DÜSSELDORF, 19th May, 1891.

The Iron Market.—On the whole there seems to be a gradual improvement in the iron market of this district. There is, however, still no advance in pig iron. For rolled iron there is an increased demand, and the works are more fully employed than during the first quarter. The iron plate trade is still unsatisfactory. Iron pipe works have had many difficulties to contend against during the past few months. Railway waggon works have been well employed at remunerative prices. A meeting of representatives of rolling mills employed in the manufacture of thin sheets took place at Geisweid on the 6th inst. It was decided to form a union among the owners of rolling mills in Silesia, the Rhine district, and the Siegen and South German districts.

The Coal Market.—Although the demand for coal in Germany has fluctuated much during the past few years, the production, on the whole, has considerably increased. The output rose from 42 million tons in the year 1880 to 59 million tons in the year 1888. Germany, therefore, ranks second in the coal-producing countries of Europe. As compared with the English production it is, however, unimportant. The strike of coal miners must be regarded as completely at an end. The general condition of the coal market is now firm. The deficiency in the output this year corresponds to the output made by one workman in 110,225 working days. As each workman produces an output of ·9283 tons per day, the total deficiency amounts to 102,321 tons. Prices are as follow:—Gas coal, 11s. 9d. to 12s. 3d. to 12s. 9d.; rough coal, 8s. 10d. to 9s. 4d. to 10s. 2d.; lump coal, 11s. 9d. to 12s. 3d.

AMSTERDAM, 18th May, 1891.

Dutch General Tramway Company.—This company, the most important of its kind in Holland, has held its annual meeting at Utrecht. From the report of the directors it appears that results have been more favourable upon the whole than in 1890. The receipts from passenger traffic were £11,609, whilst luggage yielded £213, goods £2,613, and cattle £567. The net profit of £2,138 allowed of the distribution of a dividend of £1 13s. 4d. per share of £83 6s. 8d. each.

The Blitong Tin Company.—The Government has submitted a Bill to the States-General, embodying its contract with the board of the company. It urges its acceptance as the maximum obtainable under the present circumstances. If it be true that the Government has not been able to secure the 10 per cent. royalty which it at first insisted upon, and has had to be satisfied with the royalty of 5¼ per cent., now stipulated, it is equally true that the company is no longer able to deduct from the annual profit a first sum of £41,666 for dividend purposes. That amount has been reduced to £29,166, and, after deduction of the latter sum, the net profit becomes dividable between the Government and the company in equal moieties.

Dutch Phosphate Company.—The directors of this new undertaking have submitted a first report to the shareholders, which reads favourably. The company is in possession of phosphate mines in Canada and in Florida, covering together a superficial area of about 2,000 acres. The property in Florida is particularly described as very promising; 6,000 tons from that property have already been sold at remunerative prices. The working of the mines in Canada is shortly to commence.

The Gallicia Tin Company.—Some years ago the Dutch Gallicia Tin Mining Company was formed, with a capital of over £166,666, to work tin mines in Gallicia. The capital of this concern has just been "re-arranged" by special resolutions of the shareholders. The share capital has thereby been reduced to £150,000, in shares of £1 each. There are, moreover, five per cent. debentures to the amount of £100,000. Prospects are declared to be good, although no dividend is as yet forthcoming.

An Adventurous Survey.—Recent advices from Sumatra report the departure from Padang to Siak of an expedition, organised and led by the principal Government civil engineer, Mr. Yzerman, for a survey in connection with a railway to be constructed through Sumatra, from coast to coast. The expedition has numerous carriers, and is accompanied by scientists appointed to make special reports upon minerals, plants, and woods during a seventy days' ramble through regions that no European has as yet ever trod.

STOCKHOLM, 16th May, 1891.

Finnish Railway.—It has now been decided that an official examination shall be made with regard to the proposed railway between Uleaborg and Tornea, so that a Bill for the construction of this important railway may be introduced into the next Senate.

New Gunboat.—The Kockum Engineering Company, Malmö, has secured a contract from the Swedish Government for a new gunboat, the "Svensksund," which is to be built of the best Swedish steel. It is to have duplex direct-acting propeller engines, with a capacity of 440 i.h.p. At

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the yard of the same firm was launched on the 9th inst. the new steamer "Rzfylke," built for the Stavanger Steamship Company, Norway, and intended for the tourist traffic.

THE ORNSKÖLDSVIK-MELLANSEL RAILWAY.—Parliament has voted £101,277 towards the construction of this important line,

THE HELSINGBORG SHIPYARD.—This shipyard is to be extended so that iron vessels also may be repaired there. This has been decided upon with the co-operation of the Helsan Engineering Company.

STATE TELEPHONES AND PRIVATE TELEPHONES.—The Swedish Government has sanctioned an arrangement between the State Telephone Administration and the large Stockholm General Telephone Company, in accordance with which the company has the right to carry new lines and to maintain the old lines within a radius of 70 kilometres in all directions from the main market place in Stockholm for a period of fifty years. After the expiry of this term the State Telephone Administration has the right to purchase the company's lines outside Stockholm at a valuation. If the State Telephones Administration should not avail themselves of this right, then the company is entitled to a prolongation of its concession subject to certain conditions. The Stockholm General Telephone Company has sold several of its provincial lines, and undertaken not to carry on telephone business in Sweden outside the radius of 70 kilometres from Stockholm.

CHRISTIANIA, 16TH MAY, 1891.

SALE OF COPPER MINES.—The copper mines at Riple, belonging to Mr. Corneliussen and others, have been sold to an English syndicate for experimental working. If the result proves satisfactory the mines will be finally transferred to the English syndicate at a very fair price.

NEW PAPER MANUFACTORY.—It has now been settled that the new industrial establishment at Borregaard shall also comprise paper mills.

THE BENTSE WORKS.—Messrs. H. & C. Bacho Wüg have sold their Bentse paper mills to a limited company under the style of "Akerselvens Papirfabriker." The price is £61,111.

THE NORWEGIAN MILK CONDENSING COMPANY.—This company, which was formed at Toten two years ago, with a share capital of £16,666, and in which King Oscar was a shareholder, is now ready for work. The capital has, however, proved insufficient, and a fresh issue of £11,111 has been deemed necessary.

THE BJÖRSHOLMS WORKS.—This establishment, founded lost year for the manufacture of buckets made from pressed wood pulp, also finds it necessary to increase its capital; the new issue is of preference shares, not exceeding £9,333.

EXPORT OF NORWEGIAN BOARDS TO PERSIA.—An increasing export of boards for fruit boxes is taking place from Norway to the Persian Gulf. The shipments used to be effected *viâ* London, but now Norwegian steamers go direct from Norwegian to Persian ports.

COPENHAGEN, 16TH MAY, 1891.

NARROW GAUGE RAILWAYS.—The numerous light railways proposed by Mr. Steinberg, to be built in various parts of Denmark, are attracting much attention. It is thought that these railways may in many places prove a considerable boon to fishing and to agriculture. It is proposed to carry one of these railways through the vast moors of Jutland. The cost will be very small.

DANISH BACON FACTORIES.—The question of an amalgamation of all the Danish bacon factories, co-operative as well as private, has been much discussed lately. The difficulties in the way have, however, proved too great, but now the question seems in a fair way of being arranged. At a meeting of delegates held on the 11th inst., Mr. C. F. Tietgen being in the chair, a basis was agreed upon, which will now be laid before the various factories for final acceptance. The style of the new business is to be "The Danish Bacon Factories." The capital will be divided into "debenture shares" and ordinary shares. The amount of the former is to be equal to the aggregate valuation of all the bacon factories with machinery, with an additional amount for the higher value of the I. D. Koopmann marks in the English market. The nominal amount of the ordinary shares is £222,222. Of this sum the private factories and the co-operative factories each obtain one-half as the value of working capital. The ordinary shares are distributed among the different factories in proportion to their output. The net profit is to be disposed of in the following manner: 4 per cent. on the debenture shares, then 4 per cent. on the ordinary shares; of the balance 25 per cent. are added to a reserve fund, and the remaining 75 per cent. are distributed among the ordinary shares.

NEW RAILWAY CARRIAGES.—The Danish State Railways have ordered some "bogie" carriages from the Skandia works at Rouders, which are intended to be used for the foreign express trains on the Sealand lines. These carriages are twice the size of ordinary railway carriages, and they rest upon two systems of bogies, each bogie being carried upon four wheels. A spring arrangement will further tend to reduce the shaking as much as possible. The new carriages will be divided into compartments, and will not be provided with a passage from end to end as is the case in Norway and Sweden. The compartment system is thought more convenient for the shorter Danish lines.

THE FAXE LIME WORKS.—The large Faxe Lime Company is improving its position owing to able management, and to arrangements made with other Danish and Swedish lime companies. The bricklayers' strike last summer and the long and severe winter diminished the sale, but the net profits for last year were £10,268, as compared with £9,286 in 1889. No dividend was, however, declared, but hopes were expressed that the shareholders would receive a dividend next year.

MADRID, 18TH MAY, 1891.

IMPORTANT AMALGAMATION OF RAILWAYS.—The Tarragona and Barcelona Railway has just been sold to the Southern Company of Spain under circumstances which show some rather sharp practice. The manager of the Tarragona Railway had made an agreement with the Northern Railway Company to sell them that line, which, with other concessions, was estimated to be worth £5,000,000, subject to the approval of the shareholders. At a meeting of the shareholders on the 10th inst. it was proposed to discontinue negotiations with the Northern Company, and it was decided to sell the line to the Southern Company, a secret arrangement having already been made with that object. The shares of the Northern system, and of the Banco Hispano-Colonial, which is connected with this railway, suffered a heavy fall in consequence of this announcement, as it was thought that the previous arrangement was already concluded. Señor Planas, the Chairman of the Southern Company, had in fact already made arrangements with the Rothschilds to obtain funds for the purchase of the Tarragona line, and thus got the better of the Marquis de Comillas and Señor Sosotongo, a group of financiers connected with the Banco Hispano-Colonial. It is thought that the action of Señor Planas was influenced by the fact that he had been similarly deceived by this bank a few months ago, when he tried to buy the Almansa and Valencia railway. The financiers connected with the Northern line will thus lose their control of the Barcelona financial market, which will now be assumed by the Rothschilds. The Rothschilds now have the control of seven-tenths of the whole traffic of the country, and would be able to inflict great injury on the Northern system. Their arrangement for the purchase of the Tarragona line includes an advance of £1,250,000 at 4 per cent. to complete the line which is being made from Reus to Saragossa. There is also an engagement to make a railway from Valladolid to Ariza within three years, and to connect the system with Almanza. This last clause may not, however, be carried out, as the lines from Almanza to Valencia and Tarragona will certainly be sold to them. The Rothschilds will probably obtain the concession of the line from Calatayud to Feruel and Castellon, and may possibly make an amalgamation with the Gran Central Español. The Banco Hispano-Colonial had devised a scheme for freeing the Spanish railways from foreign control, but this scheme is now at an end. The tariffs on many of the railways are very high, and little attempt is made to develop the traffic. The Northern system is well managed, though the traffic is not so susceptible of development as that of the Southern and Mediterranean system. It may possibly be the case that there is a scheme in hand relating to the remaining principal lines with a view to the introduction of the zone tariff system.

UNION OF COAL MINE OWNERS.—A large number of coal mine owners have formed an association with the title of the "Union Hullera," in order to protect their interests. Their chief aim is to obtain an increase of the duty on coal, which is now only 1s. per ton. Such means of increasing the price of coal seem unjustifiable, as the mine owners are not able to keep pace with the actual demand. This is shown by the fact that the imports of coal during the first four months of this year are in excess of those of the previous year by 25 per cent.

ROME, 18TH MAY, 1891.

AN ELEVATED ELECTRIC RAILWAY.—The highest elevated railroad in the world is about to be built in Naples. It is intended to connect the central part of Naples with the Corso Vittorio Emanuele. It is designed by Mr. Adolfo Aveno, civil engineer, and the estimated expense will be about £200,000. The road will be suspended from towers 100 metres high, in which will be elevators to carry passengers to the station. The road will be operated by electricity, generated by the force of the waterfall of the River Serreno.

THE WOOLLEN INDUSTRY.—Recently published statistics show that there are about 300,000 spindles and 100,000 looms employed in the Italian woollen industry. Seven-tenths of the latter are hand looms. About 30,000 operatives are employed, principally in Vicentino, in the Biella district, and in the Terra del Lavoro.

ACCIDENTS IN MINES.—The total number of accidents in the mines of the whole Kingdom during 1889 amounted to 196, with 68 deaths and 171 injured, whilst in 1888 there were 301 accidents, with 87 deaths and 286 injured persons. If the larger production of 1889 is taken into consideration it appears that a remarkable improvement has been realised as regards the safety of the mines. In fact, for every 1,000 persons we have the following figures:—

	1888.		1889.
Accidents	6·13	...	4·00
Deaths	1·74	...	1·39
Cases of injury	5·82	...	3·48

Comparing the value of the production with the number of deaths, we find one death for an output of the value of £24,080 in 1888, and one for an output of the value of £31,480 in 1889. In 1887 there was one death for every 720 persons employed, whilst in Great Britain in the year 1889 (see *Industries*, Vol. X., page 350) there was one death for every 538 persons employed.

UTILISATION OF WATER POWER.—An important work has recently been completed for supplying the power for an electric tramway between Pazzala and Lugano. The power is obtained from a waterfall, the water being conveyed to the generating station in iron pipes, where two turbines of 300 h.p. each drive a 1,500-light dynamo and a 60 h.p. generator.

BRITISH COAL.—The amount of British coal imported into Italy in 1890 was as much as 1,493,600 tons, against 1,307,600 tons in 1889 and 1,279,400 tons in 1888. Of the above total import in 1890, 749,000 tons were from Cardiff, 574,700 tons from Newcastle, and the rest was Scotch and North English coal from Liverpool and Hartlepool.

NEW YORK, 9TH MAY, 1891.

RAILROADS.—The Chicago, Kansas, and Nebraska Railroad was sold at Topeka, Kansas, to satisfy a mortgage of £5,200,000 against the company in favour of the United States Trust Company, of New York. The railroad was bought by an agent of the latter company for £5,066,400, its appraised value.—Arrangements are being completed for building the long-contemplated railroad from Dewitt, Neb., to Omaha and Lincoln, making a short line to the latter cities. It is stated that the Burlington and Mississippi River Railroad is supporting the project.—Contracts have been awarded for the construction of an extension of the Reading Railroad from Bound Brook to Arthur Kill, and the contractors will begin work at once. It is stated that the railway, which is to cost £300,000, will be in operation within one year. A tunnel is to be built under the Detroit River from Detroit to Windsor on the Canadian shore. It is to be 8,000ft. long, and will have cuttings of 1,000ft. at each end. There will be two railroad tracks in the tunnel.

PHILADELPHIA, 8TH MAY, 1891.

THE CONNELSVILLE STRIKE.—The Frick and McClure companies are steadily increasing their working forces. Seven thousand workmen, including a number of negroes and Italians, are to be imported from the East this week. A coke famine is threatened in Chicago owing to the strike in the Connelsville district. The Illinois Steel Company and the Calumet Steel and Iron Company have been compelled to abandon their furnaces for want of fuel, and more than 1,500 men have been thrown out of work.

LARGE "OTTO" GAS ENGINES.—During the last year or two a variety of changes in the "Otto" gas engine have been effected by Messrs. Schleicher, Schumm, & Co., of Philadelphia, who are the sole builders of this type of engine in America. Besides the numerous changes in the details of construction of this engine, the range of power and speed have been extended to such a degree that it has become a formidable rival to the most economical steam engine. The smallest engine of this type is ¼ h.p. (vertical), while the largest is 100 h.p. Only one engine of this size has as yet been put into successful operation. It is at Rockfield, Conn. It is driven by means of water gas, and furnishes the total power for an electric light installation. Three such engines have been ordered, and are now in course of construction. Some of the most important points in the construction of the engine have been materially changed. The 100 h.p. engine is horizontal, with two cylinders placed one above the other. The connecting rod of the top cylinder is hinged to that of the bottom in such a way that the two together actuate a single crank. The ignition of the gas in this engine is no longer affected by a flame, but an incandescent metallic tube is now provided for that purpose, which, although of very short life, is more satisfactory and less expensive than the old method. The slide valve, which was the source of much trouble in the old type, has, in this engine, been replaced by poppit valves. As a result of recent trials of this engine in connection with a gas producer it is claimed by the company that the engine developed 1 h.p. per hour for each pound of carbon consumed, which, if correct, is an exceedingly low figure. It is proposed by the Department of Mechanical Engineering of the University of Pennsylvania to make an official test of the performance of this engine, the results of which are looked forward to with some interest. The company has recently applied the "Otto" principle to the construction of gasoline engines of small powers. In these the ignition of the mixture is effected by an electric spark produced by a battery of Edison-Lelande cells in connection with a small spark coil. This method which has proved cheap and reliable, has been applied to some of the regular type of "Otto" engines, and has in every case given satisfactory results.

NEW BRANCH ON THE READING RAILROAD.—The new branch of the Philadelphia and Reading Railroad, known as the Philadelphia, Harrisburg, and Pittsburg Railroad, was recently completed. This railroad crosses the Susquehanna River by a very large bridge at Harrisburg; it connects at Shippensburg with the Maryland and Western and Baltimore and Ohio Railroads, and branches off to Pittsburg and the coke regions. This railroad will be of great value in the Schuylkill, Lehigh, and Lebanon valleys, where the industries use coke extensively, and it is expected that a large freight business will be done.

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THE ROYAL NAVAL EXHIBITION.

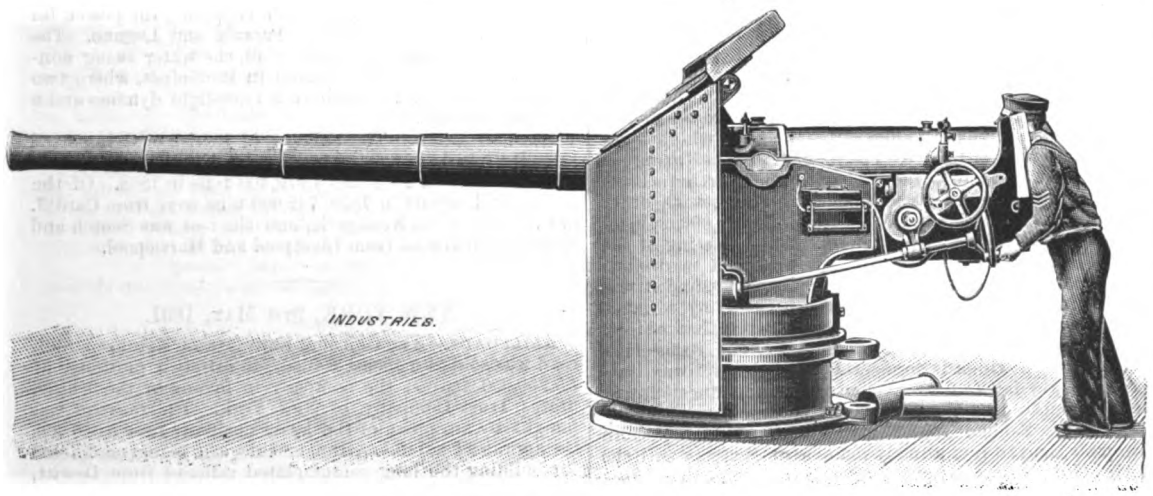


Fig. 1.—The 4·7in. Quick-firing Gun.

THE ROYAL NAVAL EXHIBITION.

SIR W. G. ARMSTRONG, MITCHELL, & CO.'S EXHIBITS.

Continuing our description of the exhibits from the Elswick works of Sir W. G. Armstrong, Mitchell, & Co., we illustrate in Fig. 2, on page 492, H.M.S. "Victoria" in the act of firing her guns. Allusion has already been made to the model of this vessel, specially constructed for this Exhibition, which, along with the photograph we reproduce, should enable visitors to form an idea of the great advances in the construction and equipment of war vessels during recent years. The model of the "Victoria" represents the vessel with her torpedo nets down (the nets, carefully finished, were made by Messrs. Bullivant & Co.) and generally ready for action, as would be the case if gun or torpedo attack were anticipated.

A comparison of the "Victory" with the "Victoria" will further accentuate the development that has taken place in the dimensions, displacement, armament and otherwise of "first-class" war vessels. The "Victory" was a three-decker, 186ft. in length, 52ft. beam, and 3,500 tons displacement, the armament, 102 guns, consisting of thirty 42 and 32-pounders, thirty 24-pounders, forty 12-pounders, and two 68-pounder carronades, the heaviest of the guns being the 42-pounder, the largest charge 10lb. of powder, and the heaviest shot 68lb. The "Victoria" has a length of 340ft., 70ft. beam, and 10,500 tons displacement, the armament consisting of two 16¼in. 110-ton guns, one 10in. 30-ton gun, twelve 6in. 5-ton guns, twelve 6-pounder and nine 3-pounder quick-firing guns, two machine guns, and six torpedo guns. The largest charge is nearly 1,000lb., or 100 times greater than in the "Victory" and the largest shot 1,800lb., or more than twenty-six times heavier than in Nelson's flagship. The weight of metal discharged from the broadside of the "Victory" was 1,150lb., from that of the "Victoria" it is 4,750lb.; but as this latter contrast does not take into account the energy of the broadside, the power of each of these vessels is better indicated by the quantity of powder expended in a broadside fire, which in the "Victory" was only 355lb. of powder, as against 3,120lb. in the "Victoria." Manual power for working the guns was solely employed in the old "first raters," and the guns, with few exceptions, were "mere blocks of cast iron," except "the formation of the bore and the drilling of the vent," and the gun carriages were very primitive. In the "Victoria," air-compressing, hydraulic, and steam power is brought into requisition, and whereas the arrangements in the "Victory" were of the simplest character, in addition to the main engines used in propelling the "Victoria" there are in connection with them no less than twenty-four auxiliary steam engines—viz., two starting, two reversing, eight feed, eight fan, four forced draught—and four circulating water engines. Besides, there are thirty steam independent engines—viz., six fan and bilge engines, two auxiliary circulating engines, four fan engines for ventilating purposes, two fresh-water pumping engines, two evaporative fuel engines, one workshop, one capstan and five electric-light engines, four air-compressing and three pumping engines for hydraulic purposes. The "Victoria" has also thirty-two hydraulic engines, including two for actuating the rudder, four for ash hoists, two boat engines, four ammunition lifts, two turret-turning engines, one topping winch, two transporting and lifting engines, two hydraulic bollards, and fourteen other engines for performing operations necessary in working the heavy guns. This makes a total of eighty-eight engines, and is exclusive of the machinery in the torpedo and other steam boats, and of the locomotive engines in the torpedoes.

There are, besides the large model of the "Victoria," several others of almost equal interest exhibited by Sir W. G. Armstrong, Mitchell, & Co., Ld. One of these represents, on the scale of 20ft. to an inch, the Elswick Shipbuilding Yard, which is capable of containing nine vessels on the stocks at one time, besides a number completing in the River Tyne. The enormous shear legs, designed to lift over 100 tons, are shown in the act of lowering a boiler into a cruiser. Another model represents the piling under the berths specially designed for armour-clads, of which there are two at the east end of the yard.

The "Esmeralda," which may be fairly styled the "pioneer" modern protected cruiser, is represented by a model on the usual scale of ¼in. equals 1ft. This vessel was built at the Walker shipyard in 1882-3 from the designs of Mr. George Rendel, and is 270ft. in length, 42ft. beam, displacement about 3,000 tons, on a draught of water slightly exceeding 18ft., when fully stored, armed, and equipped for sea. Some years previously smaller vessels of a similar type were built for China and Chili, but the closeness of their bow and stern chasers to the water made them practically useless, even in moderately heavy weather, and their vital parts were very incompletely protected. In the "Esmeralda" these defects were remedied. This vessel has an arched protective steel deck, beneath which are the engines, boilers, &c., while above are the coal bunkers. The buoyancy and stability are further protected by means of cork-filled cellular compartments extending nearly round the vessel. The armament of this vessel consists of two 10in. 25-ton breechloaders, two 6in. 4-ton guns, two 6-pounder quick-firing guns, five 37mm. Hotchkiss guns, and two Gardner guns. The propelling machinery consists of two sets of horizontal compound engines, driving twin screws, of 5,500 i.h.p., giving a speed of 18·28 knots per hour on the measured mile trial.

The "Giovanni Bausan," for the Italian Government, was constructed of practically the same design, but in the "Haniwa-Kan" and "Takachiho-Kan," of which Japanese cruisers a full model is exhibited, many improvements were introduced. These vessels are about 700 tons greater displacement than the "Esmeralda," and are provided with inner bottoms for a large portion of their length. Their protective decks extend the whole length and slope upwards from below the water-line at the side to a few inches above that level at the middle line, the sloping sides being 3in. and the centre portion of the decks 2in. thick. Greater protection is thus given to the buoyancy and stability, and, while the vessels have the same armament as the "Esmeralda," their increased size allowed the engines to be made of greater power to obtain a higher speed—viz., 18¾ knots. These vessels were the first designed by Mr. W. H. White after he joined the Elswick establishment. In the "Dogali," built for the Italian Government, Mr. White succeeded in obtaining a speed of 19½ knots on a displacement of 2,050 tons, but the largest guns on this vessel were only 6in. breechloaders. About the same time, the Austro-Hungarian cruisers "Panther" and "Leopard" were completed—vessels of a smaller type, but of high speed—viz., 18½ knots. The next model to attract attention is, however, that of the Chinese protected cruisers, "Cheh-Yuen" and "Ching-Yuen," vessels still more heavily armed and better protected, having three 8in. breech-loading guns, two 6in. guns, and 24 quick-firing guns of various sizes, besides four torpedo tubes. The protective deck on the slopes is 4in. and at the centre line 2in. thick. Their length is 250ft.; breadth, 38ft.; draught of water, 15ft.; and displacement, 2,300 tons. With forced draught the engines exerted 6,892 h.p., with which a speed of 18·5 knots was realised.

The Roumanian cruiser "Elizabeta's" model is near the last mentioned. As this vessel is a training ship, a much greater spread of canvas than is usual in this type of vessel was provided, but otherwise there is no specially noteworthy feature. Of greater interest is the Italian cruiser "Piemonte," in which a further advance was made in speed and protection. Having previously illustrated and described this vessel in connection with the Paris Exhibition, at which the model exhibited obtained a gold medal (see *Industries*, Vol. VII., page 185), a brief reference must now suffice. The vessel has 2,500 tons displacement, and attained a speed of 20½ knots with natural and 22·3 knots with forced draught. At the time of her completion—1888—the "Piemonte" was the only vessel armed with the new quick-firing guns, which permitted of twice the weight of shot and shell being fired against an adversary, even though the latter were five and six times her size, in a given time. This vessel was designed by Mr. Philip Watts, the present chief constructor at Elswick, but has since been eclipsed by the Argentine cruiser "25 de Mayo," now about ready to sail from the River Tyne, of which a full and carefully finished model is also exhibited.

There are other two models of war vessels very recently constructed at Elswick exhibited. One of these represents the three protected cruisers, "Katoomba," "Mildura," and "Wallaroo," for the Australian Colonies. These vessels are 265ft. in length, 41ft. beam, 15ft. 6in. draught of water, and 2,600 tons displacement; but owing to their size have not the powerful armament nor great protection obtained in the "25 de Mayo." The other model represents the torpedo-boat destroyers "Boomerang" and "Karakatta," of the Australian Colonies, and the "Plassy" and "Assaye," of the Indian Government, of which the two latter have not yet left the River Tyne.

There yet remains for mention a model of a large twin-screw mail and passenger steamship, which is very completely finished, and shows signs of considerable care in designing, most noteworthy being the free use of hydraulic power for the loading and discharging of cargo, and the model of the crane vessel "Atlas," designed and built by Sir W. G. Armstrong, Mitchell, & Co. for the Mersey Dock and Harbour Board.

The ordnance exhibits now demand some attention, and prominent amongst these are the quick-firing guns, the latest product of the Elswick artillery department. These guns differ from "Nordenfelt," "Gardner," and "Gatling" guns in being loaded by hand, in having only one barrel, and generally in being larger in size. The "quick-firing" gun differs from an ordinary gun by having special breech mechanism, and particularly by the use of cartridge cases, which are generally made of brass or gun-metal, composed of two or more pieces screwed or riveted together, or solid-drawn out of one piece. One of these cartridge cases constructed in the latter manner, which has been fired twenty times in a 4·7in. quick-firing gun, is exhibited to show how successfully they are constructed. After each time of firing these cartridge cases are re-formed, for which purpose special tools are provided.

The first quick-firing guns were made to fire 3lb. and 6lb. projectiles at the rate of twenty to thirty per minute under favourable conditions. Since then guns of this type have been constructed to discharge projectiles of 10lb., 12lb., 25lb., 30lb., 45lb., 70lb., and 100lb. The 12c.m. (4·7in.) quick-firing gun has, however, been so far the most largely adopted of the larger sizes, and above and on page 492 will be found illustrations, Fig. 1 showing the external appearance, and Figs. 3, 4, and 5 sectional and end views of this gun as now made. Originally introduced as a 30-pounder, it was submitted to the Admiralty (in 1886), and most exhaustively tried at Portsmouth. These trials resulted in some slight modifications to the gun, which was finally adopted by the Navy as a 45-pounder. Ever since the Elswick Company have found it difficult to manufacture this weapon with sufficient rapidity to cope with the demand, and there still appears every probability of the "quick-firing" type being more extensively adopted. Interesting trials have been carried out by the Admiralty, in order to compare the rates of firing of the new 4·7in. quick-firing gun and the 5in. breech-loading service gun. Both these weapons were mounted in gunboats, and fired under precisely similar conditions, the result being that the 4·7in. gun fired 10 rounds in 47 seconds, and the 5in. gun took 5 minutes 7 seconds to

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fire an equal number. Evidently it is only a question of time and money for the complete superseding of the ordinary service gun by the rapid firer. Besides having the advantage of firing six times as often, the latter has the further advantage that between each discharge but a slight alteration in aim is required.

Noteworthy amongst many improvements, introduced to ensure rapid loading and firing, is the Elswick breech screw. It is on the principle of the interrupted screw, but is made of a coned instead of a cylindrical shape. This arrangement secures two advantages, viz., firstly, the action of opening and closing the breech is much simplified, as the breech screw need not be withdrawn before hinging away; and, secondly, the coned shape of the breech screw enables it to take hold, not only of the inner surface of the metal of the breech hoop or jacket, but also distributes the engagement, and, therefore, the strain and support, over a much larger surface. The breech screw is further arranged so that the threads of the smaller end of the cone correspond longitudinally with the interrupted spaces of the larger end, and *vice versâ*, so that the strain and support are also distributed throughout the entire circumference of the breech screw, instead of, as formerly, half the circumference being lost by the interrupted spaces.

Electricity is used as the means of firing these guns with advantage, as electric primers can be kept in the loaded cartridge cases without the slightest danger. An explosion would be so serious that percussion primers would never be tolerated in the cartridge cases, except just before firing, however unlikely accidental explosion might be considered. Further, the use of electricity facilitates arrangements to secure the guns being in proper firing position when fired—especially necessary, seeing that the rapidity of firing is very liable to lead the gunners to omit some of the routine of their work. To obviate failure the electric light is always supplied in duplicate, and sometimes even a third current is provided, and percussion firing can also as a last resort be substituted with barely a moment's pause.

An ingenious electric sounder has been devised to assist in providing against miss-fires, and can be seen in action in the Exhibition. It commences to ring, if everything is in order, directly the gun is loaded and in the firing position. By its means all the primers can be tested before actually required for firing, and further it has the merit of being free from complication. Considerable attention has naturally been given to providing a suitable mounting for these guns. Instead of being fitted with trunnions they are placed in cradles, keys being provided on the guns, which, working in keyways in the cradle, prevent the gun from turning. The breech of the gun is fitted with a horn, which is connected with a piston rod working in the recoil press cylinder under the cradle. Two steel rods are also attached to the horn on the gun, and, passing each side of the recoil cylinder, are connected with a spiral spring which causes the gun to return to the firing position after absorbing the recoil energy. On the cradle are trunnions which fit into bearings in the sides of the carriage. The latter are cast-steel, and are bolted to the upper roller path and to the 3in. vertical shield which forms the front part of the mounting. The upper roller path is stamped into form by hydraulic pressure. It runs on twenty-four rollers, provided with flanges on the interior edges, and kept in place by a circular ring, each roller working on to an axis bolted on to the ring. Thus the resistance offered by friction is minimised, and the training of the gun we illustrate can be effected with ease by a push, although gearing is provided. Elevation is obtained by a hand-wheel geared into the elevating arc fitted to the cradle, placed so that it can be used with the left hand while the eye is on the sights, the right hand on the firing pistol, and the left shoulder pressed against the shoulder piece, so that one man can train, elevate, fire, and sight the gun simultaneously.

SHIPBUILDING NOTES.

On the 1st inst. the large steel screw steamer "Lincolnshire," carrying 4,000 tons, which has been built by Messrs. Wm. Gray & Co., Limited, and engined by the Central Engine Works, to the order of Messrs. Money, Wigram, & Sons, Limited, London, went on her trial trip. She is fitted with engines of 23in., 36½in., and 62in. diameter of cylinders, and a stroke of 39in. A special feature is a double-funnel. The vessel made a speed of 12¼ knots per hour on the whole distance, the engines being run at 91 revolutions per minute.

On the 2nd inst. the yacht "Irene," built by Messrs. A. & J. Inglis for Prince Henry of Germany, was launched on the Clyde. The "Irene" has been built to the designs of Mr. G. L. Watson. The Emperor of Germany and his brother are now both owners of Clyde-built yachts designed by Mr. Watson, the Emperor having recently bought the "Thistle" from the syndicate under whose auspices the vessel was built.

Notices of Meetings.

THIS WEEK.

Royal Institution.—Friday, May 22nd, at 9 p.m. Lecture on "The Molecular Process in Magnetic Induction," by Professor J. A. Ewing, M.A., F.R.S. Saturday, May 23rd, at 3 p.m. Lecture III., on "The Artificial Production of Cold," by Mr. H. G. Harris, M.Inst.C.E.

Physical Society.—Friday, May 22nd, at 5 p.m. Papers to be read: "Dr. Schobben's Form of Lantern-Stereoscope," by Mr. C. J. Woodward, B.Sc.; "A Simple Steam Engine Indicator Accurate at any Speed," by Professor J. Perry, F.R.S.; "Mr. Blakesley's Method of Measuring Power in Transformers," by Professor J. Perry, F.R.S.; and "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power," by Professor W. E. Ayrton, F.R.S., and Mr. W. E. Sumpner, D.Sc.

NEXT WEEK.

Institution of Civil Engineers.—Tuesday, May 26th, at 8 p.m. Annual general meeting.

The Federated Institution of Mining Engineers.—Thursday, the 28th inst., at 12 noon, and Friday the 29th, at 10 a.m. Papers to be read: "Notes on Coal Dust," by Mr. Henry Hall (H.M. Inspector of Mines), Rainhill, Prescot; "On Locked Coil Wire Ropes," by Mr. Wm. Foggin, Durham; "The Economical Use of Steam in Colliery Engines, with Results of Experiments," by Mr. John McLaren, Leeds; "The Coal Fields of New South Wales," by Mr. Geo. Blake Walker, Barnsley; "The Coal Fields of Australasia," by Mr. S. Herbert Cox, London; "The Detection of Fire-damp," by Professor F. Clowes, Nottingham, and Mr. James Ashworth, Stanley, Derby; "Reports as to the Fumes Produced by the Explosion of Roburite, Tonite, and Gunpowder"—I. Chemical Report, by Dr. P. Phillips Bedson, Newcastle-upon-Tyne. II. Medical Report, by Dr. David Drummond and Dr. George H. Hume. III. Joint Statement of Conclusions and Recommendations, by Dr. P. Phillips Bedson, Dr. David Drummond, and Dr. George H. Hume. IV. Appendix to Chemical Report. "An Electrical Safety Apparatus for Cages," by Mr. John Yates, London.

Society of Arts.—Thursday, May 28th, at 4.30 p.m. Paper to be read: "The Study of Indian History," by Mr. Charles Lewis Tupper, B.A., Bengal C.S. (Punjab).

PRICES CURRENT, 20th May, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
„ Angles	5 10 0	.....	6 0 0	„
„ Plates	5 12 6	.....	6 2 6	„
Staffordshire Bars	6 10 0	.....	7 0 0	London.
„ Angles	6 12 6	.....	7 2 6	„
Crown Sheets	7 0 0	.....	7 10 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 5 0	„
„ Ship and Girder			6 10 0	„

PIG IRON.

Middlesbro' Warrants, No. 3.	41/-	Cash.
Scotch Warrants, m/n	54/-	„
Hematite Warrants, m/n	52/9	„

Stocks in Stores.	Scotch	509,297—Dec. for week	15 Tons.
	Middlesbro'	118,538—Inc. „	1,194 „
	Hematite	146,224—Inc. „	5,755 „

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	63/-	.....	57/-	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	„ „
Summerlee	60/6	.....	56/-	„ „
Langloan	62/-	.....	57/-	„ „
Glengarnock	60/-	.....	52/-	„ „
G.M.B. ex store	54/6	.....	54/6	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£24	10	0	to	24	15	0
Copper:	British Cakes and Ingots	56	0	0	„	56	10	0
„	Chili Bars, G.O.B.'s	51	17	6	„	52	5	0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	51	17	6	„	52	5	0
„	Manufactured (strong)	63	10	0	„	64	0	0
Lead:	Common Pig	13	7	6	„	13	10	0
„	English Sheet	14	2	6	„	14	5	0
Tin:	Straits	92	12	6	„	93	0	0
„	Australian	.....				.....		
„	English Ingots	96	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: Quiet, with small business during the holidays. The visible supply of copper decreased about 1,000 tons during the first fortnight of May. The Chili bar market has been strong during the past week, and values have steadily improved. Current quotations are £51 17s. 6d. to £52 5s. cash, with firm market. Manufactured, £63 10s. to £64, "strong."

Tin: Firmer, values of foreign having advanced considerably during the past week.

Lead: Quiet, with small inquiry.

Spelter is much firmer, the Belgian strikes and the workmen's action on the Continent having materially affected the output.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	.....	—	.....
„ „ Liquid	gal.	.....	—	.....
„ Citric	lb.	0 1 7½	—	.....
„ Oxalic	„	0 0 8½	—	.....
„ Sulphuric	ton	.....	—	.....
„ Tartaric	lb.	0 1 8	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 8½	—	.....
„ Muriate (Grey)	ton	.....	—	.....
„ „ (White)	„	25 0 0	to 30 0 0	
„ Sulphate	„	10 15 0	—	.....
„ Liquor	lb.	.....	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	.....	—	.....
Bisulphide of Carbon	„	.....	—	.....
Borax	„	.....	—	.....
Bensole (90 %)	gal.	.....	—	.....
„ (50/90 %)	„	.....	—	.....
Copper Sulphate	ton	16 15 0	— 17	0 0
Copperas	„	.....	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	.....	—	.....
„ White Sugar	„	.....	—	.....
„ Brown „	„	.....	—	.....
Potash: Bichromate	lb.	0 0 8½	—	.....
„ Caustic	ton	.....	—	.....
„ Carbonate	„	.....	—	.....
„ Chlorate	lb.	0 0 5½	—	.....
„ Prussiate (Yellow)	„	0 0 10½	—	.....
„ Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 4	—	.....
„ White	„	0 3 0	—	.....
Salts: Epsom (Bags	ton	.....	—	.....
Salts: Epsom (Casks	„	.....	—	.....
„ Glauber	„	.....	—	.....
Sulphur: Sublimed Flowers	„	.....	—	.....
„ Recovered	„	.....	—	.....
Soda: Ash	deg.	0 0 1 1/16	— 0	0 1¾
„ Caustic (White 70%)	ton	.....	—	.....
„ „ (60%)	„	.....	—	.....
„ „ (Cream 60%)	„	.....	—	.....
„ Crystals	„	3 2 6	— 3	3 0
„ Bicarbonate	„	.....	—	.....
„ Hyposulphite	„	.....	—	.....
Solvent Naphtha	gal.	.....	—	.....
Tartar, Cream of	cwt.	4 19 0	—	.....
Zinc Sulphate	ton	.....	—	.....

OILS.

		£ s. d.
Cocoanut: Cochin	per ton.	35 0 0
„ Ceylon	„	29 0 0
Cottonseed	„	21 15 0
Cod	„	24 0 0
Lard	„	34 10 0
Linseed	„	22 7 6
Olive, Spanish	„	45 0 0
Palm, Lagos	„	26 10 0
Rapeseed: English	„	31 0 0
Seal: Pale	„	26 0 0
„ Brown	„	.....
Sperm	„	50 0 0
Whale	„	22 0 0
Turpentine	per cwt.	1 10 0
Coal	per gal.	.....
Petroleum (Refined)	„	0 0 5¾
Spirit		0 0 7¾

We have received the first number of a new American monthly journal entitled *Engineering*. This journal, which is issued by the Engineering Magazine Company, 124, World Buildings, New York, is well illustrated, but is not got up in the style usually adopted by the technical press, but takes more the form of a popular monthly magazine, and contains some interesting technical reading. Looking down the list of contents we find the following:—"Keeping the Mississippi within her Banks," "Gold Mining in Peru by the Incas," "The Second Summers of Village Communities," "The Mechanical Display at the World's Fair," "The Greatest Bridge in the World," "A Chat with Europe by Telephone," "Engine Room Chat," along with articles upon civil engineering, architecture, electricity, mining and metallurgy, and mechanics. We notice that the second number is entitled the *Engineering Magazine*. This, we think, is an advantage, and will prevent its being confounded with our English contemporary *Engineering*. We wish our contemporary every success.

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HOME INDUSTRIES.

LONDON, 21st May, 1891.

THE MONEY MARKET.—The influx of gold which has been attracted to this country by the advance in the Bank Rate to 5 per cent. has allayed the worst fears of those who were looking for a prolonged period of monetary stringency. Of course with the official rate at that point the situation cannot be considered easy, but satisfaction is felt at the continuous reinforcement of the Bank reserve and the virtual cessation of the draft on the slender stock of gold held in London. The amelioration of the position of the Paris Bourse and of the condition of affairs at Lisbon also tends to reassure the money and stock markets. The latter have shown a distinct tendency to improve during the week. All the investment stocks have risen in view of the better tone of the money market, and foreign securities have strengthened in response to the more satisfactory news from Paris. But Americans have been less ready to recover, the heavy exports of gold from New York continuing to depress the market there, and counteract the influence of the local conditions of the railroads, which are by common consent admitted to justify a substantial advance in prices. The lesser departments of the Stock Exchange have been featureless and business has been on a restricted scale.

THE INSTITUTE OF MARINE ENGINEERS.—A meeting of this Institute was held on the 12th inst., presided over by Mr. F. W. Wymer, Vice-President, when Mr. Macfarlane Gray gave a popular lecture on "Logarithms," at the special request of the Council. The subject was treated mathematically and historically. The lecturer succeeded in riveting the attention of his audience for an hour and a half, and presented his mathematical investigations in a most attractive form. Logarithms, he said, had been to science what steam had been to commerce, and Scotland's greatest glory is not commemorated by any one of the monuments in Princes Street Gardens, but by the brass plate in the porch of St. Cuthbert's Church, which tells that John Napier, the Laird of Merchiston, the inventor of logarithms, is buried there. In the remarks which followed, Messrs. Hawthorn, Williams, and the Chairman took part. A vote of thanks to the author of the paper and the Chairman was passed. At the next meeting of the Institute, on the 29th inst., the subject will be "The Metacentre," popularly explained by Mr. Macfarlane Gray.

ROYAL METEOROLOGICAL SOCIETY.—The monthly meeting of this Society was held on the 20th inst., Mr. Baldwin Latham, M.Inst.C.E., F.G.S., President, in the chair, when the following papers were read:—(1) "On the Vertical Circulation of the Atmosphere in Relation to the Formation of Storms," by Mr. W. H. Dines, B.A.: After giving an outline of the circulation of the atmosphere, the author referred to the two theories which have been suggested to account for the formation of storms—viz. (A) The convection theory, which is that the central air rises in consequence of its greater relative warmth, this warmth being produced by the latent heat set free by condensation; and (B) the theory that the storms are circular eddies produced by the general motion of the atmosphere as a whole, just as small water eddies are formed in a flowing stream of water. The author was of opinion that the convection theory was the more probable of the two, but thought more information about the temperature of the upper air was needed. (2) "On Brocken Spectres in a London Fog," by Mr. A. W. Clayden, M.A.: During the dense fogs in February last the author made a number of experiments with the view of raising his own "spectre." This he ultimately succeeded in accomplishing by placing a steady lime-light a few feet behind his head, when his shadow was projected on the fog. He made careful measurements of the size and distance of the spectre, and also succeeded in taking photographs of the phenomenon. (3) "An Account of the 'Leste,' or Hot Wind of Madeira," by Dr. H. Coupland Taylor: The "leste," the author stated, is a very dry and parching wind, sometimes very hot, blowing over the island from the E.N.E. or E.S.E., and corresponds to the sirocco of Algeria, or the hot north winds from the deserts of the interior experienced in Southern Australia. During its prevalence a thin haze extends over the land, and gradually thickens out at sea until the horizon is completely hidden. It occurs most frequently during July, August, and September, and usually lasts for about three days. Mr. Shelford Bidwell, M.A., F.R.S., exhibited an experiment showing the effect of an electrical discharge upon the condensation of steam. The shadow of a small jet of steam cast upon a white wall is, under ordinary conditions, of feeble intensity and of a neutral tint. But if the steam is electrified, the density of the shadow is at once greatly increased, and it assumes a peculiar orange-brown hue. The electrical discharge appears to promote coalescence of the exceedingly minute particles of water contained in the jet, thus forming drops large enough to obstruct the more refrangible rays of light. It is suggested that this experiment may help to explain the intense darkness, often tempered by a lurid yellow glow, which is characteristic of thunderclouds.

THE LATE CAPTAIN F. P. WARREN, R.N.—It is with regret we have to announce the death of this well-known inventor, who some years ago, after a long career of service in the navy, retired into private life, but only to begin a new career as one of the most prolific of inventors. The patents which have been taken out by him cover almost the entire field of industry, and include a new form of lifeboat and lubricants for engines.

THE CITY AND GUILDS OF LONDON INSTITUTE.—A conversazione was held by the students of this Institution on the 15th inst. at the Finsbury Technical College. Professor S. P. Thompson, D.Sc., delivered a lecture, entitled "Electricity in Motion," and several engineering, electrical, and chemical firms lent apparatus for exhibition.

RAILWAYS.—The gross receipts of the twenty-three principal railways of the United Kingdom for the week ending May 10th amounted, on 16,245 miles, to £1,367,942, as against 16,159¼ miles and £1,351,006 for the corresponding period in 1890, an increase of 85¼ miles, or 0·5 per cent., and an increase of £16,936, or 1·2 per cent.

COMPETITIVE LIFEBOAT TRIALS.—The committee of the Royal National Lifeboat Institution have, we understand, decided to conduct a series of competitive lifeboat trials at Lowestoft next autumn, and invite inventors and others to enter boats for the competitions, under certain regulations and conditions, which can be obtained from the secretary of the Institution at 14, John Street, Adelphi. Intending competitors must give notice on or before June 30th next.

SOUTHWARK AND VAUXHALL WATER COMPANY.—A report has recently been drawn up by the Local Government Board with reference to the Southwark and Vauxhall Water Company's Bill for the creation of £300,000 of debenture stock. It is stated in the report that, though the number of houses supplied has risen from 90,535 in 1880 to 111,155 in 1889, and the estimated population from 672,677 to 825,886, the average daily supply has fallen from 23,985,827 gallons to 23,591,919 gallons during that period. It is suggested by the Board that the Select Committee of the House of Commons now inquiring into the London Water Bill should require the company to give particulars of the storage and subsidence reservoirs, and also of the projected new filter beds.

MANCHESTER, 21st May, 1891.

THE FIFTY-THREE HOURS QUESTION.—Following upon the successful agitation in Manchester for a reduction of the weekly hours in the engineering trades to fifty-three, and the movement for higher wages in Oldham, a circular has been issued to the Bolton employers, asking for a like reduction of hours. The annual report of the Machine Workers' Association also refers to this subject, and expresses a hope that the concession will shortly be made to affect the members of this association also. There is little doubt that uniformity in this matter is highly desired by the Manchester employers, who are already handicapped by the lower wages paid in the districts outside Manchester.

THE RATING OF MACHINERY.—At a conference, held in Manchester on the 15th inst., of representatives of various assessment committees throughout Lancashire, it was complained that the proposed Bill to exempt machinery from rating would add to the confusion already existing. It was urged by the Committee that what was really desired was a clear definition of the machinery liable to rating and that exempt, and that a clear gain would accrue from this, even if the liability to assessment was removed from certain classes of machinery. It was proposed that the machines which are fixed to buildings merely for the purpose of steadying them should be exempt, as well as all machinery used for producing or communicating motive power. It is difficult to see how any machinery used in ordinary manufactures could be rated under this proposed clause, except under a proviso including machinery requiring special adaptation of the buildings.

PHOTOGRAPHY OF COLOURS.—An exhibition of photographs of various coloured objects was given at a recent meeting of the Manchester Photographic Society. The photos were taken by a system invented by Mr. A. W. Scott, of Weston-super-Mare, who proceeds upon the theory that there are four primary colours, green, red, blue, and violet. He accordingly takes four distinct pictures simultaneously by means of four lenses, in front of which respectively is a screen of one of the four colours named. The negatives are developed in the ordinary manner, and in throwing the pictures on to a screen four lenses are again used having a common focus, each of the pictures being projected through a screen of the same colour as that originally used. The result is that a picture is produced which includes the colours of the original.

PAPER WORKERS' HOURS.—A conference of workers in paper mills was recently held in Manchester at which the question of working hours was considered. It was stated that the hours in Lancashire were very long, and that a good deal of Sunday work existed. It was resolved to insist upon the cessation of work on Saturday at two o'clock, and to refuse to work longer hours after the first Saturday in July. About 15,000 people are affected.

DAIRY WORK IN LANCASHIRE.—The Council of the Harris Institute in Preston have offered to the Lancashire County Council to erect a permanent dairy school where that class of work should be taught. They also propose to appoint a professor of agricultural chemistry, who would have at his disposal the extensive chemical laboratory already existing, and who would analyse samples of artificial manures for the farmers of the county. A migratory school is also proposed to be sent out to any district where thirty-two pupils are guaranteed.

LANCASHIRE AND THE BRAZILIAN TRADE.—The Blackburn Chamber of Commerce has called attention to the recent treaty between the United States and Brazil, which provides for the admission of many varieties of goods at duties about 25 per cent. less than those charged on British goods. They point out that out of £6,232,316 value of goods imported into Brazil, £2,500,274 represented the value of cotton goods. They ask for diplomatic action to secure a new treaty, and Lord Salisbury has promised attention to the subject.

THE LINEN AND JUTE TRADES.—There is not much doing in any department just now. Most of the houses have been closed during a portion of the week, and there was very little business passing even on Tuesday. As far as prices are concerned there is a steady feeling all round, and buyers are paying higher rates for bleached goods. The advance, however, is not considered sufficiently great in proportion to the increased cost of yarns, and manufacturers will make a special effort to get still better terms from merchants. Jute goods are steady, and prices of Hessians, although not quotably higher, are very firm, buyers finding it difficult to get in on their own terms. Yarns do not sell extensively here, but for such goods as offer a stiff rate is insisted on. Quotations have advanced all along the line during the past few months. Purchases of cloth on American account are maintained at a satisfactory level, the buyers now in the market having operated freely. For South America, however, there is very little doing, and the outlook does not improve.

GLASGOW, 21st May, 1891.

GENERAL.—So far as commercial matters are concerned the present week has been a broken one. The Whit week holidays have for two days closed the Stock Exchange and the banks, and produced a general holiday feeling, though as usual this has only been fully felt in commercial circles, the imminent approach of the midsummer holidays preventing its extension to industry. The pig iron warrant market has been closed on both days, so that there have been only two days' business in the Iron Ring this week. The state of the market is peculiarly perplexing. Trade is very dull, the amount of iron in course of withdrawal from stock is trifling, and production is increasing. Yet prices are going up, while during the depletion of the stocks and fairly brisk trade prices fell persistently. The cause of this apparent anomaly is probably temporary, and is no doubt due entirely to the manipulation of the market by speculators in Glasgow and London. An astute writer in a local weekly ascribes the movements to a preponderance in the strength of the English "bulls" over the Scottish "bears." It would appear as though the Scottish sellers had immensely oversold, and the conviction that they had done so has suggested to the English buyers to call for the iron, with the result that the "bears" have been forced to enter the market heavily, thus forcing the price up rapidly. On Tuesday morning on the resumption of business the "bears" were still buying to cover their commitments, and the price of G.M.B. advanced sharply from 52s. 1½d. to 54s. 3d. Cleveland and hematite followed, advancing 2s. 3d. and 2s. respectively. Since much of the iron so bought for cover at 52s. to 54s. had been previously sold at 42s., the losses of local speculators have been heavy, and some of the smaller operators are already understood to have succumbed.

MINERALS.—The serious falling off in pig iron shipments is noteworthy in view of the price movements noticed above. The decrease last week is nearly 4,000 tons, and for the four months and a half of this year amounts to 81,298 tons. The shipments have indeed been only little more than one-half the quantity of the corresponding period of last year. Coal shipments, on the other hand, continue to exhibit the remarkable expansion noticed during the past two months. As before, the East Coast ports show a large proportion of the increase; the port of Methil, for example, recently acquired by the North British Railway, advancing rapidly into a prominent place. The increase for the year so far is 91,031 tons, or about 5 per cent. on the total for the period.

ENGINEERING.—The tunnel under the Hudson, which is being driven under the care of a young Glasgow man, Mr. Ernest W. Moir, formerly on Messrs. Arrol's staff at the Forth Bridge, is now making more rapid progress. The distance tunnelled is now about three-fifths of the whole. The shield and accompanying apparatus for excavation were made by Messrs. W. Arrol & Co., and were illustrated in these columns some months ago.

SHIPBUILDING.—For the first time for some years the Fairfield Shipbuilding and Engineering Company are about to build a sailing vessel, Messrs. Gibson & Clark having contracted with them to build a vessel of 2,300 tons for their "Pass" Line of sailing ships. The vessel will be a four-masted barque, built of steel, and will have a deadweight capacity of 3,900 tons. The contract price is said to have been £23,000, or £10 per ton.

THE DEEPENING OF THE RIVER CART.—The River Cart, upon whose banks the town of Paisley is situated, and which has hitherto been a shallow and unsavoury stream, has been deepened and rendered navigable from Paisley to the Clyde. The work was commenced in 1887, and has now been completed, the river having been opened for traffic recently. Paisley has become a seaport, and now steamers will sail not only for the ports on the coast, but even to foreign ports. The depth of the river is now 18ft. at spring tides, and 16ft. at neap tides. The width of the stream has been increased from 80ft. to 180ft. The work has been carried out under the direction of Messrs. Bell & Miller, engineers,

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Glasgow, the contractors having been Messrs. Ireland & Mitchell. The cost of the scheme has been £130,000. This sum has been obtained on loan secured by a power of taxation by the Cart Trustees upon the inhabitants of Paisley to the extent of a maximum assessment of 3d per £ on the rental, one-half payable by the landlord, and one-half by the tenant.

(From our own Correspondents.)

LIVERPOOL, 20th May, 1891.

The Pacific Steam Navigation Company.—From the report of the directors for the past year, just issued, it appears that the earnings of the company have been seriously affected by the late strikes, high price of fuel, and the competition in the Straits and West Coast service; also by the diplomatic troubles between this country and Portugal early last year. The profit on the working account is £157,071. The cost of coal was £353,164; repairs, £141,446; wages, £283,791; expense of management, £66,587, or 5 per cent. of the gross receipts; sending officers to the Pacific coast, £3,000. £127,817 is written off for depreciation, and £26,676 for the boiler fund. The book value of the fleet and property stands at £1,307,362; twenty-one West Coast steamers are valued at £436,935, or about £12 8s. per ton—rather a high estimate; fifteen ocean steamers are valued at £777,662, or about £12 per ton, and as this includes such steamers as the "Oruba," "Orizaba," &c., the price is a fair one. The underwriting account stands at £215,185, or 16 per cent. of the book value of the property. Two dividends of 10s. and 8s. per share respectively have been paid, carrying forward to 1891 the sum of £13,000.

The Transatlantic Cattle Trade.—The report of the Departmental Committee of the Board of Trade and the Board of Agriculture, appointed by Mr. Chaplin to inquire into and report upon the Transatlantic cattle trade, was issued last Saturday, and the following is a brief summary of the principal recommendations of the Government:—Cattle should not be carried on the bridge decks or poops; nor under temporary shelter on the upper deck; adequate artificial ventilation to be provided in lower decks; they should not be carried anywhere so as to interfere with the navigation of the ship or the lowering of boats, the fittings to be strong enough to resist the greatest possible strain. The committee consider that the well-being of the cattle depends to a large extent upon the efficiency of the cattlemen, and recommend four men to every 100 head of cattle; "deadheads" or "stiffs" to be discontinued; the foreman and assistants to be under the authority of the captain. They consider that the Board of Agriculture should make regulations as to the parts of the vessel which may carry cattle and the space to be allowed for each; to the size and fittings of pens and passages, to the lighting and ventilation; and that powers of inquiry with regard to casualties and losses of cattle during transit should be granted, similar to those now possessed by the Board of Trade.

LEEDS, 20th May, 1891.

Iron and Steel Trade.—There is little or no improvement in the demand in the finished iron and steel trades, and just now, owing to the holidays, business is exceedingly quiet. Last week few firms were really busy. Quietness also then characterised the engineering trade, though, of course, some establishments are still in the position of keeping their hands fully employed.

The Coal Trade.—All classes of coal are in fair demand at prices which have ruled for some time.

SHEFFIELD, 20th May, 1891.

Iron and Steel.—Most of the forges and rolling mills commence work again to-morrow morning, which fact goes a long way towards proving that business is fairly good on the whole. No fresh orders of importance are coming forward for a while, the last good "lines" being the 3in. and 4in. all-steel plates for the "Hood" and "Revenge," by Messrs. Chas. Cammell & Co. Other plates of a similar character are to be made by Messrs. John Brown & Co. and Messrs. Vickers, Sons, & Co., River Don Works. The latter firm are now busy with their Russian order of all-steel plates. It is satisfactory to know that our own naval authorities are fully alive to the importance of having a number of the swift cruisers protected by thin all-steel plates. The Parkgate Steel and Iron Company have issued their twenty-seventh annual report, which states that during the past year the company experienced a greatly decreased demand for iron and steel, with a considerable reduction in price. There has been no reduction in fuel and very little in labour; the company have recently purchased sixty 10-ton waggons at a cost of £3,900. The rolling stock now consists of seven locomotives and 533 waggons of all kinds. The net profit on the year's working is £13,000, out of which it is proposed to pay a dividend of £3 per share, to write off £3,000 for depreciation, and to carry forward £1,035 12s. 3d. to next year's account. The subscribed capital of the company is £300,000, of which £225,000 is paid up. This company possesses one of the best modern plate mills extant for the production of boiler and ship plates, angles, &c.

Coal.—There is practically no change to report. Fuel of all kinds is dear and scarce; at present there appears no signs of a reduction in price. House coal is in great demand, and likely to remain so, judging by the weather recently experienced.

The Sheffield Society of Engineers.—This Society are to-day paying a visit to the Earle's Shipbuilding and Engineering Company, of Hull, by kind invitation of Mr. A. E. Scaton, the general manager and director.

Cutlery.—There is a slight increase in the demand from America, with which country trade has been at a standstill for six months. Two or three good "lines" for mixed qualities have come in lately, the best class predominating. In joiners' tools there is a good business doing with German houses, and also with the English Colonies.

NORTH STAFFORDSHIRE, 20th May, 1891.

The Iron Trade.—We have the general Whitsuntide holiday at the various local works, and in some cases the state of trade is so bad that they will not be started till Monday next. There is no improvement to show, either in prices or demand, while on the other hand there is no diminution in the cost of production. Several works are being carried on at an actual loss, and short time is the order of the day.

The Pottery Trade.—The arbitration was concluded last Friday, and the umpires have undertaken to give their award on Monday next. If any alteration is made in the rate of wages it will date from that day. Some startling evidence was adduced as to the unprofitable state of this industry. The award is awaited with great interest and some anxiety by both sides.

LEICESTER, 20th May, 1891.

Wool Spinning and Yarn Trade.—Though the approach of the Whitsuntide holidays has for some little time back deterred many buyers from operating, still there has been a fairly satisfactory turnover. The market remains very firm; prices rule about as follow:—Deep-stapled fleeces of good quality, 23s. to 23s. 6d. per tod; superior, 24s. to 25s. per tod; choice lots, with large proportion of Shropshires, 26s. to 26s. 6d. per tod. The nearness of the advent of the new clip on the market to some extent curtails operations, and there are many indications that a heavy turnover will be made when it is offered. It is generally thought that the total quantity will be under the average and choice lots rather scarce. Spinners are fairly busy, and an average quantity of new business is on offer, but the old question of unremunerative prices remains and blocks business.

Hosiery Trade.—There is an increase of activity in this industry. The fancy department is considerably better off for business, whilst the underwear department in medium and heavy woollens is busy. The Cashmere hose trade is rather quieter, but, on the whole, the outlook is more cheerful generally in this industry.

Boot and Shoe Trade.—Business is very depressed. There was some activity immediately preceding Whitsuntide in completing orders, but the influx of new orders is very meagre, and the trade is certainly under the average. A few houses are keeping all departments on full time, but many factories are only working part time. The leather merchants find trade very dull and buyers cautious. Nevertheless the market remains firm, and there are few inducements to buy speculatively.

SWANSEA, 20th May, 1891.

Tinplates.—Some interesting statistics have been published regarding the wages of tinplate workers, which go some way to show that notwithstanding the design of the McKinley tariff to keep Welsh tinplates out of the American market, there is still considerable room for reductions in cost of manufacture that may, in a great measure, frustrate the attempts of the Protectionists. The average earnings per week of the various workers are given as follow:—Rollers, £2 14s. 1d.; doublers, £2 3s. 6d.; furnacers, £2 0s. 11d.; behinders, 19s. 9d. (these are usually youths between seventeen and twenty years of age); shearers, £2 11s. 5d.; head annealers, £2 10s. 4d.; assistant annealers, £1 16s. 4d.; packers, £1 9s. 2d.; tinmen, £2 8s.; washmen, £2 8s. (many only from twenty to twenty-one years of age); risers, 16s. (youths from seventeen to twenty years of age); assorters, £2 8s.; boxers, £3 17s. 9d., a sum which includes £1 2s. to £1 5s. per week for an assistant.

Coppermen's Strike.—A remarkable dispute has occurred at Messrs. Vivian's Hafod Isha Works, where, one of the men having left the union, his fellow employés declined to work with him, and demanded his dismissal. The masters not seeing their way to do this, about 300 men have thrown up their employment.

BARROW-IN-FURNESS, 20th May, 1891.

Hematite.—There is a steady trade in hematite pig iron, but the consumption is not increasing at the rate at which prices have lately been advancing. Ordinary qualities of hematite have gone up to 54s. net cash, in consequence of the operations of a "ring" or "corner," but this is no indication of the life of demand. Makers have been quoting 51s. 6d. to 52s. 6d. per net f.o.b. for parcels of mixed Bessemer numbers, but the holidays have intervened, and caused, at any rate, a temporary cessation of business. Stocks have been further reduced to the extent of over 7,000 tons, and they now stand at 150,000 tons in the aggregate. There are still only thirty-nine furnaces in blast, and thirty-eight standing idle.

Steel.—The prospects in the steel trade are rather better, although the works are stopped for a week during the holidays. The Bessemer rail department has been strengthened by the receipt of new orders at £4 11s. 6d. per ton for heavy sections, and there is every reason to expect large contracts from shipbuilders for material. Steel plates are quoted at £6, angles at £5 10s., and steel boiler plates at £6 15s. per ton. The business doing in hoops is steady at about £6. Heavy castings are in good demand, and likely to remain so. Billets, slabs, and blooms are quiet, and the trade in tinplate bars is quiet.

Shipbuilding.—Fewer orders are offering in the shipbuilding department, but it is known that increased activity may be expected at the Barrow yard during the summer months, and that engineers, ironfounders, and boilermakers will participate in the improvement.

Iron Ore.—There is a quieter demand for iron ore, and raisers are not making any profit. They are selling good average best qualities at 10s. per ton net at the mines, and they have large stocks in hand, and have, in many cases, closed their mines owing to the unremunerative trade offering.

MIDDLESBROUGH, 20th May, 1891.

Pig Iron.—There was a very small attendance at the market yesterday, and a general disinclination to do business. In fact the market was completely disorganised by the large advance in prices reported from Glasgow, and prices of makers' iron here are purely nomimal, there being a large difference between those of buyers and sellers. Merchants quoted from 42s. 6d. to 43s. per ton for No. 3 G.M.B., but buyers would not pay more than 40s. 6d. or 41s. Middlesbrough warrants have gone up to 43s. 3d. per ton sellers, and 42s. 9d. buyers. This difference of price between makers' iron and warrants may make holders of the former send their iron into the stores in order to sell it as warrants, since they will be able to get more money for it. It is impossible to get reliable prices at present for the lower qualities of pig iron, as holders have ceased to quote owing to the market being so uncertain.

Shipments.—The shipments of pig iron are still well kept up, 21,730 tons being despatched last week, making a total of 46,619 tons up to the 16th of the month, as against 35,878 tons for the same period of May, 1890. Of the 46,619 tons, 18,145 tons went to Scotland, England and Wales took 4,685 tons, and 23,789 tons went to foreign parts.

Manufactured Iron and Steel.—Quotations for both manufactured iron and steel are rather easier, but makers report that during the past few days they have secured one or two contracts. Common iron bars are £5 10s.; iron ship plates, £5 10s.; iron ship angles, £5 7s. 6d; steel ship angles, £5 15s.; steel ship plates, £6, all less 2½ per cent. and f.o.t. at makers' works. For heavy steel rails £4 10s. per ton is still the quotation. 21,829 tons of manufactured iron and steel have been shipped from this port this month.

NEWCASTLE, 20th May, 1891.

The Holidays.—In accordance with old-established custom the whole of the principal works in the district, including shipyards, engine factories, and collieries, have suspended operations for the Whitsuntide holidays, and industrial matters are consequently somewhat out of gear. Things, no doubt, will have returned to their normal condition by the end of the week.

The Coal Trade.—There is still a good deal of activity in the local coal trade, the qualities used for manufacturing purposes being most in demand. The Northumberland miners have declined to submit to a small reduction of wages recently asked for by the coal owners, and the latter have intimated their intention to abandon the claim for the present, the recent improvement in trade having made it possible to continue present rates without serious loss. The improvement, however, is not of such a nature as to afford ground for the belief that it will last for any lengthened period, and it is probable that in the course of a few weeks the claim for a wages reduction will be renewed.

New Companies.—The prospectus has just been issued of "The Tyne Shipping and General Investment Trust, Limited," which has been established for the purpose of purchasing or effecting exchanges of shares in shipping. The capital is to be £100,000, in shares of £10 each, and one-half of these are now offered to the public for subscription. The directors are all local gentlemen connected with shipping, and the registered offices are at 6, Mosley Street, Newcastle. The mortgage debentures of Messrs. W. B. Reid & Co., Leases Brewery, Newcastle, have been fully applied for, and the allotment will take place this week.

The Elswick Ordnance Works.—Several departments at this great establishment are still very slack, but it is understood that orders of importance have lately been received, and an early return of briskness is anticipated. Some new machinery for forming, by means of hydraulic pressure, various accessories required in gun construction has just been put in operation, and it is said that the results are extremely satisfactory. The iron and steel articles produced are superior in finish to ordinary smith work, and the cost of manufacture is considerably less.

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THE ROYAL NAVAL EXHIBITION.

(*For description see page* 488.)

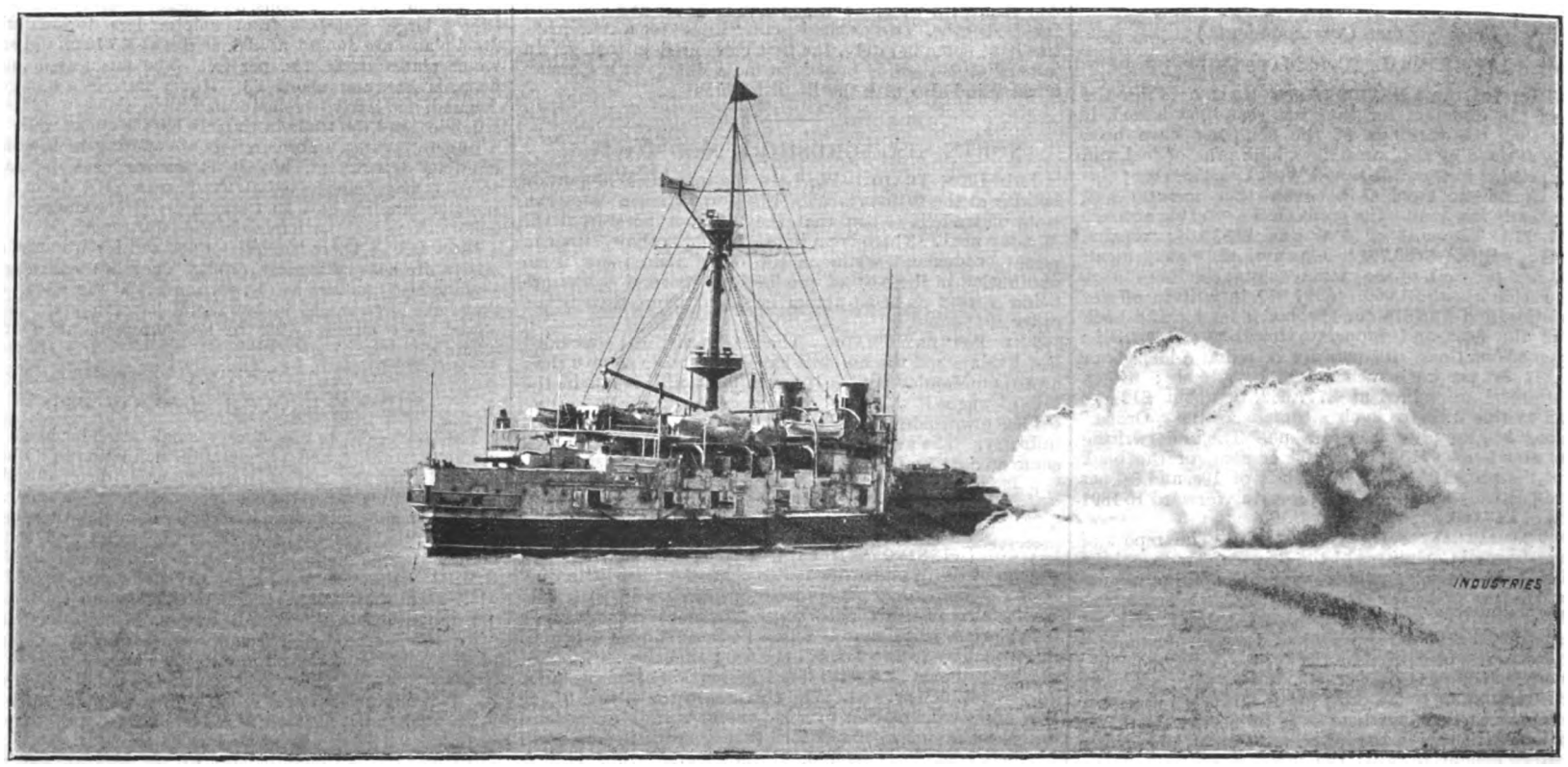


FIG. 2.—VIEW OF H.M.S. "VICTORIA" WHILE FIRING HER GUNS.

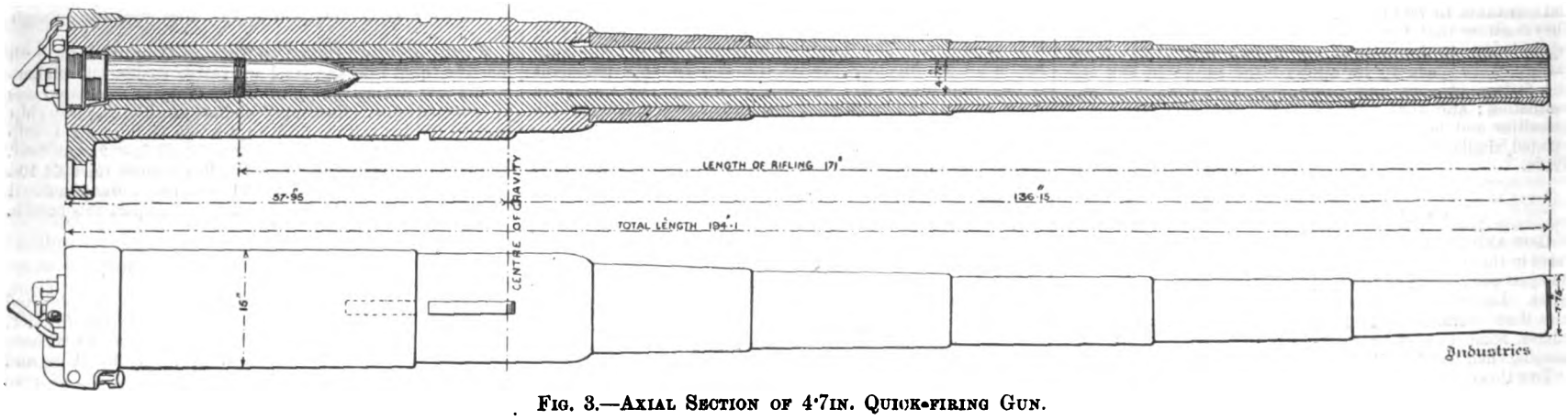


FIG. 3.—AXIAL SECTION OF 4·7IN. QUICK-FIRING GUN.

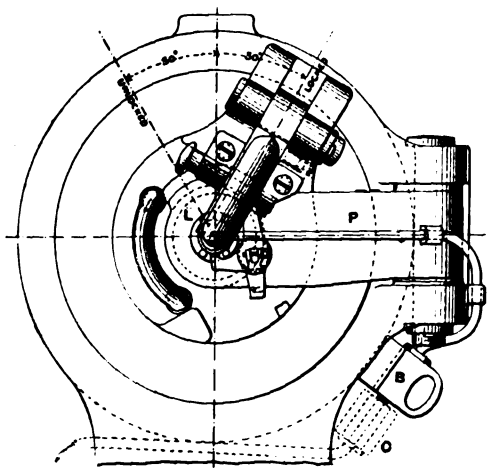


FIG. 4.—END VIEW OF 4·7IN. GUN.

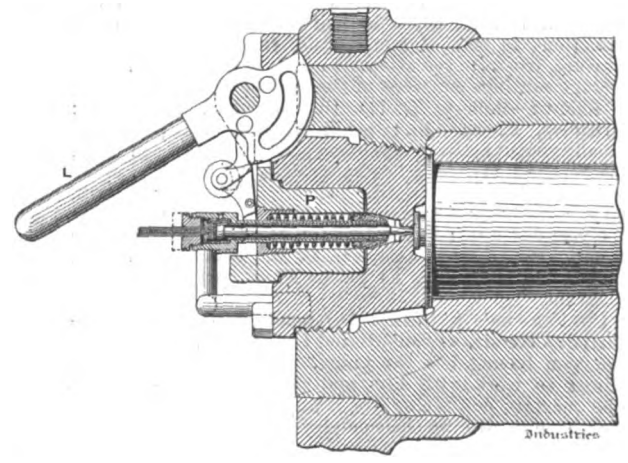


FIG. 5.—SECTION OF BREECH GEAR.

MR. KEELY ON LATENT FORCE.

SOME years ago we heard a great deal about Mr. Keely and his motor, which was to revolutionise all our mechanical notions and our industrial methods, but the subject was never seriously taken up by engineers or scientific men, and Mr. Keely, failing to give any explanations which were intelligible to ordinary men, was practically laughed out of court. He, at least, still believes in the correctness of his ideas, and has endeavoured to enlighten the world regarding them in the current number of *Lippincott's Magazine*, but we confess frankly that we cannot make much of his explanations.

Some time ago Mr. Keely was asked, What is the amount of energy that you get out of, say, twelve drops of water when decomposed into ether? and he replied "that from that amount of water a force can be developed that will fill a chamber of seven-part volume no less than six times with a pressure of ten tons to the square inch." Questioned further, if so many foot-pounds of energy were put into vibratory motion, how many foot-pounds could be got out of it, he replied that "all molecular masses of metal represent in their interstitial molecular spaces incalculable amounts of latent force, which, if awakened and brought into intense vibratory action by the medium of sympathetic liberation, would result in thousands of billions more power in foot-pounds that that necessary to awaken it. The resultant development of any and all forces is only accomplished by conditions that awaken the latent energy they have carried with them during molecular aggregation. If the latent force that exists in a pound of water could be sympathetically evolved or liberated up to the seventh subdivision or compound-inter-etheric, and could be stored free of rotation, it would be sufficient to run the power of the world for a century."

In view of these possibilities the exhaustion of our coalfields is a matter of little moment. While wishing to be charitable to Mr. Keely, we must say that these statements look uncommonly like nonsense, lightened by an occasional glimmer of sense. Still, men who have some claim to be considered scientific say that "Keely has seemingly demonstrated the discovery of a force previously unknown to science."

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 22ND MAY, 1891.

MR. PLIMSOLL AND TRUSTS.

MR. SAMUEL PLIMSOLL, who has long had the sailor under his special care, has widened his sympathies so far as to include the general public. In an alarmist article, contributed to this month's *Nineteenth Century*, he has sounded a note of warning against the growth of trusts, syndicates, and "corners." In sounding this note, however, Mr. Plimsoll is a little late in the day, as he should have let us know the dangers of trusts before they came upon us, and not, according to him, after they are in full flood. Moreover, the tone he adopts would seem to indicate that he thought he had discovered the existence of these monsters of modern industry and commerce, and that they had grown with mushroom-like rapidity. Now, neither of these things is quite true. Many economists and some few journals —*Industries* being a good instance—have repeatedly noted the gradual growth of these combinations, have pointed out their elements of strength and their elements of weakness, and, while not suggesting any legislative interference at present, have indicated that an attitude of watchfulness is necessary in the public interest. Mr. Plimsoll gives a list of seventy-one "trusts," which, he says, have been formed in the United States in two years. Mr. Plimsoll does not always give the official title of the combinations, and he classes under the generic name of trust some combinations that, perhaps, are scarcely entitled to be so classified. Moreover, they have not all been formed in the past two years. In fact, very few of them have. The Standard Oil Trust, for instance, included in Mr. Plimsoll's list, was formed in 1882, after the very close co-operation of its constituent companies for ten years previously. The "Standard" is certainly a powerful and successful combination, but it has been the growth of years, and is, moreover, probably the only entirely successful and secure trust in America. The others have had greater or less difficulty in consolidating themselves, and some of them have passed through the experience of the Copper Syndicate. Many others of the trusts upon the list have been in existence from three to five or six years. In spite of Mr. Plimsoll's unsoundness as to matters of fact, the main purport of his paper certainly entitles it to attention. The unregulated growth of trusts might, as he argues, result in a practical re-imposition of the restrictions upon trade which were withdrawn when our tariffs were almost, if not altogether, abolished. It is a common observation in America that the great industries there will, ere long, be able to dispense with a protective tariff, because they will be able to protect themselves—that is, that they are nearly powerful enough, by means of trusts, to fix arbitrary prices for their commodities, and thus to withdraw them from international competition as effectually as they are now enabled to do by the protective tariff. It is to be noted that while a tariff protects a home manufacturer from external competition, it does not protect him against the competition of his own countrymen; indeed, it often enhances that, whereas a trust effecting arbitrary fixation of prices abolishes competition altogether. Thus, in protecting the producer and his group of capitalists until they were strong enough to stand alone, the American legislatures have unintentionally created formless and irresponsible power, at once able and willing to continue, under another guise, the tariff which the legislature was prepared to abolish. So far as the United States and Canada are concerned, the evolution of trusts must necessarily be watched with considerable anxiety. Several of the States of the Union have legislated on the subject, and, even apart from special legislation, there is considerable doubt as to the legality of trusts in common law. The growth of trusts in countries where protective tariffs are highly developed suggests a connection between trusts and tariffs. And the existence of this connection is confirmed by the rarity of trusts in this country, the only Free Trade country in the world. It is not difficult to discover the connecting link between trusts and tariffs. A tariff enhances domestic competition until this competition becomes ruinous, then the combination arises as a last hope. The last hope sometimes succeeds beyond expectation, and a trust is consolidated. In our own country competition, keen enough in many branches, is not so keen as it is in America. Our business men, as a rule, are less ambitious; social influence may be gained in this country with moderate means, in America with enormous means alone. There is proportionally in this country also, perhaps, a larger number of persons of more nearly equal abilities for the conduct of considerable affairs than there is in America. There are numerous other differences between the economic and social conditions of this country and those of the United States, which tend to suggest that any extensive adoption of the trust here is unlikely; and that, however necessary even the most drastic legislative interference may become in the United States and in Canada, the time has not yet arrived when such need be pressed in this country. It might be argued, with some probability of success, that the existing law is sufficient to prevent the growth of the trust idea. The main argument against the trust is that it is opposed to public policy because it "acts in restraint of trade" and tends to raise prices. Now, whatever "acts in restraint of trade" is liable to be prohibited under the common law; and it would take some trouble to devise a scheme at once more specific and less likely to be used as a means of escape than that already provided. Again as to the tendency to raise prices, it is pointed out by the apologists of trusts that the concentration of skill and capital, and the diminution of administrative expenditure resulting from the formation of a joint-stock company, results also, and in a greater degree, from the formation of a trust. It is argued that the saving so effected would enable the trust at once to make a larger profit for its constituents and to charge a lower price to its customers. Unfortunately this philanthropic intention is seldom fully realised. The trust succeeds, as a rule, in the first endeavour, and finds means to avoid engaging in the second. Yet, on the whole, though the trusts of the United States and Canada do not reduce prices much, if at all, they do not as a rule enhance prices—they only keep them from falling. It is an evidence of the purely arbitrary character of their price lists, that they have generally arrested the fluctuations at the point at which prices stood when the trust was formed. Thus, in the case of the Standard Oil Company, oil

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was declining rapidly, prices had fallen fully 10 per cent. per annum between 1861 and 1872, while there was no trust; fully 7 per cent. per annum from 1873 till 1881, while there was an incipient trust; and only 2¼ per cent. per annum during the maturity of the trust. It is impossible to say whether the existence of the Standard Oil Trust makes petroleum cheaper or dearer to-day than it would have been had there been no Standard Oil Trust. It is possible that had the fall of prices continued for some time the capital devoted to the business would have found some more remunerative outlet, and there would thus have been diminished production and enhanced price until, perhaps, the whole of the fall, or more than the whole of it, might have been recovered. Many trusts can point to reduced price lists as a justification of their existence, but after all, the gauge is delusive: the question, which in most cases cannot be answered with any reasonable approximation to accuracy, is—what would prices have been without these combinations, would they have been less or more? In failing to grasp that there is a possible good side to the trust, and that judged by the standard of his own choosing—viz., the standard of the effect of the trust upon prices—Mr. Plimsoll errs so decidedly, that an apologist of the trust would have no difficulty in knocking Mr. Plimsoll's warning and its supporting argument into fragments. Apart from definite statistical proof, which in the nature of the case does not appear to be possible, there can be little doubt that as regards benefit or injury to the community the presumption is against the trust. The trust would have no reason for existence unless prices tended to be reduced by competition. As regards its other alleged function, there are advantages in comparatively small and carefully supervised concerns which to a large extent outweigh the economies effected by administration on a large scale. Though mere cheapness cannot be represented as a social end, it is undoubtedly to the benefit of the community in general that no section of it should be permitted to place a ransom price upon its labour or upon its commodities. Since no more effectual means of preventing this "cornering" than the commonplace means of competition has yet made its appearance, it would seem as though the justification of the trust, from its own point of view, were its condemnation from the point of the public. There was something in Adam Smith's reproach, that traders never meet together but they "hatch some public mischief," for, although combination has its legitimate uses, it may, as a combination of labour or of capital, be pushed so far as to constitute itself a public nuisance. Thus, while a prohibition of the practice of walking along a street arm in arm might justly be regarded as oppressive, a combination of persons who chose to march in a body enlaced arm in arm from one side of the street to the other would probably find that it had transgressed against the public sentiment, if not even also against the law of every civilised country. The desire on the part of the trusts, both in this country and in America, to establish themselves in public favour by showing that, on the whole, they are a benefit to the people at large, must certainly tend to impose a natural limit to arbitrary management. The same force would even more decisively make itself felt in this country, and this, coupled with the fear of legislation following unwise exercise of opportunities, may be trusted to keep the trust question in check for some time to come.

THE ANALYTICAL CHEMIST AND THE INSTITUTE OF CHEMISTRY.

Although it is now nearly six years since the Institute of Chemistry obtained its charter of incorporation, the public are only now slowly beginning to realise the importance of having a body of qualified analytical and consulting chemists in their midst. In our issue of last week we gave a report of the conference held at Burlington House, at which a series of interesting papers were read and discussed, which show that the Fellows of the Institute have now become keenly alive to the responsibilities which rest upon those practising this comparatively young profession. As is generally the case when a new idea is being developed, there were differences of opinion as to the best way of protecting the public from the impositions of quackery on the one hand and the evils of professional unionism on the other. We have so recently given our readers a historical sketch of the inception and growth of the Institute (see *Industries*, Vol. X., page 163), and urged the advisability of the acquisition of compulsory powers and the adoption of a practice qualification for those entering the profession, that we do not propose to further discuss the internal management or constitution of the Institute. Mr. Hehner, at the conference last week, read a paper entitled "The Analytical Chemist in Relation to the Public, the Profession, and the Institute," and it is the first of these relations to which we wish to draw the attention of our readers at the present time. There can be no doubt that the professional chemist is rapidly becoming of more value to the public, but the increasing numbers of men who style themselves analysts, analytical chemists, and so forth, render it necessary that an authoritative warning should be given to the public by the Press that it will do well to examine carefully into the credentials of its chemical advisers before entrusting them with any work of responsibility. It may be difficult for the public to realise that the Chemical Society, which has recently celebrated its jubilee with such a flourish of trumpets, is simply concerned with the advancement of the science of chemistry, and that its Fellows as such are *not* trained to undertake the elucidation of commercial and technical problems. In the earlier days, when the application of chemical analysis to raw materials, foods, and drugs was being demonstrated as useful to the public welfare, the professor and the scientist acted as pioneers in this demonstration. At the present time we owe some thanks to these earlier investigators, who not only endeavoured to educate the public to the proper understanding of the importance of the purity of articles of commerce, but at the same time laid the foundations of the modern methods by which adulteration and sophistication may be detected and accurately estimated. The analytical chemist at the present day is a professional servant of the public, and it is essential that he should not only discharge his duties with exactitude and promptness, but should be acquainted with the exigencies of trade, the requirements of buyers, the difficulties of manufacture, and should be in touch with the business in which his aid is generally indispensable. The Institute of Chemistry was founded to supply the public with such men, and its curriculum and professional examinations are supposed to be arranged with this object in view. We take it that the public will now have the advantage of knowing that a "F.I.C." is qualified to assist in such commercial problems, and we may further take it that a "F.C.S." is simply a member of a time-honoured institution for the furtherance of pure chemistry. The latter may possibly be a teacher or *dilettante* in chemical science, but not have a particle of professional knowledge. We make these remarks, as we know that there is a tendency on the part of public bodies to regard the Fellowship of the Chemical Society as a guarantee of professional ability; also that some local authorities consider that a medical man, or a pharmaceutical chemist, as such, is qualified to certify as to the purity of foods and drugs. We wish to urge the importance of discriminating between the various divisions of professional ability, and to show the improbability of one man being proficient in several branches of knowledge. Formerly, in a small town, the surveyor and the medical officer were able to advise on all technical matters which were likely to arise in the municipal affairs, but with the development of trade and the progress of local industries the public require the services of the civil and sanitary engineer, the gas examiner, the analyst, and the electrician, whilst the medical officer himself may well devote his time to work which pertains to hygiene and sanitary science. We regret to see that in an important London vestry the authorities have thought it advisable to still continue to combine the appointments of medical officer of health, foods and drugs analyst, and gas examiner. In this particular case the medical Press, as representing the medical profession, and the Institute of Chemistry, on behalf of analytical chemistry, pointed out the anomaly of an appointment with triple duties of such diverse character, and we doubt whether the Local Government Board will confirm such a course. There is as little relationship between the duties of a medical officer of health and a gas examiner as between those of a veterinary surgeon and a dentist, and we trust that it will not be long before the public recognises that the analysis of water and gas, of foods and drugs, and articles of commerce cannot be done efficiently or satisfactorily in the public interests except by highly trained and properly certified professional men.

In our recent articles we pointed out that the Institution of Civil Engineers had successfully overcome a similar difficulty, and that, although it is still open to any unqualified person to put "C.E." after his name, still the public have found out that membership of the Institution of Civil Engineers is a generally satisfactory guarantee of proficiency. The breaking down of the quackery attending the use of "C.E." by unqualified men was, however, an easier task than that which the Institute of Chemistry has before it, in disillusioning the public as to the absence of any professional value in the Fellowship of the Chemical Society. Professor Odling expressed himself very strongly on this point at the recent conference, and showed that it was extremely undesirable that the Fellowship of the Chemical Society should be considered in any degree tantamount to an attestation of scientific or professional ability. We hope that the Council of the Institute in their own interests, as well as in the interest of the public, will give his views on this subject the widest publicity. We are inclined to think that more can be expected from greater activity on the part of the Council of the Institute than from attempts to rouse the public from their apparent apathy and lethargy in matters which are of such vital interest to public health and commercial morality. The conference held last week is the first of a series of semi-annual meetings which the Council has arranged to be held in London, and we hope that, by selecting subjects of general interest for discussion, the Institute will demonstrate by its activity in this direction that its Fellows are worthy of the confidence of the public. We are aware that some will urge that such proceedings are of the nature of an advertisement, and derogatory therefore to the profession, and are prompted by motives of self-interest rather than for the public welfare, but, if our space permitted, we could readily show that beneficial results to the public must necessarily follow from a knowledge of the true scope and aim of the Institute of Chemistry.

NEW SALOON PADDLE STEAMERS.

During last month there were launched from various shipbuilding yards on the Clyde five saloon paddle steamers, which have been constructed with a view to their being employed in the ensuing summer passenger traffic, and three of this number have already been completed and placed on the measured mile for their speed trials. The largest—the "St. Tudno"—was constructed by the Fairfield Shipbuilding and Engineering establishment, Govan, her principal dimensions being:—Length, over all, 277ft.; breadth, 22ft. 6in.; depth, moulded to upper deck, 19ft. 6in.; and gross register tonnage, 900. This vessel is intended to conduct a new express service between Liverpool, Llandudno, and the Menai Straits, the double journey to be accomplished within twelve hours. The graceful character of her lines forward and aft reveals the fact that speed was of primary importance in the consideration of her design. Twenty-two statute miles per hour is the speed aimed at, and to realise this a pair of powerful compound diagonal surface-condensing engines have been fitted, with cylinders of 51·5in. and 93in. in diameter respectively, and a stroke of 5·5ft. Steam is provided from two double-ended steel boilers at a working pressure of 115lb. per square inch. The principal apartments of the ship are situated on the main deck, and are most elaborately furnished, every convenience being embodied in the saloons, dining-rooms, smoking room, &c., that ingenuity can suggest for the comfort of passengers. The "St. Tudno" had a satisfactory preliminary trial of her engines in the Firth of Clyde on the 9th inst.

On the same date the "Woolwich Belle" completed her official measured-mile trials, and had a protracted run of six hours' duration at full power. This vessel has been built for the Woolwich and Clacton-on-Sea Steamboat Company, for passenger traffic between London and Clacton-on-Sea, by Messrs. William Denny & Brothers, Dumbarton. She is built of steel throughout, and measures 200ft. in length by 24ft. beam, her registered tonnage being about 400 tons. Her construction is that of a promenade deck steamer, the after first-class saloon being carried out to the ship's side, below which is the dining saloon, while the second-class saloon is situated forward below the main deck. To enable the steamer to pass under London Bridge at any state of the tide she is provided with a funnel which telescopes into the uptake, while the mast is also adapted for lowering. Compound surface-condensing engines are fitted, which enabled the vessel to steam on the official trial for the full period of time at an average rate of about 17½ statute miles per hour, the engines running throughout from start to finish without the slightest hitch. The "Woolwich Belle" has a neat and fascinating appearance, and this, taken along with the results achieved, fully maintains the honours already earned by Messrs. William Denny & Brothers as regards paddle-wheel steamers.

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The new "Lord of the Isles," was placed on the measured mile in the Gareloch on the 9th inst. This splendid paddle steamer has been built to replace the old vessel of the same name, which was purchased at the end of last season by the Victoria Steamboat Association of London, and which plied on the Clyde from 1877. The new steamer, which is 255ft. in length, by 25ft. beam, by 8·5ft. in depth, has been built and engined by Messrs. D. & W. Henderson & Co., Partick, for service between Glasgow and Inverary. In general appearance she resembles her predecessor, the principal difference being in the arrangement of the saloon, which in the new steamer occupies the whole breadth of the main deck, whereas in the old steamer a passage way was left between the saloon and the sides. This improvement admits of greater space being utilised for the promenade deck, which extends for three-quarters of the length of the ship. The saloon is tastefully decorated in white and gold, the furniture being of black walnut upholstered in terra cotta velvet. The dining-room is situated below the main saloon, and the officers and crew are berthed forward under the main deck. A great deal of interest is at present being centred on the Clyde in the new steamer, and, in virtue of her greater length and more powerful engines, it is confidently expected that she will completely eclipse in speed the performance of the first "Lord of the Isles," which used to perform the daily run of 228 miles at an average speed of 20 miles per hour.

Less palatial than the "Lord of the Isles," although, perhaps, not less comfortable, is the "Marchioness of Lorne," built by Messrs. Russell & Co., Greenock, to augment the Clyde service of steamers belonging to the Caledonian Steam Packet Company. This vessel is, practically speaking, a replica in miniature—being about 100ft. shorter—of the now famous "Duchess of Hamilton," constructed last year by Messrs. Wm. Denny & Brothers for the same company. The "Marchioness of Lorne" is built of steel throughout, of somewhat heavier scantlings than is usually adopted in Clyde river boats, as she is intended for the winter traffic between Ardrossan and Arran. In this vessel the hurricane deck runs right forward to the bow, the fore and main saloons, which extend to the sides, being between this deck and the main deck, with first and second class dining saloons below. Generally speaking, in this class of boat, triple-expansion engines are rather the exception than the rule, but with a view to keeping well abreast of the times the owners of the "Marchioness of Lorne" specified that she was to be fitted with this type of machinery, and the construction of the same was entrusted to Messrs. Rankin & Blackmore, of Greenock, the cylinders being 17·5in., 30in., and 40in. in diameter respectively, with a stroke of 60in. Steam will be supplied by two boilers of the Navy type, working at a pressure of 140lb. per square inch with forced draught on the closed stokehold principle. The dimensions of this vessel are:—Length, 154ft.; breadth, 20ft.; and depth to hurricane deck, 13·25ft.

The "Ravenswood," built by Messrs. S. M'Knight & Co., of Ayr, for Messrs. P. & A. Campbell, for their passenger service between Bristol and Tenby, is another vessel in which attention has been given to secure the much desired quality of speed. This vessel is 15ft. longer than the "Woolwich Belle," with the same beam, and is fitted with a diagonal surface-condensing engine, the cylinder being 56in. in diameter with a stroke of 72in., steam being supplied from two haystack boilers. This steamer has deck saloons forward and aft, with a promenade deck 160ft. in length, and, as in the other vessels, every conceivable provision has been made for the safety and comfort of passengers.

Letters to the Editor.

TYPE-WRITER FOR THE BLIND.

To the Editor of "Industries."

Sir,—A slight error occurs in your description of our Braille-type writer in your issue of the 8th inst.

The fourth key is depressed only for spaces between words, or when it is necessary to advance the traveller without embossing the paper. The traveller advances automatically for spaces between letters or parts of a letter after depressing one or more of the three keys which actuate the punches.

Yours, &c.,
Cockburn, Phillips, & Montgomery.

2, Princes Mansions, Victoria Street,
Westminster, S.W., 15th May, 1891.

THE DECIMAL SYSTEM.

To the Editor of "Industries."

Sir,—The reply given by the Chancellor of the Exchequer to the influential deputation which recently waited upon him to urge the introduction of the metric system of weights and measures, as the first stage in the adoption of a complete decimal system, must be considered by all real lovers of progress as most unsatisfactory. While admitting that the reform would be attended with great advantages, he thought that such a change would confuse almost everybody in the country, and he declined to recommend the Government to appoint that convenient instrument of delay—a Royal Commission.

The question to consider is whether even a Chancellor of the Exchequer ought to be allowed to set aside such a question, supported as it was by such a deputation, and the opinions of the Associated Chambers of Commerce and the Decimal Association. It has now been discussed for many years, and the system has been adopted by almost every country claiming to be considered civilised, and yet on the personal opinion of one man this country is to be kept at a disadvantage, not only in the matter of business but also of education. I hope that steps will at once be taken to bring public opinion to bear on the Government to at least prepare the way for its introduction. I believe that the inconvenience of the change has been very much exaggerated.

Yours, &c.,
Decimal.

London, 18th May, 1891.

ENGINEERS IN THE NAVY.

To the Editor of "Industries."

Sir,—In connection with the correspondence which has taken place in your columns recently, the following paragraph, which I have culled from one of your American contemporaries, serves to show that engineers in the British Royal Navy are not alone in their dissatisfaction of their position, and that the position of their brethren in the United States Navy is quite as bad if not worse than their own.

The writer states that "some of the reasons why competent machinists will not remain in the engineer force of the United States Navy are given by an honourably discharged one, who asserts that a good machinist is paid and treated better and thought more of outside. He can do as he pleases, and has some place to read in or do otherwise after his day's work is done, which he cannot in the navy. A good machinist certainly should enjoy the same privileges as a carpenter, sailmaker, boatswain, or gunner, for he is certainly of as much importance as any one of these, and there is no reason why he should not enjoy the same comforts as a merchant marine engineer, as he does the same duty and has to pass about the same examination. The *American Machinist* makes the sensible suggestion that machinists in the navy should be rated as warrant officers, like carpenters, boatswains, &c., as thus rating them would be likely to secure a better class of men for the service."

Yours, &c.,
C. J. W.

Liverpool, 15th May, 1891.

THE NATAL GOVERNMENT RAILWAYS—OPENING OF THE EXTENSION TO THE TRANSVAAL.

To the Editor of "Industries."

Sir,—Another link in the chain of events which tend to form a united South Africa was completed to-day in the opening of the railway to Charlestown, the extreme limit of the Natal Colony and boundary of the Transvaal. The main trunk line from the coast is now completed. From Durban to Charlestown is 304 miles, and, in travelling this distance, every train has to be pulled up a total vertical height of 13,350ft., or more than 2½ miles. From Newcastle to the Ingogo the line follows the Buffalo Valley, and, in fact, runs for a considerable distance along its banks, but at this point it ascends into a subsidiary valley. The scenery all along the route is of a very interesting nature. At Ingogo we come to the first station on the new section—a distance of 283¾ miles from Durban, or 10 miles from Newcastle.

From Ingogo we run along a fairly even track until Boscobello is reached, and here we have to ascend a height of some 500ft., which is accomplished by means of the reversing station principle. This is a principle hitherto unknown in South Africa, but is very commonly used in America and Switzerland. By this means heavy grades are avoided, and it was to secure a ruling gradient of 1 in 50 throughout that the principle was adopted. It is somewhat difficult to describe, but is worked somewhat as follows:—The train coming along the main line is stopped after ascending a steep ridge. The engine then runs down a second line of rails, and is coupled on to the end of the train, which is pulled backwards above the main line on to a second ridge. The same process is again adopted, and, another ridge having been safely got over, the train proceeds on its way in the ordinary course. The reversing station principle is very interesting to watch, and this interest is all the more enhanced by the reason of the splendid view offered to the sight in ascending the various ridges. Below we see the Boscello farm, and the higher we ascend the more beautiful does the view become.

It may be mentioned that while the telegraph wire which runs in a straight line up the heights is *two miles* in length, the line has to run a distance of six. The line here runs pretty even, the ruling gradient being 1 in 50 until we come in sight of Laing's Nek. The gradient here is very steep, being 1 in 30, and in one small portion 1 in 20, which is certainly one of the heaviest grades on the line, and to overcome it two engines have to be brought into requisition for every train of any weight. From there we run a distance of four miles into Charlestown, the terminal station of the N C. Railways, and situated at a height of 5,386ft. above the level of the sea. There are only three bridges of any importance on the section. The first of these is the Incandu, just outside of Newcastle. It is an iron bridge, consisting of one span of 100ft. and two spans of 40ft., erected on solid masonry abutments, the whole forming a very substantial structure. The second crosses the Imbazan, being a one-span bridge of 60ft., and the third, which consists of one span of 100ft., bridges the Ingogo.

The scenery throughout the section is very pretty, and the district through which the line passes naturally affords special attraction to the English tourist, inasmuch as the line skirts all the memorable battlefields of the Boer War.

Just above Boscobello we catch a glimpse of the towering Majuba, which appears to frown down upon us as we rattle by, and presently we pass close to O'Neall's house, where the Transvaal Convention was signed by Sir Evelyn Wood and President Kreuger on the 24th March ten years ago, which led to the restoration of an independence that ought never to have been violated.

Ascending a little further, and looking to the right, we find straight in front of us Laing's Nek, and further on the Ingogo Heights and Mount Prospect, all of which specially attract the visitor's attention. Coming to Laing's Nek Tunnel, it may be stated that the tunnel is 2,200ft. long, perfectly straight through, and is being constructed to avoid a long detour, which would be otherwise necessary, and dangerous owing to the severe curves.

The tunnel, which is the longest and the greatest engineering feat in South Africa, was pierced on the 28th January, and the masonry work is now being rapidly proceeded with. It is expected that it will be ready for opening in September or October next. For the present the line will only be open for passenger traffic, but it is expected to be ready for the transport of goods in September. This extension leaves only now a coach journey of about twenty-four hours to Johannesburg or Pretoria, while previous to this it took three to four days *in fine weather*.

The opening ceremony was performed with the usual Colonial *éclat* and hospitality by the Governor of Natal, Sir Charles Mitchell, K.C.B., and suite, together with the leading members of the Legislative Council, who went per special train to Charlestown to meet President Kreuger, General Joubert (of Laing's Nek and Majuba Hill fame), and the deputation coming from the Transvaal as the invited guests of the Colony.

Yours, &c.,
D. W. Watt.

Natal, South Africa, 7th April, 1891.

MARINE ENGINE TRIALS.

To the Editor of "Industries."

Sir,—The Report of the Research Committee of the Institution of Mechanical Engineers, and your recent article thereon, contains much that is of interest to marine engineers. It is to be hoped that the Committee will note the suggestions you make, and extend their investigations in the directions you indicate. As you say, the importance of the subject is such as to warrant the assistance of the Government or of the shipowners of the country, and it would prove a good investment if the work were thoroughly and systematically done.

The Committee would do good service if they would help to settle in an authoritative manner the proper method of arranging steam jackets in marine engines of the type now in ordinary use. Those who are responsible for the design of the "Iona" seem to have adopted a very good plan, but one which differs very materially from the practice of some of our best marine engineers. The high-pressure cylinder was placed in the middle, and had three metals or walls around it. Counting from the inside, the first metal is the working barrel. Between the first and the second metal a space forms a steam jacket at full boiler pressure, and this is the only jacket about the engines. The space between the second and the outer wall is partly the receiver between the first and second cylinders, but mainly it is the receiver between the second and third cylinders. The jacket thus, by this ingenious arrangement, gives off heat inwards to the first cylinder, and outwards to the receivers, thus imparting heat where, according to theory, it is most efficient, and not on the second or third cylinders, as it is very often put. It thus has the effect of drying, or superheating, to a certain extent the steam where such is likely to do the most good. It is to be regretted, as Professor Kennedy mentioned in the discussion, that the apparatus designed for measuring the amount of priming had broken down, and thus prevented the investigations of this part of the trial being carried to a successful termination, for this, in conjunction with the arrangement of the steam jackets, affects fundamentally the whole question of marine engine economy. Multiple-expansion engines and steam jackets are only devices for getting rid of the evil effects of the condensation of the steam in the cylinders. It is to be hoped that the Committee will direct special attention to these matters, and give forth such a Report concerning them that in future there may be something like uniformity in practice.

Yours, &c.,
M.I.N.A.

Glasgow, 18th May, 1891.

NOTES ON PATENT LAW.

IV.

(*Continued from page* 417.)

Having now ascertained what is capable of being patented, we have in this article to address ourselves to the totally different inquiry as to what will be actually protected by a given patent grant. It is well understood that this depends in some way upon the specification which the patentee has lodged at the Patent Office, but it is important for a full apprehension of the subject that the rule should be accurately stated, and not left involved in vague and cloudy language.

Originally, then, it should be understood that a patent grant was, as a rule, made in respect of some art or craft which the patentee practised. In an old case which was tried in the time of Queen Elizabeth it was considered to be a very weighty objection to a grant of the monopoly of making and importing playing cards that the person to whom the grant was made was a gentleman of the Court unversed in trade, and was not fitted personally to undertake either the manufacturing or commercial operations of which he had acquired the

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monopoly. This principle does not, however, appear ever to have obtained the force of law, although the set of opinion and authority was undoubtedly at one time in that direction. Very early in the history of our patent law the principle was clearly recognised that the grant of monopoly was made in requital of a public service rendered by the patentee in teaching the people of the realm a new trade. Hence it was at one time contended that no patent grant should be made for longer than seven years, because seven years was the ordinary period of apprenticeship, and it was considered that it would not be right to prohibit the artificers whom the patentee had instructed in his art from following the craft to which they had been brought up. This strict logic did not in the end prevail, but to this day the idea remains, so to speak, embalmed in the patent term, which is granted for fourteen years—that is, for two seven-year periods—and renewable, if renewable at all, for a further period of seven years. Indeed, so fixed has this principle of the essentially contractual nature of a patentee's right become in our patent law, that it is almost certain it would have led to the rule that a patentee must hold his patent on the condition of practising his invention, if it had not happened that the better expedient of a specification setting forth the invention in detail, to be filed at the Office of Patents and open for the instruction of the public, was thought of at the beginning of the last century.

The various steps by which the specification as originally devised came to be modified into the particular documents with which we at the present time are familiar, under the names Provisional Specification and Complete Specification, need not be traced. Enough has been said to show exactly what their bearing on the patent is, and to enable the reader to perceive how and why the rule should obtain that a patentee can only have protection for what he has disclosed in his specification. It is the disclosure, the teaching of his invention to other people, that is the meritorious foundation of the grant. If the patentee fails in this particular he withholds the consideration in respect of which the grant is made, and if the consideration fails the grant itself fails, and he is a patentee no longer except in name.

The first principle, then, is that the *patented invention* can only be something which the patentee has described in his specification, and described so that other people may learn from the description what it is and how it is to be made or performed. Hence the extreme importance of a full and accurate description, upon which, indeed, as being the very essence of the specification, and, therefore, the main condition of a valid patent grant the patentee's rights wholly depend. This description, according to modern practice, may be put into two forms. The one (the provisional specification) is a very compendious account of the matter which serves to identify the invention and to describe its nature in general terms. Great latitude of description is allowed in this document, and it is accordingly generally drawn up in very vague and comprehensive language. In its preparation the patentee often relies upon his own draftsmanship, or seeks the assistance only of such persons as he can treat with the greatest confidence, since until this is lodged at the Patent Office he has absolutely no rights in his invention as such, and any unguarded disclosure of it would amount to a publication which might invalidate the patent grant. It is indeed a most dangerous thing to attempt any exact description of an invention in the provisional specification, and this for two reasons—(1) because the provisional specification once lodged cannot be amended, and, therefore, any inaccuracy of description is irremediably fatal to the grant founded upon it; and (2) because nothing can be eventually claimed as a part of the protected invention which cannot be brought under some part of the description contained in the provisional specification. Now it often happens that during the period of nine months which the patentee enjoys for the preparation of the complete specification, he devises improvements in the details of his invention, improvements which add greatly to the value of the patent. If these improvements can be shown to be mere elaboration in detail of what was stated in general terms in the provisional specification that will be held to be a legitimate development, but if the provisional specification describes one thing and the complete specification passes that over and describes something else in its place, even though it be a mere matter of detail, the thing so substituted cannot be included in the patent, and if the attempt be made by claiming to protect it, the result will be to render the patent void.

This serious risk carries no countervailing advantage, since it does not in any way better a provisional specification to make it minute in its description. The law does not require any such minuteness, and the public are not benefited by it, since the provisional specification is not now published except in conjunction with the complete, from which full information must be obtainable. A skilful draftsman therefore aims, in the preparation of a provisional specification, at generality. He will, of course, be careful to be accurate, since inaccuracy would be fatal to the grant for which he is laying the foundation. But he will make no attempt to be precise. He will rather seek to leave as much room as possible for the modification in detail of the exact arrangements which are present to his mind as he writes. The only thing that he must needs make clear is the nature of the invention. So soon as that has been made to appear he may desist; indeed, the sooner then he gets to the signature—and eventually to the Patent Office—the better. Nothing but danger lurks in any single supernumerary word in a provisional specification.

It is perhaps safer, though scarcely necessary, to interpose the observation here that throughout this article the word "detail" is used with reference to the general scope of the invention. Many inventions—indeed, most inventions nowadays—are inventions of pieces of mechanism which may fairly be called details. Every now and then, indeed, some invention bursts upon the world of such scope, that nobody would think of belittling it by calling it a detail. The telephone, for example, was, a few years ago, a case in point, as also was the phonograph. These marvellous instruments, when first they were brought to the knowledge of the instructed world, seemed more wonderful for what they were than even for what they could do. They lay so far apart from the beaten track of invention, and even of discovery, up to that date, that probably few people who were capable of forming any opinion on theoretical grounds as to their capabilities at all believed, when first they heard them described, that the means said to be employed were at all adequate to the ends said to be attained. Whether in the construction of a telephone a straight bar magnet or a horseshoe magnet were used would, in the first description, have been the merest matter of detail. But nobody can now have a master patent for the telephone, and in all the later specifications these details are the very essence and substance of the several inventions. It would, therefore, be a great mistake in a provisional specification under a patent for improvements in telephones to refer to the improved parts in the language which would have been apt enough in the first telephone specification. The condition that the nature of the invention shall be made to appear could not be satisfied in this way, and when, therefore, the patentee is directed to generalise as much as possible in his provisional specification, the admonition must be understood with reference to the cardinal principle just laid down. Generalising does not mean using vague, still less does it mean using inaccurate language, but it means describing an invention in terms so large and elastic that they will comprehend every form, whether perceived at the present time or not, in which the essential features of the invention can be embodied. Every modification of the idea present in the writer's mind which does not destroy some one or more of these essential features, is a matter of detail only, and should not be excluded by the terms of the provisional specification.

Before passing from the provisional specification, it may be well to note that, under the new law of 1885, the filing of a provisional specification at the Patent Office does not amount to, nor does it necessarily lead to, a publication of the invention. Prior to that date the practice at the Patent Office was to publish abandoned provisional specifications, but that is not so now. A patentee who has suffered no publication of his invention during the period of provisional protection may now, therefore, abandon his provisional specification at his discretion. By so doing he incurs no further risk or detriment than that resulting from the loss of the date at which he lodged it. It may be that his invention has been re-invented or even published in the interval. If so, he may find himself anticipated by a later inventor, but he does not now commit what used to be the fatal error of anticipating himself.

This discussion of the features of a provisional specification will have prepared the reader to seize the leading characteristics of the complete specification. For, indeed, it may now be summed in a word. *Particularity* is in a complete specification what *generality* is in a provisional —its chief, indeed, its one, excellence. The words of the Act (Patent Act 1883, Sec. 5, s.s. (4) which define this requirement are:—"A complete specification, whether left on application or subsequently, must particularly describe and ascertain the nature of the invention and in what manner it is to be performed, and must be accompanied by drawings if required."

Bearing in mind what has been already said as to the purpose of the specification, the reader will readily appreciate that the particular description of this section must be a statement so precise that a reader may learn from it the inventor's secret more or less as an apprentice might learn it in the inventor's workshop. Indeed, it is hardly possible in this connection to be too precise. Those patents which break down for faulty descriptions in the specification generally fail at this point, and even accomplished draftsmen are apt to err through striving too hard to generalise the description given in the complete specification, which should be perfectly definite and minute. A very good plan, which many experienced draftsmen adopt, is to put two descriptions into the complete specification, the one couched in general terms —often a verbatim repetition of the provisional specification—and, following upon that, a detailed description, introduced by way of illustration. The freedom which the writer thus secures is of the greatest advantage to him. He makes no attempt in his detailed description to amplify, and, therefore, is under no temptation to sacrifice perspicuity to comprehensiveness. On the contrary, he sets before his mind's eye an actual specimen of the invention worked up into shape, and gives as lucid a description of that very thing as he can formulate. It may be that parts might be otherwise arranged or variously modified in form and relation—that does not trouble him at all—his general description has already conveyed that intimation, or, if he doubts that, the doubt is set at rest by a sentence expressly introduced for the the purpose. Thus, one constantly finds in such descriptions parentheses like the following:—"It will be understood that I do not confine myself to the exact form of (such and such a part) here shown," or "It will be obvious that some other arrangement of parts may be adopted than the one just described without departing from the spirit of my invention." In this way the desired elasticity may be secured in the language used, while, at the same time, the requirements of the Act as to precision are fully observed.

Another thing which aids freedom in the writer of the descriptive part of a complete specification is the recollection that it is quite allowable to include in the description things that are not included in the patent. This is, indeed, usually inevitable, since it is seldom possible to give an intelligible description of a patented improvement without adding to it as explanatory matter some description of unimproved parts which the improved are intended to supplement or supersede. In order that a patentee may not be embarrassed by the effort to distinguish all through his description between what is new and what is not new, the Patent Act of 1883 provides that a complete specification "must *end* with a distinct statement of the invention claimed." So long as this requirement is satisfied it matters nothing how much the description may in its course have been involved with old and unprotected matters. The one indispensable quality of the descriptive passages in a properly drawn specification is perspicuity. The distinctness which comes of clearly defining the invention claimed can be secured, and best secured, by a separate passage expressly devoted to the definition, and thus the draftsman is set free to pursue with undivided attention the one object of preparing such a description as will enable a competent person without further direction or experiment to make the patented article or perform the patented operation.

The proviso involved in the word "competent person" here used opens out a new topic, which we must reserve for the next article.

(*To be continued.*)

Reviews.

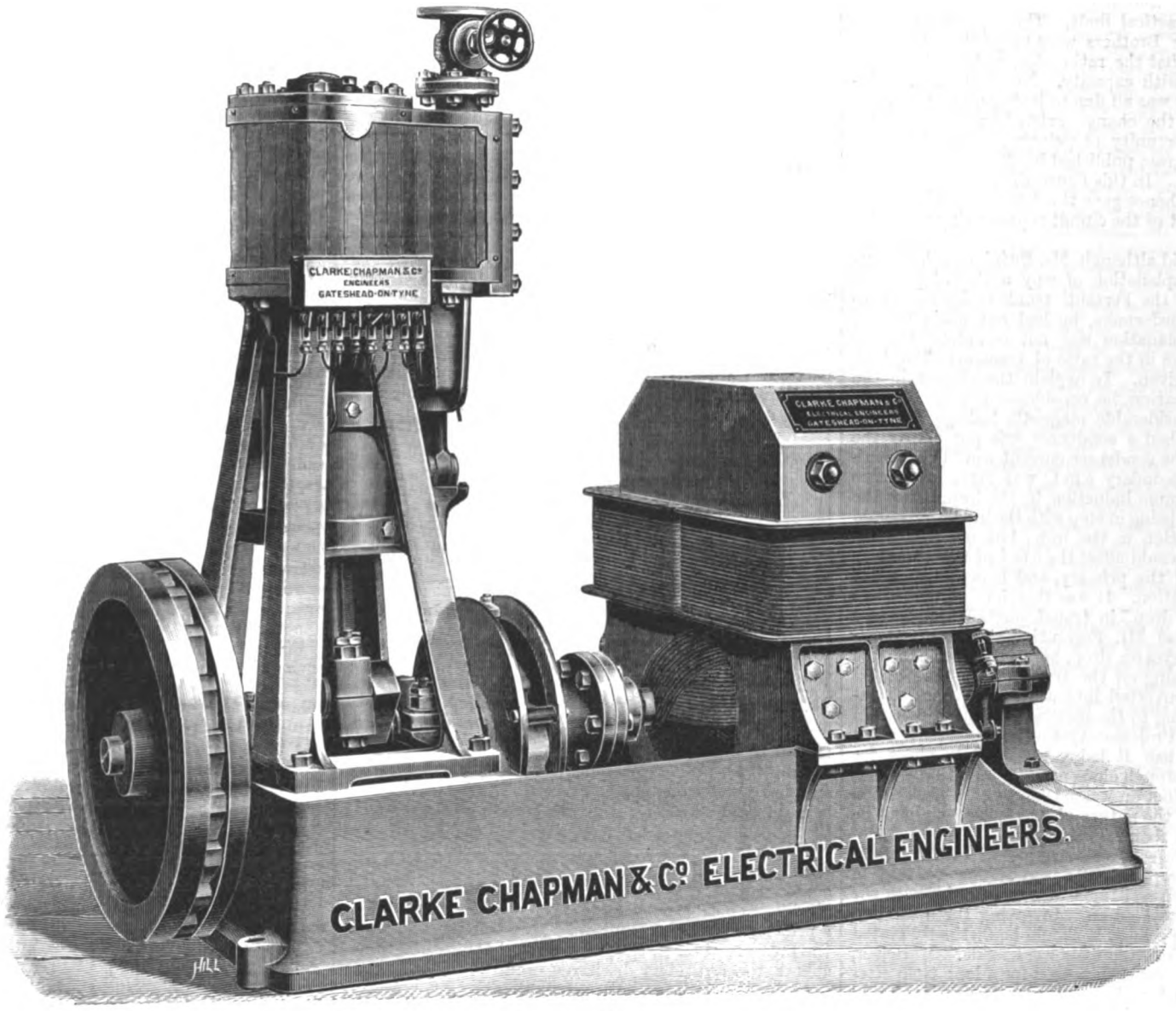
THE SCOTTISH RAILWAY STRIKE, 1891: A HISTORY AND CRITICISM. By James Mavor, Professor of Political Economy and Statistics, St. Mungo's College, Glasgow, &c. Edinburgh: WILLIAM BROWN. 1891.

When the history of the labour movement of the latter part of the nineteenth century comes to be written a prominent position must be given to the record of the strikes which took place and the results which followed from them, and the contemporary records will be deligently studied by those who aim at being impartial historians. The London Dockers' Strike formed the subject of a very large number of articles, but the majority of these were tinged to a very considerable extent by a partisan spirit. Probably the "Story of the Dockers' Strike," as told by Mr. Llewellyn Smith and Mr. Vaughan Nash, was the most impartial from a historical and the most useful from an economic point of view. Professor Mavor has rendered a similar service in connection with the recent railway strike in Scotland, and, while recognising that as yet it is not possible to estimate even approximately the economic effects of the strike, he has given a trustworthy record and criticism of the events connected with it, and made some estimate of the place in the general labour problem of the special questions which have been raised during its course. A narrative is given of the transactions prior to the strike, of the leading events during its progress, of the issues involved and of the various negotiations for settlement, and he impartially criticises all parties concerned. He gives figures on the hours of labour which show that some of the men

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COMBINED ENGINE AND DYNAMO.

CONSTRUCTED BY MESSRS. CLARKE, CHAPMAN, & CO., ELECTRICAL ENGINEERS, GATESHEAD-ON-TYNE.



GENERAL VIEW.

were kept on duty for periods altogether beyond permanent human endurance. He gives tables to show the daily percentage of instances of men on duty for 18 hours and upwards at a time, and the percentage of men, who, after having been on duty for more than 12 hours, were allowed to resume duty with less than eight hours' rest, and in both of these matters the North British Railway does not come out to advantage.

Mr. Mavor gives a very useful *résumé* of the legal questions that arose during the course of the strike, which ought to be carefully studied by all connected with trades unions, while his discussion of men and methods will be recognised as impartial. He says it is perfectly clear that, no matter what the terms may be upon which the men have capitulated, the central issue of the strike—the reduction of hours—must be faced, and that, if need be, by the raising of additional capital. He makes a suggestion which may lead to rather important results. The English Railway Servants' Society owns over £70,000, of which the sum of £24,000 is invested in 4 per cent. Debenture Stock of seven of the English lines. The sum is not a large one in proportion to the capitals of the companies; but Mr. Mavor points out that, if we consider the capital value of the men themselves, it becomes evident that they, as well as the shareholders, should be represented upon the Board of Directors. If they cannot do so as representatives of the men, they might take their places at the Board as representing the men in their capacity of shareholders, for which they might qualify themselves by investing a few thousand pounds in the ordinary stock of the company. Professor Mavor's little book will be found most useful, not only as a trustworthy record of an important labour struggle, but also as containing valuable economic criticism and information, which may be studied with advantage by capitalists and workers alike.

COMBINED ENGINE AND DYNAMO.

THE illustration given above represents a combined steam engine and dynamo constructed by Messrs. Clarke, Chapman, & Co., of Gateshead-on-Tyne, and exhibited on their stand at the Royal Naval Exhibition. The plant, which is compactly arranged, consists of an engine and dynamo coupled direct and bolted on the same bed-plate, the engine having a cylinder 8¼in. diameter with an 8in. stroke, being of sufficient power to drive a dynamo giving an output of 9,000 watts. The makers have special appliances for machining the frames and cylinders of these engines, whereby the main bearings, motion bar seatings, motion bars, cylinder, and cylinder stuffing-boxes are all bored at one setting, the cylinder flanges being also faced at the same time, thus ensuring all these surfaces being perfectly true with one another. The main bearings are of ample length and diameter, the extreme pressure being 220lb. per square inch, whilst that on the crank pins is about 450lb., and on the motion bars only 50lb., when fully loaded with a steam pressure of 120lb. per square inch. The dynamo, which is of the drum type, is constructed to give an output of 9,000 watts, or to furnish 150 16 c.p. lamps at 65 volts.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT a meeting of this Institution, on the 14th inst., a discussion took place on a paper entitled "Some Effects of Alternating Current Flow in Circuits having Capacity and Self-Induction," by Dr. J. A. Fleming, F.R.S.

Mr. Swinburne said he was particularly interested in the subject, for he believed he was the first to suggest the true explanation of the phenomenon known as the Ferranti effect. When the effect was first observed, it was looked upon as peculiar, and various authorities were exercised in finding an explanation. In December last, when he read a paper "On Alternate Current Condensers" before the Physical Society, no authoritative statement as to what actually occurred had been published, but he took the conditions and worked backward to see what the effect ought to be. He then found that putting a condenser on the secondary mains would increase the pressure, and explained the rise by the action of the "leading" condenser current on the magnets of the alternator. Whether the rise might be said to be due to armature reactions or to self-induction was chiefly a question as to what was meant by self-induction. He thought any rise due to the transformer would be small, but Dr. Fleming had found it fairly large. This was probably owing to the comparative smallness of the transformers used, for in very large transformers, such as he assumed were employed, the magnetic leakage to which he (Mr. Swinburne) attributed any rise caused by the transformer was relatively small.

Professor Ayrton said he took great interest in Dr. Fleming's paper, because it confirmed many results brought forward by Dr. Sumpner and himself in a paper recently read before the Physical Society. Referring to paragraph 6 of Dr. Fleming's paper, he said that the general statements about Mr. Blakesley's conclusions and those of the author was rather confusing, for Mr. Blakesley's results were only applicable to shunted condensers, whereas those of Dr. Fleming referred to unshunted condensers. On slip 4, in treating of Resonance, the author, he said, concluded that there was only a narrow range of capacity within which the pressure at

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the condenser may be much greater than that at the machine. This conclusion resulted from his having chosen a coil having a resistance of only 10 ohms and a very large self-induction of 200 secohms (henries). As a matter of fact resonance effects spread over a large range, and in practice it was impossible to get a coil with such a large time-constant as Dr. Fleming had imagined. The pressure at the condenser could, therefore, never be 100 or 1,000 times that at the alternator, 5 or 10 times being about the practical limit. The experiments made by Messrs. Siemens Brothers were very interesting, and distinctly proved that the ratio of transformation of a converter varied with capacity. No doubt Mr. Swinburne would say it was all due to leakage, but nevertheless the fact that the change existed was certain. He also took the opportunity of pointing out a mistake he had made in a diagram published in *The Electrician* on January 2nd, 1891. In this figure the connections were shown wrong, and hence gave the impression that a rise occurred in the part of the circuit representing the mains themselves.

Mr. Evershed said although Mr. Swinburne had conceived the true explanation of why a rise of pressure should occur when the Ferranti trunk mains were connected to the transformers, he had not made himself clear, and his explanation was not complete, for the cause of the change in the ratio of transformation had, he said, not been given. To explain the change in the ratio of transformation, he considered a 1 to 1 transformer having considerable magnetic leakage between the two coils. When a condenser was put across the secondary mains the condenser current would be a maximum when the secondary e.m.f. was zero. But zero e.m.f. meant maximum induction in the iron, hence the condenser current being in step with the induction would increase the induction in the iron; but, owing to leakage, this increase would affect the e.m.f. of the secondary more than that of the primary, and hence change the ratio of transformation. It was therefore quite possible to neutralise the "drop" in transformers by putting on condensers, and had Mr. Ferranti designed his transformers to give a greater drop, he might have arranged so that when working on the trunk mains the "drop," instead of being converted into a rise, was exactly compensated. Referring to the method of writing equation (31) mentioned by Professor Ayrton, he protested against the terms other than R being reckoned in ohms, for passing currents through ohms meant generation of heat, whereas no self-induction wasted energy. In his opinion the terms were of the nature of e.m.f., and ought to be called e.m.f. rather than resistances.

Mr. Addenbrooke said the soaking in of the charge might affect the capacity in a way similar to that in which the insulation resistance of a cable varied with the time the current was kept on. In giving the insulation resistance of any specimen it should be distinctly stated under what conditions the tests were made. Moreover, the resistance of a cable increased for a long time after it was manufactured, and almost any desired insulation resistance could be obtained by waiting long enough.

Mr. Preece, replying to Professor Ayrton's statement that a coil having a time-constant of 20 seconds could not be made, pointed out that Faraday's coil at the Royal Institution required two minutes for the current to attain its maximum value. A submarine cable when coiled in its tank had also an enormous self-induction, as was proved by a test made by Mr. Edison at the Telegraph Construction and Maintenance Company's works, when he found that a telegraphic "dot" put in at one end of the cable came out 27in. long at the other.

THE PHYSICAL SOCIETY.

This Society varied its ordinary procedure as regards the place of meeting by paying a visit on the 9th inst. to Cambridge. Assembling at Liverpool Street Station, members and visitors to the number of about 100 were conveyed in saloon carriages direct to their destination, the whole journey being accomplished in about seventy-five minutes.

At 2.30 p.m. a meeting of the Society was held in the lecture-room of the Cavendish Laboratory. The papers read were all by authors resident in Cambridge. After the meeting the visitors inspected the Cavendish Laboratory. Amongst the many interesting instruments and apparatus to be seen, specially noticeable were Professor J. J. Thomson's 50ft. vacuum tube, glowing from end to end with a luminous discharge; Mr. Shaw's pneumatic bridge, by which the pneumatic resistance or conductivity of various shaped orifices and channels can be compared; and the new air condensers to be used by Mr. Glazebrook as standards. The Cambridge Scientific Instrument Company had an interesting exhibit, including a dividing engine, Boy's radio-micrometer, electrically driven tuning-forks, and various recording instruments, amongst which was Galton's apparatus for registering the growth of plants. Other things which attracted attention were Glazebrook's spectrophotometer; Lord Rayleigh's coils and apparatus used in his determination of the ohm; a collection of models, medals, and instruments formerly belonging to Professor Maxwell; the resistance standards of the British Association, together with the historic rotating coils and electrodynamometer used in the determination of the B.A. unit.

At the science meeting, held in the Cavendish Laboratory, Professor Ayrton, F.R.S., being in the chair, the following communications were made. The first paper was on "Some Experiments on the Electric Discharge in Vacuum Tubes," by Professor J. J. Thomson. The phenomena of vacuum discharges were, he said, greatly simplified when their path was wholly gaseous, the complication of the dark space surrounding the negative electrode and the stratifications so commonly observed in ordinary vacuum tubes being absent. To produce discharges in tubes devoid of electrodes was, however, not easy to accomplish, for the only available means of producing an electromotive force in the discharge circuit was by electromagnetic induction. Ordinary methods of producing variable induction were valueless, and recourse was had to the oscillatory discharge of a Leyden jar, which combines the two essentials of a current whose maximum value is enormous and whose rapidity of alternation is immensely great. The discharge circuits, which may take the shape of bulbs or of tubes bent in the form of coils, were placed in close proximity to glass tubes filled with mercury, which formed the path of the oscillatory discharge. The parts thus corresponded to the windings of an induction coil, the vacuum tubes being the secondary and the tubes filled with mercury the primary. In such an apparatus the Leyden jar need not be large, and neither primary or secondary need have many turns, for this would increase the self-induction of the former and lengthen the discharge path in the latter. Increasing the self-induction of the primary reduces the e.m.f. induced in the secondary, whilst lengthening the secondary does not increase the e.m.f. per unit length. Two or three turns in each were found to be quiet sufficient, and on discharging the Leyden jar between two highly-polished knobs in the primary circuit a plain uniform band of light was seen to pass round the secondary. An exhausted bulb, containing traces of oxygen, was placed within a primary spiral of three turns, and on passing the jar discharge a circle of light was seen within the bulb in close proximity to the primary circuit, accompanied by a purplish glow which lasted for a second or more. On heating the bulb, the duration of the glow was greatly diminished, and it could be instantly extinguished by the presence of an electromagnet. Another exhausted bulb, surrounded by a primary spiral, was contained in a bell jar, and when the pressure of air in the jar was about that of the atmosphere, the secondary discharge occurred in the bulb as is ordinarily the case. On exhausting the jar, however, the luminous discharge grew fainter, and a point was reached at which no secondary discharge was visible. Further exhaustion of the jar caused the secondary discharge to appear outside the bulb. The fact of obtaining no luminous discharge either in the bulb or jar, the author could only explain on two suppositions—viz., that under the conditions then existing the specific inductive capacity of the gas was very great, or that a discharge could pass without being luminous. The author had also observed that the conductivity of a vacuum tube without electrodes increased as the pressure diminished until a certain point was reached, and afterwards diminished again, thus showing that the high resistance of a nearly perfect vacuum is in no way due to the presence of the electrodes. One peculiarity of the discharges was their local nature, the rings of light being much more sharply defined than was to be expected. They were also found to be most easily produced when the chain of molecules in the discharge were all of the same kind. For example, a discharge could be easily sent through a tube many feet long, but the introduction of a small pellet of mercury in the tube stopped the discharge, although the conductivity of the mercury was much greater than that of the vacuum. In some cases he had noticed that a very fine wire placed within a tube on the side remote from the primary circuit would prevent a luminous discharge in that tube.

Following Professor Thomson's paper was one on "Some Experiments on the Velocities of the Ions," by Mr. W. C. D. Whetham. In studying electrolysis, the question as to whether there is any transference of solvent when a porous wall is absent presented itself to the author. The ordinary methods of testing for transference, such as by increase of pressure, or by overflow, not being available, when there is no diaphragm, the author used different coloured solutions of the same salt, such as cobalt chloride in water and in alcohol, the former of which is red and the latter blue. By putting the solutions into a kind of U-shaped tube, any change in the position of the line of junction of the two liquids could be measured. Two aqueous solutions in which the anion was the same were also tried, one combination being cupric chloride and common salt, and in this case the line of demarcation traversed about 7in. in three hours. The results hitherto obtained by this method agreed fairly with those found by Kohlrausch.

A paper "On the Resistance of some Mercury Standards" was afterwards read by Mr. R. T. Glazebrook. In 1885 M. Benoit, of Paris, supplied the author with three mercury standards nominally representing the Paris Congress ohm, now commonly known as the Legal ohm. Tests of these standards were described in a paper read before the Physical Society in 1885 by the present author. Recently he had occasion to compare two of the standards with the British Association coils. The mean of many concordant results gave the resistance of one of the mercury standards (No. 37) as 1·01106 B.A.U., whilst that of the other (No. 39) was 1·01032 B.A.U. Expressing them in legal ohms the present resistances are (No. 37) ·99986 and (No. 39) ·99913, whilst in 1885 the values obtained were (No. 37) ·99990 and (No. 39) ·99917. This shows that within the limits of experimental error the ratios of the mercury standards to the B.A. coils have remained practically unchanged during six years. The numbers given above are based on Lord Rayleigh's determination of the specific resistance of mercury, which differs appreciably from that found by Mascart and other observers. Taking the mean of the later concordant determinations, the values of the mercury standards expressed in legal ohms become (No. 37) 1·00033 and (No. 39) ·99959. The values given by the maker were 1·00045 and ·99954 respectively, showing a very close agreement. The author also found that refilling No. 37 from the same sample of mercury produced no appreciable change in its resistance, whilst No. 39 was somewhat affected by a similar operation. Experiments on the coefficient of increase of resistance of mercury with temperature gave the value ·000872 as the mean coefficient between 0° and 10° C., a number rather less than that obtained by Kohlrausch.

Following this, a paper, "On an Apparatus for Measuring the Compressibility of Liquids," by Mr. S. Skinner, was read. The apparatus described consists of a large spherical flask, with a long narrow neck, containing the liquid to be experimented upon, the lower part of which was in communication through a stopcock and flexible tube with an adjustable reservoir. By raising or lowering the latter the flask could be easily filled or emptied or the quantity of liquid adjusted. The flask was enclosed in a bell jar, whose interior was in communication with a pump and barometer gauge. So sensitive was the arrangement that the compression of water produced by blowing into the jar caused the liquid to descend about 1 centimetre in the neck of the flask. This movement corresponded with a change of volume of about half-a-millionth. The coefficient of compressibility has been tested at different temperatures, and the results were not very different to those obtained by Tait and others. The influence of salts in solution in changing the compressibility had also been tested, and a great difference in this respect found between electrolytes and non-electrolytes.

"Some Measurements with the Pneumatic Bridge" was the title of a paper read by Mr. W. N. Shaw. The action of the apparatus is analogous in many respects to the Wheatstone's bridge, and its object is to compare the pneumatic resistances of various orifices,. We described it specially on page 485. The proportional arms are represented by two circular holes in thin plates of mica, the third arm by an aperture provided with a sliding shutter adjustable by a screw, and the fourth might consist of any aperture or tube whose conductivity was to be determined. The several apertures are pneumatically connected by large wooden boxes. The battery takes the form of a Bunsen burner, with a long chimney, whilst the galvanometer is represented by a glass tube connecting opposite chambers and containing a vane, which sets itself at right angles to the tube when no air current is passing. The apparatus is remarkably sensitive to movements of the shutter, and on starting or stopping the draught after balance had been obtained, effects analogous to those produced by self-induction are observed. By its use it has been found that bevelling off one side of a hole in a thin plate increases the pneumatic conductivity of the aperture very considerably, particularly when the bevel is on the egress side. Another interesting result is that for square-ended tubes of given size the conductivity first increases as the length is made greater, and afterwards diminishes with further increase of length. Putting a flange on the outlet end reduces the anomalous effect, whilst a bevelled mouthpiece similarly placed causes it to disappear.

In the discussion on Professor Thomson's paper, Professor Fitzgerald said the beautiful experiments were likely to lead to very important results. He did not quite understand how placing a fine wire in a vacuum tube could prevent the luminous discharge, for if the

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wire was on the side remote from the primary, and if there was any great increase in specific inductive capacity, he would have expected the air to screen the wire.

Professor Lodge asked for further information as to the action of the magnet in preventing the after-glow, and in some cases precipitating a luminous discharge. The experiment with the exhausted bulb within the bell jar was also difficult to understand, and he did not see why one of Professor Thomson's two suppositions must necessarily be true.

The President inquired whether Professor Thomson had tried Mr. Crookes' experiment, in which the electric pressure necessary to produce a discharge was greatly lessened by putting a phosphorescent material in the tube.

Professor Thomson, in reply, said he had not tried the experiment, but the phosphorescence he had observed was of quite a different character to that produced in Mr. Crookes' tubes. To Professor Fitzgerald he said the action of the wire was probably a question of time, and thought the whole field was in some way thrown on the wire, and thus discharged. In reply to Professor Lodge, he had not ascertained the true nature of the effect of a magnet on the glow, but he believed the glow to be due to a combination which might be prevented or facilitated by the action of the magnet causing the density to be different in different parts of the bulb.

M. Guillaume, in discussing Mr. Skinner's paper, described the methods used by Sabine, Taurin, and others in determining the compressibility of liquids, and pointed out their defects. The chief difficulty in such experiments was in finding the compressibility of the reservoir. Numbers expressing the compressibility of mercury obtained by different observers were given, the best values varying between ·0000039 and ·0000040.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

IX.

(*Continued from page* 475.)

Soap Powders.—Soap powders, or dry soaps, are usually intended as scouring agents, or for use with hard water, and consist largely of carbonate of soda, together with more or less real soap, and often a considerable proportion of water.

The method of manufacture is usually to melt scraps and clippings of ordinary pale soap, and to boil with soda crystals dissolved in their own water of crystallisation. When sufficiently boiled down or evaporated, the mass is run out of the pan into a trough or cooler, and a quantity of soda ash and bicarbonate of soda crutched into it while cooling, after which it is allowed to set into a stiff paste, and is then spread out to dry, either spontaneously in the air or by steam heat. The dried material is then ground in a mill to a fine powder or flour, and packed for sale, the packets being filled and lightly pressed in a hard wood or metal mould to give them the square form. The quality of dry soaps varies enormously, the proportion of water in a number of samples I have examined ranging from 25 per cent. to 60 per cent., and the amount of real soap from 18 per cent. down to 1·5 per cent., the remainder being principally carbonate of soda.

Toilet Soaps.—Under this head may be classed all medicated and fancy soaps, intended and sold specially for toilet use. They vary in quality to as great, or even greater, extent than do ordinary household soaps, and too much care can hardly be exercised in the choice of a soap, the use of which may possibly have an injurious effect on the skin, and therefore on the general health. A large number of so-called "toilet" soaps contain an objectionable amount of free caustic and carbonated alkali, which renders the skin harsh, dry, and liable to become "'chapped," besides injurious colouring matters, such as vermilion, arsenite of copper, &c.

The absence of free alkali is of greater importance in soaps intended for toilet use than in those intended for any other purpose, and the estimation of the amount of this substance present is, perhaps, the best single test of the value or even the adaptability of a toilet soap. Dr. Alder Wright, in his Cantor Lectures, classifies these soaps into three groups, according to the proportion of free alkali contained in them. He finds that the best toilet soaps adapted for use on a sensitive skin never contain more free alkali (carbonated) than 2·5 per cent. of the amount of alkali present in the form of soap, and he accordingly places in the first class, those soaps which are either actually neutral, or free from uncombined alkali, or else contain not more than the amount stated above. The second class includes soaps in which the free alkali exceeds 2·5 per cent., but is less than 7·5 per cent. of the total, while all soaps which contain more than this amount are placed in the third class.

In addition to the percentage of free alkali, however, certain other points are taken into consideration, in deciding the claim of a sample to be regarded as a first-class soap; such as its freedom from rankness, or rancidity of the original glycerides used in its manufacture, and its non-liability to oxidise and become discoloured on keeping. It must not be weighted nor adulterated with inert or injurious materials, and if coloured, or medicated, the colours used, and the agents added, must be of an uninjurious character, and not liable to affect the skin when the soap is used habitually. It must also produce a good lather, and be economical, emollient, and pleasant in use.

To eliminate free alkali from finished soap, Dr. Alder Wright has proposed the addition of ammonium chloride, which reacts with the uncombined alkali, forming sodium chloride and ammonia, the latter being dissipated by the heat of the liquid soap and on exposure of the cut bars to the air.

The lowest form of so-called toilet soap consists merely of ordinary fitted primrose or household soap, tinted with various colouring matters, and slightly scented with nitrobenzene, citronelle oil, and other cheap perfumes. The free caustic soda, which such soap nearly always contains, is wholly or partially neutralised by the addition of cocoanut or palm oil while being crutched; and this attempt to neutralise the free caustic alkali is, in many cases, the only claim such soaps have to be regarded as toilet soaps. Ordinary household and laundry soap is very often treated with oil in the same way to neutralise free caustic soda, and these would have as valid a claim to be ranked as toilet soaps as the cheap coloured tablets referred to, the very small extra amount of perfume added to the latter being practically of no moment. The colouring matter frequently added to this class of soap also forms an objection to its use, vermilion, red lead, and other insoluble, gritty, and poisonous mineral colours being used, instead of the more harmless organic or vegetable tinctorial substances, for the reason that the former are better able to withstand the action of light and do not readily become faded when exposed for some time.

Another and better class of toilet soap largely made in this country is prepared by remelting white curd soap in a jacketed pan, and tinting, either by crutching in colouring matter, or by the addition of a certain proportion of coloured soap, the latter method being preferable. The bars of soap to be remelted are first reduced to thin shavings, by passing them, with pressure, over an inverted plane, similar to an ordinary joiner's tool, mounted on four legs. The long, broad shavings are then placed upright in the heated pan, resting against and supported by the sides all round. This is called a "round," and it is allowed to melt down before a second round is put in, and so on until the soap is all melted. If the product is to be tinted by the addition of already coloured soap, the white and coloured shavings are put into the pan in alternate rounds. A little oil is then crutched into the melted soap, together with potassium carbonate, common salt solution, and various other substances, which are occasionally used; and, if intended for a medicated soap, a certain proportion of the active principle, such as thymol, carbolic acid, eucalyptus oil, &c., after which it is placed in a frame, where the perfumes are added and the soap allowed to cool. These soaps, after cutting into tablet pieces, are usually dried in a steam-heated stove for a short time before they are stamped and packed.

The best transparent soaps are made by what is called the alcohol process, which consists in dissolving ordinary, good, opaque soap, made from tallow, lard, and other fats and oils, in boiling alcohol, and subsequently evaporating off the solvent, leaving the soap in a more or less transparent condition. By this process any carbonate of the alkali, sulphate of soda, and other impurities present in the original soap are entirely eliminated in the finished product, as these substances are insoluble in alcohol; but, on the other hand, any free caustic alkali which it may contain is dissolved along with the soap itself. The solution of the soap, which is first reduced to shavings and dried as completely as possible, is effected in a closed vessel resembling a still, and when all the soap has dissolved the solution is placed in another still, from which the alcohol is distilled off and condensed, ready for further use, after which the residue of hot soap is withdrawn and placed in suitable frames to set. After cutting, the soap, which is usually muddy-looking and far from clear, is exposed for some time to warm air, to evaporate remaining traces of alcohol and water, during which time it becomes clear and transparent. By long keeping and exposure to air the soap also darkens in colour, acquiring a rich amber tint. The addition of glycerine materially improves the soap by giving a more transparent product, besides imparting a pleasant, emollient feel in use. Sugar and rosin also have the property of increasing the transparency, but their use is not to be recommended, because the addition of sugar also renders the product more soluble or wasteful in use, whilst soap containing rosin is apt to contain free alkali or to liberate an increased amount of that substance when the soap is dissolved in water. There are, therefore, various qualities of soap made by the alcohol process, resulting from the presence or absence of the above and other substances, and also from the substitution of methylated spirit for pure alcohol, as is sometimes the case.

A large amount of low-priced transparent soap is made, by the so-called "cold process," from castor oil, tallow, cocoanut, palm, and other oils. This soap almost invariably contains not only free carbonated, but also caustic alkali, in comparatively large quantity, some samples containing as much as 25 per cent., or even more, of excess of alkali, over that combined with the fats and existing as soap, rendering its use highly irritating to and probably likely to cause blotches or pimples on a sensitive skin. This kind of soap also consists largely of sugar—to the extent of 20 per cent. or 30 per cent.—and of water, the percentage of real soap being comparatively only small. To make the soap, the fats and oils are melted at a low temperature (180° Fahr. to 190° Fahr.) in a jacketed pan, provided with revolving crutching arms or mixers, as previously described, and the exact quantity of strong caustic soda solution of about 1·30 sp. gr., required to completely saponify the oils, is vigorously crutched in. The pan is then covered and left at rest for some time, during which the temperature rises considerably, and the saponification is supposed to be completed. A quantity of sugar, dissolved in hot water, is then stirred into the soap, and some crystals of sodium carbonate also added. Methylated spirit is then put in, to clear the liquid, and cause the fob to rise to the surface; while the pan again remains covered and at rest for some time, after which the fob is skimmed off, and the clear thin soap ladled into the frames, where the perfumes are added, and it is allowed to set. After two days it is cut into bars and tablet pieces, the latter requiring to be carefully stoved before being stamped and packed.

This kind of transparent soap is generally coloured with aniline or other colour to imitate the amber tint of the better-class soaps, and, although it is sold at a low price, it is so wasteful in use, dissolving rapidly in the water, especially if hot, that it cannot really be regarded as being cheap, irrespective of its other objectionable points.

(*To be continued.*)

SOCIETY OF CHEMICAL INDUSTRY.

LIVERPOOL SECTION.

At the last meeting of this section a paper was read by Mr. J. H. J. Dagger on "The Manufacture and Industrial Value of Aluminium." After some reference to the history of the subject, Mr. Dagger proceeded to deal with the electrolytic processes for the preparation of aluminium. The ores that can be employed for the purpose are bauxite and corundum, for although alumina is widely distributed in other forms, these latter are too impure to be of any service in the preparation of the metal. The only other ore that comes into use in the method is the double fluoride of sodium and aluminium (cryolite), which is, however, not used as a direct source of the metal, but only as a flux. In referring to the relative values of the electrolytic and sodium processes for the preparation of aluminium, the author of the paper was of opinion that it was not possible for the latter to produce the metal in a pure state at so low a price as the former could. This price had been reduced from 15s. per lb. in 1888 to 5s. per lb., its present value, and further reduction in price was to be expected rather in improved methods for purifying the alumina than in more advantageous means for separating the aluminium therefrom. Of the electrolytic processes, both the Heroult system, as worked on the Continent, and the Hall process were described, full details of the method of working given, and the results obtained being illustrated by two blocks of the metal weighing about 3lb. each, produced by the latter process.

In conclusion, Mr. Dagger referred to the physical properties of the metal and the industrial applications for which, in his opinion, it was likely to prove of value. Aluminium is unacted on by air or moisture, sulphuretted hydrogen, ammonium sulphide, or cold dilute sulphuric acid, as long as it is pure, but if iron or silicon be present it is not proof against the above reagents. Cold nitric acid does not affect the metal, and the organic acids and their salts have practically no corrosive action. Owing to the non-poisonous nature of the salts of aluminium it would be of value for making cooking utensils, tins, and cases for preserved foods, &c. Its high specific heat and malleability would also give it important applications. Castings can be readily made with the metal in ordinary dry sand moulds, and bars of aluminium give out a clear musical sound when struck, but the presence

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of even a small proportion of impurity destroys the resonance. The tensile strength of the metal is only half of that of the best wrought iron, and this would prevent its ever replacing iron or steel for structural purposes. But for light machinery, gas and water fittings, steam pipes, electrical machinery, and for all art and decorative purposes, aluminium had a great future before it, and was destined to replace some of the older metals, especially copper. Aluminium plating was also likely to supersede both tin and nickel plating, whilst the chemists' laboratory was likely to receive many welcome improvements in the form of aluminium utensils.

An interesting discussion followed, during which, in reply to various questions put, Mr. Dagger stated that the yield of aluminium obtained from the oxide amounted to 97 per cent. of the theoretical quantity; also that the difficulty of soldering aluminium had been partially overcome by employing an alloy of aluminium, copper, and zinc. Aluminium, although it only melted at 1,300°, began to soften at 600°-700° F., a fact which would prohibit its use in various chemical operations.

At the same meeting Mr. J. Hayes read a note on "An Interesting Point for Chemical Manufacturers in the New German Patent Law," in which it was pointed out that in accordance with the new German patent law, which will come into action from October next, a patent taken out will extend not only to the process patented, but also to the product produced, and the patentee will have a claim in the case of products when produced by his process and without his consent. This change from the law of 1877 will remove what has been a distinct grievance to German chemical manufacturers, especially in the case of the importation of products from countries where no patent for the production of the same has been taken out.

THE MANUFACTURE OF LACTIC ACID.

In a recent report of the meeting of the London Section of the Society of Chemical Industry (see *Industries* of the 20th March) we recorded the fact that lactic acid is being made in America on a large scale from glucose. According to Mr. C. F. Cross, lactic acid will find extensive application in the calico-printing trade, the demand that will arise as soon as its merits are known being sufficient to absorb all that can be produced for some time to come. It is therefore a matter of special interest that a sign of the reality of this demand, and of the corresponding efforts that have been made to meet it, should be afforded from a wholly independent source. Commenting on the fact that most of the processes hitherto in use have not been available for the successful manufacture of lactic acid at a cheap rate, G. Jacquemin, in the *Jour. Pharm. Chim.*, describes a method of his own, which he claims to be free from the tediousness, uncertainty, and expense previously inevitable. Completely saccharified malt is mashed in the same way as in brewing, save that the temperature is kept longer at 50° C., in order to obtain as much maltose and as little dextrin as possible. The temperature is then raised in succession to 60°, 63°, and 65° C., and finally to the boiling point, whereby a wort rich in sugar and containing sufficient albumenoids for the subsequent nutrition of the lactic ferment, but thoroughly sterilised, results. It is neutralised with calcium carbonate, and the pure ferment, prepared by Pasteur's process, added. Fermentation is carried on in vessels whose lids are provided with a water-seal. Three tubes pass through this cover. The first is a siphon for drawing off the heavy carbon dioxide which is a product of the fermentation. The second is a tube for the admission of air, filtered by passing through cotton-wool, to replace the carbon dioxide as fast as it is drawn off. The third reaches to the bottom of the vessel and ends in a rose, and is used for blowing sterilised air through to stir up the contents, a process which should be done at least twice a day. The vessel is kept at 40°-45° C. by steam coils, the fermentation being found to proceed best at that temperature, and being under these conditions completed in five to six days. The fermented liquid is drawn off, filtered, evaporated, when calcium lactate quite free from smell separates out. The separation of lactic acid from this salt is accomplished in the ordinary way.

Notes.

ENGLISH GOODS IN RUSSIA.

A recent official report states that all over Russia British goods are preferred to those of German or French make, but owing to the considerable difference in price, the excessive transport charges, and the unwillingness of the British manufacturers to alter their patterns to suit the requirements of Russia, the goods of the latter countries are rapidly ousting those originating from Great Britain. It is not so very many years since that the plough trade of Russia was monopolised by British firms, many of whom have had to give way to their German competitors.

RAILWAYS IN NEW SOUTH WALES.

At the end of last year there were 2,182 miles of railway open for traffic in New South Wales, as against 2,171 miles in 1889. There was an appreciable increase in the revenue last year, the receipts for the last quarter of the year amounting to £914,141, being an increase of £107,516 on the revenue for the last qnarter in the year 1889.

THE JAFFA AND JERUSALEM RAILWAY.

The construction of the railway between Jaffa and Jerusalem, which is in the hands of a French company, is actively progressing, and seems likely to become an accomplished fact. The company which has undertaken the construction of the railway has three years in which to complete the work, but it is expected that it will be finished fully a year before the required time, a portion being already completed. When the railway is completed pilgrims will be able to use it in their journey from Jaffa to Jerusalem.

COAL RAISING IN MICHIGAN.

There are now three leading localities in Michigan, U.S.A., where coal is mined in quantity. These are Jackson, Owosso, and Sebewaing, the latter of which promises to become the most important, although the largest establishment at present is that of the Standard Mining Company, located one mile from Jackson. The coal bed at this point varies from 3ft. to 4ft. in thickness. The quality of the Sebewaing coal is, states the *American Manufacturer*, much better than the product of the Jackson County mines. The coalfield of Michigan is detached from that of any other State.

FIRE-BRICK MANUFACTURE IN RUSSIA.

In the vicinity of Adjikent, in the government of Elizavetopol, a kind of refractory clay has been discovered of the quality required for preparing fire-bricks. Mr. Levin, a Swede, has availed himself of the discovery, and has established works at Baku for manufacturing fire-bricks. The output of those works amounted in 1890 to about 450,000 bricks. This industry, which it is intended to extend, is likely to oust from the local markets the fire-bricks now coming from Glasgow.

MEASURING ELECTRICAL POWER.

There will probably be an interesting meeting of the Physical Society this week, and perhaps a lively discussion on the methods of measuring electrical power in alternating circuits. Dr. Fleming has recently made the three-voltmeter method more practical by using three ampere meters in an analogous manner. It is questionable whether any of these methods are so good as an electrostatic or an electromagnetic wattmeter. Unfortunately some persons have a prejudice against wattmeters. It has however, little foundation, as a reasonably well-designed wattmeter is accurate within errors of observation.

METALLURGICAL PROGRESS IN LEEDS

To the various metallurgical processes carried on in Leeds we must now add those connected with copper smelting. For many years past cupreous iron pyrites have been burnt at vitriol works in the town, the burnt pyrites being sent away to copper works for further treatment. Messrs. John Nicholson & Sons, of the Church Street Chemical Works, Hunslet, Leeds, who are large burners of pyrites, erected works about four years ago for the treatment of the cinders by the wet extraction method silver and gold being recovered by the Claudet process, the copper precipitate obtained being sold to Liverpool, Swansea, or German copper smelters, the residual oxide of iron —"purple ore" or "blue billy"—being used in puddling or in the local blast furnaces, while the waste liquors, which contain sulphates and chlorides of iron and sodium, play a somewhat important part in the clarification of the sewage of the town, the iron salts taking the place of the sulphate of alumina generally used in precipitation processes. The conversion of copper precipitate into ingot copper being a comparatively simple operation, and as a considerable quantity of copper is used locally, Messrs. Nicholson have recently erected furnaces for its treatment. The precipitate, mixed with a small proportion of coal or other reducing agent, is first treated in a roaster furnace, when "blister" copper is formed, together with some slag. The blister copper is afterwards refined—*i.e.*, the impurities are removed by oxidation—and after skimming off the slag the excess of oxide is removed by poling in the usual manner, and when the copper has attained the necessary degree of toughness and ductility it is made into ingots or cakes of commercial copper, while the resulting slags are practically freed from the copper they contain by fusion with sulphide ores in another furnace.

MINING IN ALGERIA.

The district of Bougie is rich in mineral deposits, though but few of them are actually worked. One English company possesses mines at Tadergount and Karrata, yielding argentiferous grey copper ore, which is said to contain as much as 35 per cent. of copper and 100oz. of silver per ton. The deposit of red hematite at Dybel Animi is very important, but it cannot be worked until a railway between Bougie and Setif—which would pass close to the mines, and which is at present under consideration —is constructed. Amongst other deposits at present unworked are the lead mines of Cavallo, the argentiferous grey copper mine of Tellionine, and numerous other deposits of lead, copper pyrites, sulphide of antimony, calamine, manganese, iron, &c. Some of these have already been worked, mainly by English capital, but on account of the want of economical means of transport have been suspended.

A LARGE ELECTRIC MINING PLANT.

The Cœur d'Alene Silver-Lead Mining Company have, states the *New York Electrical Engineer*, contracted with the Edison General Electric Company for an electric power transmission plant, which, when completed, will probably be the largest in the world, to operate all the machinery and furnish light for their mill and mine at Burke, Idaho. The plant consists of two 225 h.p. Edison generators, to be located about a mile and a half from the mill, and driven by water power from the falls of Canyon Creek, using Pelton wheels under about 690ft. head. The mill machinery will be driven by an 80 h.p. motor belted direct to the main shaft of the mill. The Ingersoll steam drill compressor now in use will be operated by a 60 h.p. motor driven from the fly wheels of the compressor. The Lidgerwood steam hoist now being used will be operated by a 50 h.p. motor geared direct to the present driving shaft. The pump, located on the 500-foot level, will be driven by an 80 h.p. motor geared direct. The entire plant is at present being operated by steam, and the application of electricity will be so arranged that all the machinery, or any portion of it, can be operated by either steam or electric power at any time.

THE JABLOCHKOFF PATENT.

Another venerable patent has joined the majority. An attempt was made to galvanise it into life again, but its existence could not be prolonged beyond its allotted days. Little was known of this patent until recently, when it was suddenly brought forward to cover transformer distribution. The owners did not attempt to deal harshly with the public, and their moderation secured royalties instead of opposition. While the loss of the patent may be regretted from the owners' point of view, it may be as well to mention that Jablochkoff did not invent transformer distribution. Though his claim may have covered it, it was a mere accident. His object was not to transform from a high to a low pressure, nor to save copper in leads; but to allow a number of lamps to be run off one machine, or, in the words of those days, to "subdivide the electric light." He thought that by putting the lamps on secondary circuits of transformers in series, they might go out accidentally without destroying the continuity of the dynamo circuit. His transformer was specially designed to be short-circuited completely. He makes a merit of having the copper in metallic contact with the iron of the core throughout. We merely mention this as one of the too common cases where the merits of an invention are taken away from the real inventor and given to some earlier worker who has unintelligently stumbled on something like it, without in the least understanding its capabilities.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

4th May, 1891.

7668. Gilmer, W. F. ..... Coupling for railway carriages.
7669. Anderson, J. ..... Water-raising apparatus.
7680. Powell & Williams..... Dusting and polishing tin or terne plates.
7683. Thistlethwaite, J. ..... Footsteps for small spindles.
7689. Lentz, G. ..... Steam boilers.
7693. Jones, J. ..... Roller grinding mills.
7704. Burgess & Davis ..... Vacuum evaporating apparatus.
7708. Legrand, G. J. J. ..... Supplying air to furnaces.
7709. Edwards, E. ..... Attaching the picking strap to the picking stick in looms (*Held*).
7711. Hollingworth, E. ..... Jacquard mechanism of looms.

5th May, 1891.

7718. Mays, J. A. ..... Amalgamating apparatus.
7721. Dixon, G. ..... Steam boilers.
7724. Suiter, A. ..... Pressure gauges.
7725. Suiter, A. ..... Fittings for compressed gas vessels.
7726. Mole, F. M..... Bronzing machines.
7729. Hatfield, J. ..... Coupling mechanism for railway cars.
7730. Crowe & Allan..... Liquid fuel furnaces.
7734. Hunting, A. A. ..... Apparatus for treating leather.
7746. Parker, J. J. ..... Spring frame for safety bicycles.
7747. McCarter & Cooper..... Motive power engines.
7748. Moore, E. J. ..... Steam boilers.
7750. Davis, G. ..... Steam engines.
7751. Bolthoff, H. ..... Steam engines and valve gear.
7752. Egge, F. ..... Machine for automatically manufacturing sheet metal chains.
7758. Lake, H. H..... Vacuum pumps (*Nye*).
7766. Whittall, J. ..... Pumping apparatus (*Kinder*).
7767. Farjasse, M. H. C. W.... Brake apparatus for stopping and starting vehicles.
7768. Crossley & Holt ..... Oil motor engines.
7779. Stracey, G. H. C..... Apparatus for facilitating the ascent of engines or trains up steep gradients.
7789. Jenkins, T..... Apparatus for cleaning tin and terne plates.

6th May, 1891.

7815. Potts, S. ..... Endless conveyers.
7816. Baird, M. B. ..... Steam generating apparatus for ventilating purposes.
7818. Black & Fleming ..... Fans for ventilating mines.
7819. Dyson, A. E. ..... Screw-down cocks.
7827. Timmis, I. A. ..... Railway signalling.
7849. Millar, J. S. ..... Valves and ports of steam engines.

7th May, 1891.

7856. Stokes & Stokes ..... Machine for making nuts for screw bolts.
7859. Fitzpatrick, H. D. ..... Machine for cleaning roads (*Hentschel*).
7866. Newall, J. W. ..... Cutting the teeth of bevel wheels.
7867. Thompson, W. P. ..... Evaporating apparatus (*Wirth & Co.*).
7868. Ingham & Derbyshire... Machines for cutting screw threads.
7872. Malloch, J. M. ..... Stop valve.
7875. Penney, C. ..... Passenger communication for railway trains.
7879. Bailey, W. H..... Machinery for winding and twisting yarns.
7884. Hindle, Hindle, & Isherwood..... Mechanism for operating shuttle guards of looms.
7898. Moores, W. ..... Combing machines.
7914. Ashlin, H. C. ..... The construction of vessels.

8th May, 1891.

7928. Murray, A..... Portable drilling, tapping, and studding apparatus.
7945. Hutchinson, W. S. ..... Water-gas furnaces.
7946. Allison, H. J. ..... Tool posts (*Ronan*).
7948. Greenwood, H. ..... Machinery for compressing gunpowder into pellets.

9th May, 1891.

7982. McAnelly, J..... Lubricators.
7992. Liversidge, W. G. ..... Feed motion of drills.
8000. Munns, W. H..... Car coupling (*Schatz*).
8007. Price, J. T..... Paper folding machines.
8014. Thompson, W. P. ..... Steam boilers (*Binder*).
8016. Saxby, J. ..... Interlocking apparatus for railway point and signal levers.
8026. Seitz, E. ..... Centrifugal pump.
8032. Horn, W. W. ..... Gas engine (*Vanduzen & Vanduzen*).

ELECTRICITY.

4th May, 1891.

7667. Callendar, H. L. ..... Dynamo-electric machines.
7688. Saunders, A. ..... Spiral filament for incandescent lamps.
7697. Elmson, C. P..... Accumulators.
7700. Allison, H. J. ..... Storage battery plates (*Kennedy & Diss*).

5th May, 1891.

7715. Washburn, G. A. ..... Storage batteries.
7755. Lake, H. H..... Dynamo machines (*The Crocker Wheeler Electric Motor Company*).
7762. Van Depoele, C. J. ..... Reciprocating electric engines.
7778. Thompson, W. P. ..... Conductors (*Williams*).
7781. Boucherot, P. ..... Means for converting electric currents.
7782. Wallaston & Mudford Induction apparatus.

6th May, 1891.

7822. Giraud, P. ..... Thermo-electric stove.
7831. Reynier, H. ..... Insulating partitions for batteries.
7850. Horn, W. W. ..... Automatic telephone exchanges (*Strowger*).

7th May, 1891.

7857. Bryan & Woodhouse & Rawson United, Ld. Construction of rheostats.
7858. Snell & Woodhouse & Rawson United, Ld. Switches.
7878. Rowan & McWhirter ... Appliance for preventing ignition of gases in connection with dynamos, &c.
7911. Grimston, G. S..... Switch.
7912. Grimston, G. S..... Electric capstan.

8th May, 1891.

7937. Cox, C. W. ..... Resistance devices.
7949. Goward, P..... Secondary batteries.
7960. Sanders, R. D. ..... Manufacture of metal tubes by electro-deposition.
7970. Wahlström, E. A. ..... Distributing electric energy.

9th May, 1891.

7976. Binswanger, G. ..... Handles for light switches.
7979. Pritchett, G. E. B. ..... Accumulators.
8031. Howard, H..... Apparatus for heating and welding by the electric arc.
8034. Shepard, A. L..... Device for facilitating the connection and disconnection of electrical conductors.

CHEMISTRY.

4th May, 1891.

7692. Fischesser, J..... Azo-colouring matters.
7713. Johnson, J. Y. ..... Production of new diazo dyes (*Badische Anilin & Soda Fabrik*).

5th May, 1891.

7756. Eberhardt, M. ..... Compound for extinguishing fires.
7757. Fish, C. H. ..... Furnaces for burning sulphur.

6th May, 1891.

7803. Lembach, Schleicher, & Wolf ..... Manufacture of ortho-oxyquinoline.

8th May, 1891.

7963. Imray, O. ..... Manufacture of nitro-and amido-methyl-phenylpyrazolon (*Die Farbwerke vormals Meister, Lucius & Brüning*).
7964. Imray, O. ..... Blue colouring matters (*Die Farbwerke vormals Meister, Lucius & Brüning*).

9th May, 1891.

8006. Martin, E. L. C. ..... Manufacture of caustic soda and caustic potash.
8018. Lunge & Dewar ..... Recovery of sulphur, carbonate of soda, and iron oxide from double sulphide of sodium and iron.
8022. Honman & Vullier ..... Process of manufacture of white lead.

MISCELLANEOUS.

4th May, 1891.

7673. Morison, W. C. ..... The reduction of ores.
7676. Campion, A. J. ..... Hard metals.
7712. Varney & Hiratt ..... Railway rails.

5th May, 1891.

7719. Melling, J. ..... Joint for pipes.
7723. Nelson, E. ..... Washer.
7727. Platt & Platt ..... Die for making dividable tiles.
7735. Whitehill, W. ..... Automatic measuring taps.
7736. Jones, G. P. ..... Safety catch for hoist cages.
7775. Wood & Milner's Safe Company, Ld. ..... Safes.
7777. Thompson, W. P. ..... Cooling certain metals (*Clamer*)
7787. Hammond & Gordon ... Railroad spike.

6th May, 1891.

7823. Tofts, G..... Inking roller for printing machines.
7824. Skaife, W. ..... Galvanising metals.

7th May, 1891.

7855. Barron, E. R..... Guards for belts.
7871. Sharne, A. ..... Automatic signalling to trains.
7916. Tabrar, J. ..... Nuts, washers, and bolts.

8th May, 1891.

7919. Hutton & Daniels ..... Ratchet braces.
7924. Oakes, Leigh, & Mellor Picking band for looms.
7981. Smith, F. W. ..... Typewriting machines for the blind.
7982. Dawson, S. ..... Guard to weaving shuttle.
7988. Keith, T. de W. ..... Wrenches.
7952. Hall & Storm ..... Wrenches.
7974. Vibert & Rowland ..... Preventing incrustation in boilers.
7975. Schluss, F. O. C. M..... Fastening devices for securing rails to sleepers.

9th May, 1891.

7986. Holt, M. ..... Pickers.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

6788. Macey & Cummings.
7082. Boult (*Lachaume & Pasteyer*).
7812. Baudry-Diot.
7875. Saint.
7419. Walkington.
7498. Elliot & Tucker.
7966. Jones.
8169. Strandberg & Davis.
8415. Meltzer.
8613. Porges.
8726. Johnson (*Badische Anilin & Soda Fabrik*).
8815. Carroll.
8860. Bayly (*Patten, Robertson, & Fraser*).
8930. D'Iszoro.
9103. Johnson (*Von Heyden*).
9257. Wohle.
9393. Lindner.
9417. Behrens & Watson.
9584. Rofe.
9595. Latham.
9675. Randell, Randell, Randell, & Brett.
9846. Watson.
9904. Clarke.
9919. Shopland & Miller.
10155. Ruscoe.
10217. Williams.
10285. Hutchinson.
10316. Andrews.
10334. Vosper & Rafarel.
10348. Rylands.
10378. Somerville.
10390. Anderson.
10408. Clifford.
10424. Cook.
10434. Buckley.
10438. McMahon & Coppin.
10465. West & Mummery.
10474. Blackburn, Bray, & Clayton.
10501. McKenzie.
10519. Zietz.
10544. Duffell & Duffell.
10553. Nightingale.
10558. Rickard.
10563. Randler.
10576. List.
10605. Court.
10628. Mann & Smith.
10636. Nightingale.
10658. Bayly (*Menge*).
10677. Cooper.
10691. Challis & Challis.
10742. Siemens Brothers & Co., Ld. (*Siemens & Halske*).
10763. Burton.
10779. Knowles, Webster, & Dornan.
10824. Leigh (*Proust*).
10898. De Susini.
10942. Kemp.
10997. Young.
11041. Andrews.
11089. Farmilor, Richard, & Panario.
11881. Kreiss.
11455. Cairncross.
11751. Floor & Bolt.
12345. Berresford.
12542. Guigon.
13569. Notton.
14886. Ross.
15491. Taft. (1st March, 1890.)
15761. Smith.
16061. Bird.
20028. Logan.
20478. Brownhill.
20589. Topp.
21232. Vaughan
6947. Griffith.
7188. Lawrence.
7162. Hardie.
7219. Perry.
7885. Livens.
7480. Hartridge.
7919. Douglas.
8084. Andrews & O'Kelly.
8394. Wright.
8582. Neate.
8666. Pratt.
8792. Heywood.
8804. Gover.
8837. Malet.
8901. Davidson & Davis.
8924. Cockbopt & Farmer.
9005. Hooker.
9188. Tichborne, Darley, Purcell, & Geoghegan.
9403. Harvey.
9526. Leechman.
9594. O'Brien.
9638. Auvache & Valentine.
9698. Neal.
9732. Marchisio.
9867. Hilde.
9914. Isaacs.
10008. Topliss & Kay.
10192. Fowler.
10279. Lumb.
10294. Stuart.
10323. Hutchinson.
10344. Simpson.
10377. Hopkins.
10379. Gilmour.
10397. Moore & Cattell.
10413. Pegg.
10426. Knox.
10436. Thompson (*Bolland*).
10447. Edwards (*Schindler*).
10469. Shaw & Fidler.
10486. Hughes (*Vaile & Vaile*).
10487. Mitchell.
10509. Johnson (*Badische Anilin & Soda Fabrik*).
10551. Jardine.
10554. Battersby & Knowles.
10562. Hobson.
10567. Hancock & Simons.
10604. Reeves.
10621. Normanton & Normanton.
10651. Bayly (*Anderson*).
10675. Friedlander.
10684. Richardson.
10741. Siemens Brothers & Co., Ld. (*Siemens & Halske*).
10743. Siemens Brothers & Co., Ld. (*Siemens & Halske*).
10806. Mills (*Greenfield*).
10859. Walb & Walb.
10899. Elliott.
10960. Borland, Wood, & Carter.
11043. Horn.
11141. Merk.
11244. Thompson (*Zara*).
11385. Cloudsley.
11495. Heald.
11906. Radermacher & Bressley.
12762. Wieland.
13831. De Pass (*Müller & Schweiser*).
15642. Campion.
15776. Hawke.
17568. Barrie.
20033. Forster.
20572. Jones (*Cupples*).
20821. Corning. (21st May, 1890.)
21263. Moore.

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1891.

88. Thompson (*Jewell & Jewell*).
248. Corning. (9th June, 1890.)
771. Binns.
1755. Hope.
1958. Johnson (*Chase*).
1967. Clark (*Easton*).
2344. Johnson & Crane.
2458. Hoffmann.
2618. Garniss & Bunting.
2731. Moore. (6th August, 1890.)
3027. Broadhurst.
3187. Ellis.
3347. Tobey & Burt.
3714. Swayne.
3799. Clark.
3895. Corning. (5th August, 1890.)
4377. Morisson & Chagot.
4418. Mantell.
4760. Strange & Winslow.
4834. Lutschaunig.
5107. Warrington.
5164. Parry.
5244. Coy.
5271. Thompson (*Alexander*).
5506. Weston.
5576. Condon.
5697. Schmidt.
5736. Crompton.
5770. Huelsse (*Milden*).
5776. Hagans.
5782. Boult (*Karras*).
5800. Scott & Davenport.
5828. Poole.
5858. Gordon (*Okrassa*).
5870. Bökelund.
5899. Jensen.
5948. Hutchins.
5959. Wallis.
5970. Boult (*Wells*).
5983. Le Sueur.
6004. Pearson.
6016. Nuttall.
6037. Pedley.
6040. Coppock.
6062. Clark.
6071. Lake (*Fiske*).
6081. Laidlaw.
6097. Thompson (*Jalsovicsky*).
6121. Wollmann.
192. Down & Down.
220. Crawford & Lambert.
532. Lake (*Spooner*).
677. Imray (*Seaton & Seaton*).
1300. Rogers.
1949. Bate.
1969. Lake (*Burrell*).
2019. Walker.
2425. Gossett.
2472. Amory & Grenville.
2730. Moore. (6th August, 1890.)
3010. Donaldson.
3118. Dittrich.
3331. Currie.
3449. Rabbidge.
3777. Thompson & Miller.
3855. Shaw.
4035. Booth & Pickersgill.
4259. Lake (*The Giant Electric Motor Company*).
4755. Card.
4792. Silkman.
4880. Frey.
5152. Schulz & Stahlecker.
5175. Hauberg.
5252. Graff.
5336. Lönnerberg.
5568. Skinner & Connolly.
5640. Griffiths.
5698. Morby & Butcher.
5754. Hughes (*Boutville*).
5771. Pedersen & Hörg.
5778. Chesewright.
5798. Bersin.
5825. Müller.
5839. Tompson.
5864. Carruthers & Stevens.
5891. Lake (*Clark*).
5917. Mens.
5954. Rogers.
5962. Moir.
5980. Thompson (*Smead*).
6003. Reilly.
6009. Allison (*The Franco-American Patent Can Opening Company*).
6047. Roach. (8th October, 1890.)
6075. Horst.
6083. Priest.
6103. Tooth.
6125. Ritter.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Stop Cocks and Valves.—*W. H. Spencer & J. M. Ralston, Hitchin.*—These improvements relate to full-way valves in which the valve proper is formed of two separate discs, which are pressed outwards against their seats when the passage is being closed as the valve approaches the end of its travel. The

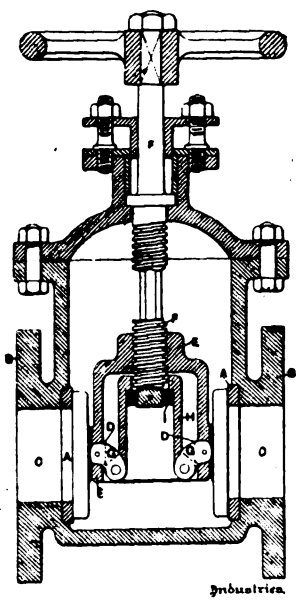


illustration herewith shows in vertical section a full-way stop valve in the closed position, A A being the faces or seats on which two valves B slide for the purposes of closing the passages C. On the backs of the valves are two projections D fitting into suitable apertures in a hollow box E, which is raised and lowered by the actuating screw F, which has no motion in the direction of its length. Fitted between the projections F and fixed to them by a pin are links G, which are also attached to the sleeve H, and at the bottom of the actuating screw F is a collar I, screwed on, and adjustable as may be necessary. Guides to prevent the valve from taking up a wrong position on its seats are provided on the sides of the valve casing, into which grooves fit projections (not seen in the illustration) on the box E. As the valve approaches the end of its travel the sleeve H at a certain point is prevented from descending further by the collar I, while the box E is forced downwards by the screw F, and, carrying the valves B and links G with it, causes the links to press the valves against their faces and close the passage. By means of the collar I the valves can be adjusted to close at any desired point. Claims: The arrangement substantially as described.—No. 3033. February 19th, 1891. 6*d*.

Railway Brakes.—*E. Hartmann, Düsseldorf, Germany.*—This inventor desires to enable railway vehicles having brakes of any known kind to be employed in trains together with vehicles having brake apparatus worked either by compressed air or by vacuum. For this purpose such first-named vehicles are provided with an additional conduit pipe, having at each end of the vehicle flexible extensions with coupling devices for coupling with the air pressure or vacuum pipes of adjoining vehicles. Each of these special pipes are connected to both ends of a cylinder, adapted for use either as a double-acting air or vacuum cylinder, and capable of operating various types of brakes in a manner

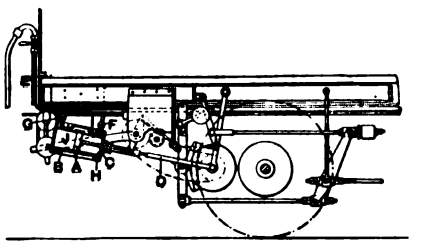


FIG. 1

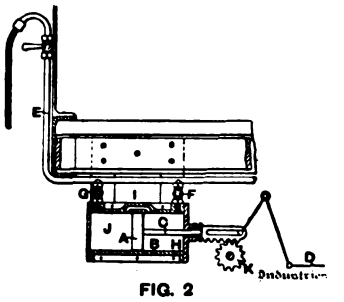
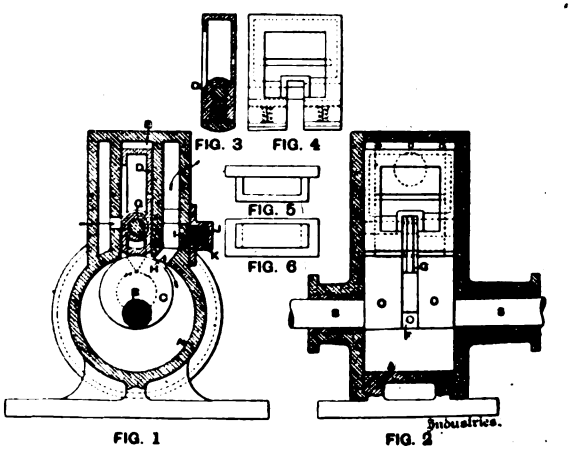


FIG. 2

presently to be explained. Fig. 1 shows the application of the apparatus to the working of a chain brake; in this illustration the piston A of the special brake cylinder B is connected by a slotted rod C to the rod D of the brake friction-drum in such a manner that operation of the latter in the ordinary manner by its own gear is not interfered with. The cylinder B is connected at each end to the train pipe E by branch pipes provided with cocks F G. For operating the chain brake by air pressure air is admitted at F; the piston is then moved back from the front end H of the cylinder until the channel I is uncovered thereby, whereupon the air passes through I to the opposite side of the piston, which is then in equilibrium. To apply the brake, air (as in the Westinghouse automatic brake, for example) is discharged from the train pipe E, and the air pressure in the space J behind the piston causes a rapid movement of the piston from J towards H because of the diminution of pressure in H, the passage I being too small to prevent any material escape of air from J to H during the brief interval that elapses before the piston, in its movement, closes that passage, and thus keeps the brakes applied until a recharging of the train pipe reproduces the operation at first described. To operate this mechanism by vacuum the cock F is closed and that at G is opened, and the whole of the interior of the cylinder is exhausted; an admission of air to the vacuum pipe to apply the ordinary vacuum brake apparatus produces, as in the previous example, a difference of pressure in the ends H and J of the cylinder, the pressure in J being superior, as before, although probably less in degree. The resulting operation of the brake is similar to that already described, and either operation would be automatic in the event of a breaking apart of the train. The piston rod of the special cylinder B may be operated by hand gear to apply a brake, the hand gear operating a pinion K gearing into a rack on the piston rod, as shown in Fig. 2. Other arrangements for hand-brake working are described, in which slotted connections and other arrangements for permitting the independent working of the brakes by hand and by power are comprised, and it will be evident that the application of non-automatic air and non-automatic vacuum working to the piston A is easily arranged by opening cock G in the former case and cock F in the latter. Claims: An air pressure or vacuum brake apparatus consisting of a cylinder with a bye-pass passage, and fitted with valves such as F and G, the parts being arranged and operated as described, whereby a carriage with such brake apparatus can be coupled to and be operated in conjunction with other carriages having either the same or a different kind of brake apparatus.—No. 8079. May 23rd, 1890. 8*d*.

Water Gas.—*J. Blum, Berlin, Germany.*—The inventor produces water gas by the chemical reaction between crude petroleum or other hydrocarbon, and heated nickel, cobalt, or copper. He considers it essential that the water and petroleum should be intimately mixed, that the quantities in the mixture should be very nearly in the chemical proportions requisite for mutual decomposition, and that the temperatures of the metals should be, for nickel, not less than 570° Fahr., for cobalt, not less than 630° Fahr., and for copper, not less than 850° Fahr. A water-gas generator, in which these conditions may be obtained, is described, and consists of a seamless steel or copper tube having flanges at both ends to which lids are screwed or bolted. Through the upper lid passes an injecting tube, and through the lower lid a tube through which the generated gases find egress. Two-thirds of the generator, from the bottom upwards, are filled with a net work of nickel, cobalt, or copper wire, or of copper wire plated with nickel or cobalt; pieces of these metals or fireclay plated therewith may be substituted. Surrounding the generator is the furnace, in which burn gas flames for heating the exterior of the generator, and above the furnace and the generator is a circular tank of iron with an inner compartment of the same material, the two compartments communicating by openings, one at the top of the inner tank and another at the bottom; a single tube places both these compartments in communication with the generator. The outer compartment is for water, the inner one for petroleum, and the areas of the two bear the same ratio to one another as do the quantities of water and petroleum necessary for mutual decomposition. In practice the ratios of area are made as 4:1, but the sectional area may be reduced to satisfy chemical requirements by the insertion of vertical heating tubes in the outer tank. A valve controlling communication between the tanks and the generator is connected by a rod to the safety valve; thus, when the tanks are filled with water and petroleum, the whole being heated, vapour is formed, which presently becomes of sufficient pressure to lift the communicating valve, and the fluids are dispersed through a perforated tube on to the heated metallic contents of the generator, becoming instantaneously decomposed and converted into water gas, which can be generated at any pressure permitted by the strength of the material of the generator. It may be used as a motive fluid in an ordinary engine, and afterwards be returned to the furnace and burnt. Claims: The process of obtaining water gas by the decomposition of water by means of a hydrocarbon in the presence of a heated metallic body; the use of a generator charged with nickel, cobalt, or copper as described; the tank, by means of which liquids in regulated quantities and correct proportions are caused to enter the generator.—No. 5289. April 5th, 1890. 8*d*.

Rotary Engine.—*G. D. Davis, Poplar, London.*—This invention has reference to improvements in rotary engines especially designed for use with steam as the motive fluid, but they may be adapted for use with air, water, or gas. In carrying out the invention a cylinder is employed, through the centre of which passes a shaft, lying in the axis of the cylinder and carried in suitable bearings formed in the ends thereof. On this shaft is eccentrically mounted a cylindrical piston, which works in contact with the cylinder at a peripheral line, and along this line of contact is a renewable piece fitted into a groove in the piston, to make a steam-tight joint between it and the cylinder. In a circumferential groove at the middle of the piston's length is a strap operating a sliding abutment, the lower end of which bears upon the periphery of the piston, the said abutment forming also a valve, which is balanced by the admission of steam to both its faces, and which is reciprocated by the piston in a chamber formed in one with the cylinder above referred to. In the illustrations below Fig. 1 is a vertical section of one modification of the engine, Fig. 2 a sectional view of the same at right angles to Fig. 1; Fig. 3 is a sectional view of the sliding valve or abutment, shown as having its lower part fitted with springs to keep it up to its work, the said lower part being renewable, Fig. 4 being an external view of Fig. 3, and Figs. 5 and 6 being respectively a plan and side view of the renewable piece. A is the cylinder, B the main shaft, C the piston, D the sliding valve and abutment, E the valve chamber, F the strap or ring driving the valve D by the link G. Steam being supplied to the interior of the valve D as shown by the arrow, and thence to the interior of the cylinder A (into an increasing space which, when the engine



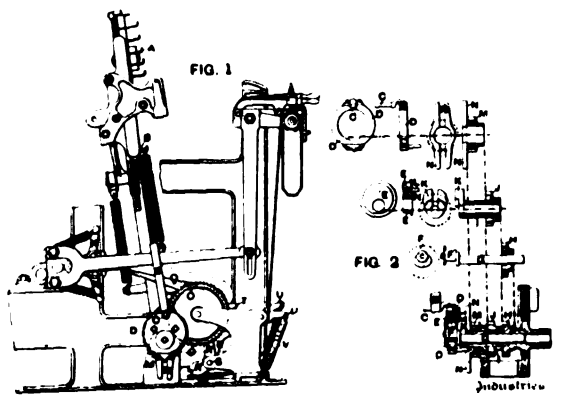
moves from its present position, will be enclosed by the abutment, part of the periphery of the piston, and part of the end and interior surfaces of the cylinder) the piston will rotate, and the steam will ultimately exhaust by the port H. Part I of the wall of the valve chamber is made moveable in grooves, and is kept to its work against the lower face of the valve by means of a spring J contained in the removable chamber K provided for it. For convenience of construction the eccentric strap and rod may be formed in two parts, so as to be applied on opposite sides of the main shaft, and held together by pins at the lower end, and by the gudgeon in the valve at the upper end. Another modification conforming to the same general principle, but having details slightly different, is described, and the inventor claims: In a rotatory engine, a rotating piston, a cylinder therefor, in combination with a sliding reciprocating abutment and valve operated by the piston, and the rest of the details of the arrangement, as described in the specification.—No. 7807. May 20th, 1890. 8*d*.

Boiler Furnaces.—*J. Ashworth, Dalton-in-Furness, Lancaster, & W. Kneen, London.*—This invention is an improvement upon a prior invention, described in Specification No. 7393 of 1885, the object of both inventions being the consumption of more fuel per square foot of fire-grate than can be obtained by ordinary arrangements. Air is forced under considerable pressure, by means of a fan or other forcing device, through pipes or passages, continued through the ashpit in the form of a box, and into a pipe or passage behind the bridge, with outlet orifices presented away from the bridge, and so directed that the air from them, or from some of them, is caused to pass across the direction of the draught of the furnace, piercing the products of combustion from the fire, and impinging in admixture with the said products upon fire-brick or other refractory blocks or projections which are situated at the sides

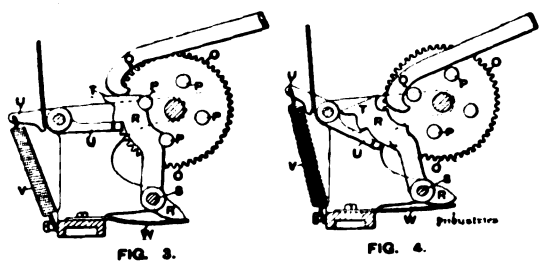
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of the combustion chamber at the rear of the bridge, the space at the centre of the flue between those blocks being left clear for draught. Claims: In furnaces, a passage provided with an air-forcing device and carried to behind the bridge and terminating in a pipe or passage with perforations therein, so as to direct the air across the line of draught, and against blocks or projections from the walls of the combustion chamber at each side, arranged so as to leave a space between them.—No. 6876. May 3rd, 1890. 6*d*.

SHUTTLE-CHANGING MECHANISM.—*R. Whytlaw & J. Kincaid, Glasgow.*—This invention relates to shuttle-changing mechanism in use with vertically shifting shuttle boxes, and relates to steadying and locking devices to ensure accuracy of working at high speeds, the general arrangement of parts being illustrated n the partial side elevation of a loom (Fig. 1) and in the series of separate views shown in Fig. 2, these details being illustrated in



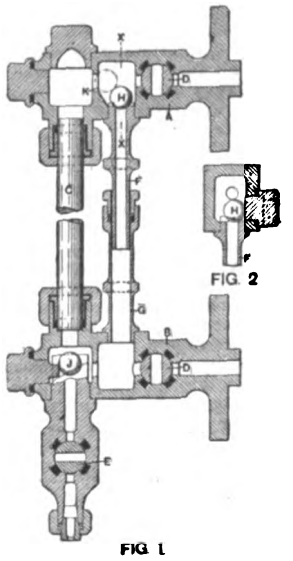
combination in Fig. 3. Additional detail views are given which will presently be referred to. The shuttle box A is connected by its spear B to an eccentric pin C upon a ring D which fits and can turn upon an eccentric sheave E, this last fitting and turning on the crank pin F of a short shaft G which rotates in the frame H. On G there is a pinion H which rotates it and the crank pin F, and G also carries, loosely, the sleeve I, having fixed on it a pinion J for turning E by means of the grooved plate K and the pin L upon the eccentric and fitting the groove in K; by a similar arrangement a third pinion M, also loose upon the sleeve I, turns the outer ring D. The plate N forming part of the mechanism operating D is made to extend in opposite directions, so that it may be balanced. The pinions M, J, and H gear with pin wheels O (only one of which is seen in Fig. 1), each pin wheel being loose on a shaft carried by the frame H and having each four pins or studs P (see Fig. 4) capable of being acted on by a hook Q operated from the low shaft of the loom so as in each reciprocation to turn the pin wheel through a quarter of a revolution. When any pin wheel is acted upon upon by its hook Q, exactly half a turn is imparted to D, E, or F, and the parts are so arranged that the half-turn moves the eccentric D E or crank F from its highest to its lowest position or *vice versâ*. The half-turn of the crank pin F gives a vertical movement equal to the space between one shuttle cell and the next higher or lower cell, the vertical movement of the eccentric E may be equal to the space of one cell or of two cells, and that of the other eccentric D may equal the space of three cells or of four cells. A crank pin and two eccentrics will serve for six shuttles, and as the shuttle box is operated by the combination or by the difference of the distinct motions it may readily be seen that each additional eccentric will double the capacity of the loom. The hooks Q



can act at each second beat of the lathe, but they do not engage with the pins O except when a change of shuttle is required, as may be regulated by a Jacquard mechanism for example. Friction discs are applied to prevent overrunning on the part of the pin wheels, and the locking device referred to in the first paragraph is illustrated by Figs. 3 and 4, in which a lever R is centred at S, and has two segmental concavities fitting two of the pins P and locking them, the part T of the lever R keeps the hook Q from acting on the pin wheel except when required; another lever U turns up under R which it moves into locking position by the action of the strong spring V. When a shift is required the outer end of U is pulled up by the Jacquard mechanism, and a blade spring W causes R to move away from the pin wheel as in Fig. 4. An arrangement of springs X is provided connecting the hook Q with the parts actuating them, to avoid breakage in the event of any obstruction occurring in the working of the apparatus. Claims: Shuttle-changing mechanism as described in combination with steadying and locking devices; the spring yielding devices for preventing damage in the event of obstruction occurring.—No. 8698. June 5th, 1890. 8*d*.

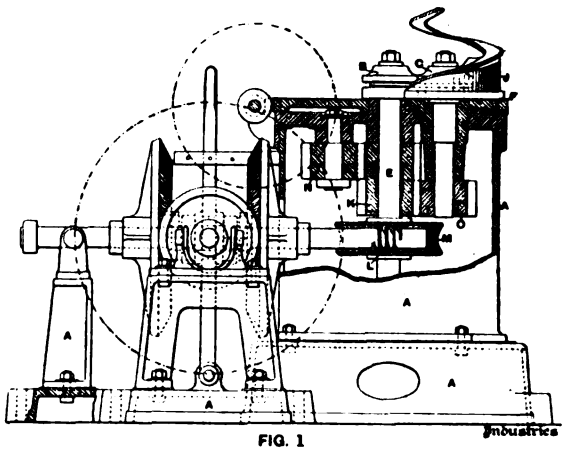
BOILER FLUES.—*J. Fell, Sheffield.*—An improved internal flue for steam boilers, designed for greater strength and durability, is described as follows:—The first of the improvements is applicable to the so-called "parallel" flues of boilers, as usually constructed of rings with successive lap joints, the smaller end of one slightly tapered ring being received by the slightly larger end of the next ring, and so on, the edges of the plates facing away from the fire; in such a flue the inventor flanges up the front or larger end of each flue ring, to form a stiffening flange, each of which flanges may be further strengthened by having an angle or tee iron riveted thereto; or alternate seams only need be flanged for moderate pressures; or the boiler flue may be constructed of plain rings, the meeting ends of each pair of rings being riveted to a channel iron. The second series of improvements consists in coning or tapering successive rings of the flue, and forming the larger or smaller end of each ring into a reverse curve, successive rings being lap-jointed, small end into large end, as previously described; or the large end of a taper ring may be bent inwards around the circumference, and the smaller end bent outwards, successive rings being lap-riveted together. One of the advantages claimed for the construction of a flue in conical sections is that, in case of shortness of water occurring, the area becoming bare is reduced, and the parts covered with water retain their form and prevent collapse or rupture of the flue. Instead of flanging the flue plates a separate flange may be rolled, to which plain conical plates can be riveted in the ordinary manner. Claims: Internal flue rings with flanges on their lap ends; double-flanged belt, zone, or channel plates riveted to the flue rings, for strengthening purposes; flues formed of a combination of cones, substantially as described. —No. 2751. February 16th, 1891. 6*d*.

WATER GAUGES.—*J. A. & J. Hopkinson, Huddersfield.*—The improvements in water gauges described in this specification relate to gauges of the class in which automatic shut-off valves are employed for preventing the escape of water and steam in case of breakage of the gauge glass, the particular objects in this case being to afford large thoroughfares, particularly in the top or steam arm of such gauges, for the flow of water and steam to the glass; to facilitate the removal of the valve and the cleaning of the said ways and thoroughfares; and larger balls may be used than in ordinary gauges. An annular piece has been in some instances employed in the top or steam arm, having a hole of considerably less area than the bore of the gauge glass, to diminish the area for escaping steam in the event of the glass breaking. The inventors do not use this washer, and thus are enabled to effectually blow through the top arm and the glass, and they get, under normal conditions of working, a thoroughfare

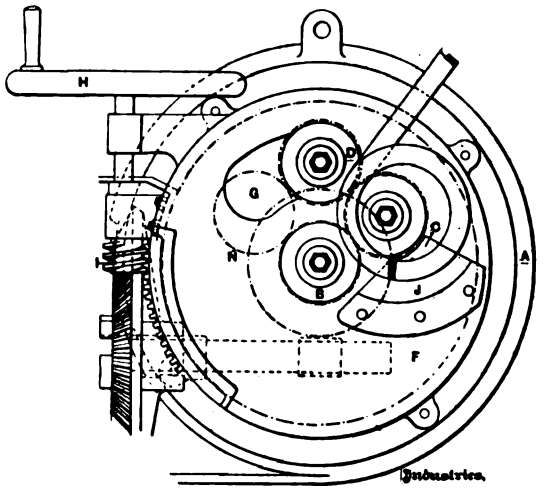


equal in area to the full bore of the glass, and the valve is readily removable. Fig. 1 is a longitudinal central section through a gauge constructed according to this invention, Fig. 2 a transverse section on the line X X (Fig. 1). A is the steam arm of the gauge and B the water arm, the arms being connected by a glass tube C in the usual manner; D D are the plug-cocks, and E is the try-cock. In addition to the connection formed by the gauge glass, the upper and lower arms are connected by a supplementary tube of metal, constructed in two sections F G, with expansion joint and stuffing-box as shown. The connection through this tube between the top and bottom arms is closed, under normal conditions (as in Fig. 1), by a valve or ball H resting on a valve seat I at the top of the tube, the seat being inclined (see Fig. 2) and the ball retained thereon by the screw I, and it is obvious that the ball will roll out of the gauge when the said screw is removed. Moreover, the said ball or valve lies within a deep recess formed in the upper arm so as to allow of an unobstructed thoroughfare above it, and by opening the try-cock E a full discharge of the steam is ensured through the upper arm as if no valve were fitted. Any suitable arrangement of bottom valve J, such as that shown, may be employed. Should the gauge glass break, the ball J is forced against its seat, closing the exit, whilst pressure acting through the supplementary tube on the under side of the valve H in the top arm, and assisted by the escaping steam, closes the communication between the boiler and the glass, and stops the escape of steam. A bye-pass K restores equilibrium of pressure after the glass is replaced. The auxiliary or supplementary pipe connecting the top and bottom arms is the essential feature of the invention. The general principle, and not the mere details of arrangement, are claimed. In another modification a spindle is shown for forcing the valve H from its seat to restore free communication after the valve has been in action, and in some cases a spring is employed in connection with this spindle to keep the valve from its seat except when the glass is broken. Other modifications of detail are shown, in which the automatic prevention of the escape of steam is provided for by ball valves resting on inclined seats, and in all cases arranged to give clear thoroughfares, with convenience for cleaning and rapid removal of parts. Claims: In a water gauge the supplementary connection between the upper and lower arms; the same, with the upper automatic shut-off valve; the ball in the top arm, retained on an inclined surface by a lateral support, on the removal of which the ball will roll out; a steam arm, independently of the auxiliary tube, with a ball resting on inclines; the particular arrangements described and illustrated in the specification.—No. 6141. April 22nd, 1890. 11*d*.

HELIX-FORMING MACHINE.—*J. Laidlaw, Glasgow.*—This invention relates to a machine for forming solid bars into helices, such as used in corn conveyers. In carrying out the invention three rollers are preferably employed, one of which is carried on the end of a shaft, the upper or neck bearing of this roller in a framing, serving as an axis for a turntable, arm, or equivalent. The turntable carries another roller at a determined distance from the centre of the turntable, and the third roller is carried on



a short shaft turning on a bearing cast upon the framework below the turntable, which is slotted to allow this third roller to come through the table into a suitable position, and also to permit of the turntable being rotated as much as is necessary without moving the third roller. Since the axes of the first and third rollers have fixed centres, the roller carried upon the turntable may be readily moved into any suitable position relatively to the other two rollers, to give the material operated upon a curve of the required radius. The rollers are grooved to suit the section of the bar operated upon, and after the bar has passed through the bending rollers it is forced over a wedge-shaped surface to give it a helical formation. Fig. 1 is an elevation of the machine, partly in section, and Fig. 2 a plan of the turntable and rollers. In these figures the framework of the machine is marked A, and B C and D are the three rollers, the roller B being carried on a shaft E, the neck bearing of which forms a centre for the turntable F. The third roller D is carried on an independent shaft, which comes up through the slot G of the turntable (see Fig. 2). If the turntable is moved the distance between the rollers C and D will be increased or diminished. The turning of the table is effected by the hand-wheel H and worm-wheel I; thus the relative positions of the rollers can be adjusted to suit the radius to which the bar is to be bent. J is the guiding surface to bend the curved bar into a helix. The rollers B C and D are actuated by reversible worm gearing, as may be seen below, the roller B and spur-wheel Q being driven by the worm L and worm-wheel



M, the said spur-wheel Q gearing with the spur-wheel N, which in turn drives a toothed wheel attached to the axis of the roller D. The wheel O upon the shaft of roller C is also driven by the spur-wheel K. Claims: The combined bending and helix-forming machine, substantially as described.—No. 3697. March 2nd, 1891. 8*d*.

SCREW BLANKS.—*H. Nettlefold & J. Sheldon, Birmingham.*—This specification has reference to the manufacture of screw blanks to be made into screws, and in the heads of which blanks, grooves or depressions are made for the reception of a screw-driver in place of the ordinary nick, the said grooves extending diametrically nearly, but not quite, across the head—that is, the grooves are closed at their ends instead of opening in the under conical side of the head as the ordinary nick does. In making this ordinary closed groove, the impressing tool, on entering the flat face of the head, tends, while being depressed into the head, to force the metal out on either side of it, thus distorting the circular figure of the flat face and leaving a depression or deficiency of metal at the ends of the groove, and leaving the sides of the groove rounded. To produce the said closed groove without distorting the head or rounding the edges or ends, the upsetting tool employed upon the head of the blank is provided with two crescent-shaped depressions in its under face, these depressions being of somewhat shorter radius than the circular head of the blank, and situated symmetrically at opposite sides of the centre of the tool. Slight parallel depressions are also made in the die, at a distance apart slightly greater than the breadth of

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groove desired, these depressions crossing the plane of the die face from one crescent-shaped depression to the other. Thus, on the otherwise flat face of the head produced on a blank are formed two crescent-shaped projections and two parallel ribs, upon which the impressing tool operates in such a manner that the groove made is in a line crossing the centre of the face of the head, and bisecting each of the crescent-shaped projections, and while the metal spreads outwards at each of the longer sides of the tool the crescent-shaped projections are flattened by the flat face of the tool and forced towards the ends of the closed groove which is in course of formation. The parallel ribs on either side of the groove are also flattened, and the rounding of the edges of the groove prevented, the projections supplying material just when it would otherwise disappear and permitting rounding to take place. Claims: Forming, on the face of the blank, ribs or projections which supply deficiencies of metal during the operation of grooving in order that the circular form of the head may be preserved, and the edges of the groove remain sharp.—No. 15709. October 7th, 1889. 8*d*.

Steam Boilers.—*O. Imray, London.* (*The Hogan Engineering Company, New York.*)—The object of this invention is to promote the circulation in water and steam boilers having sections supported side by side, or one upon the other, and this object is effected partly by furnishing distinct channels for the upward and downward movement of the water, and partly by facilitating the downward movement of the fluid in the cooler parts of the boiler, while obstructing any movement of the fluid into such portions from the hotter parts of the boiler. Such a result is secured by providing connections between the upper parts of the several sections for the upward passage of the hotter fluid, and separate connections between the lower parts of the sections for the downward passage of the cooler fluid, the cooler fluid being preferably protected from the gases heated in the fire-box. The invention is shown herein as applied to house-heating boilers, made by dividing the water space into separate cast-iron perforated water sections, having intermediate smoke chambers. In the illustrations Fig. 1 is a vertical section of a sectional cast-iron boiler, Fig. 2 is a plan of one of the water sections over the fire-box, and Fig. 3 is a vertical section of the same on the line X X of Fig. 2. The boiler is shown formed with annular fire-box sections A and B, four horizontal sections C, D, E, and F, and a top section G, from which the heated fluid

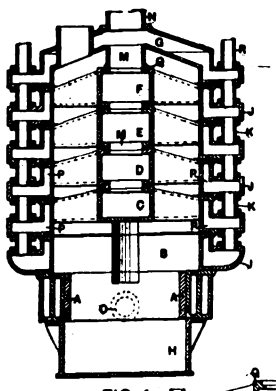


FIG. 1

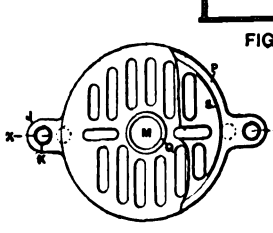


FIG. 2

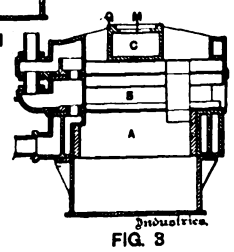


FIG. 3

is discharged. H is the ash-pit and I a door aperture in the section B. Hollow lugs J are projected from two opposite sides of the sections B to G inclusive, and are connected by thimbles K screwed into the lugs with jam nuts L. The sections C to G, as shown in Fig. 2, are round, and are formed at the centre with nozzles adapted to fit into one another, and perforated to form a central connecting passage M. The top section is furnished with a water outlet pipe N, and the bottom section with a water inlet pipe O. Depending water legs P are projected downward from the margins of sections C to G, thus separating the sections by intermediate smoke chambers, the smoke passages being provided at opposite sides with nozzles Q to heat the fluid in the central water passage M. The top of each section, as shown in Fig. 1, is sloped upward towards the nozzle, to facilitate the movement of the heated fluid toward the centre of the boiler, and pipes upon the top section form, with the thimbles K, a continuous external passage from the section B for the return fluid from the radiators. The fire-pot section A is a hollow ring, subdivided to circulate the feed-water, and connected by hollow lugs with the section of above. The pockets J and thimbles K being exterior to the water legs P, are colder than the contents of the boiler, and thus serve as downward conductors for the return fluid from radiators, when the latter are in connection with the boiler. The pockets being open to the water leg at the margin of each section serve as intermediate connections between the colder conductors and the contents of each section, and thus permit a circulation of the colder fluid from such section downward when required. To prevent the heated fluid within the section from flowing into the pockets a deflector is provided at the entrance to each pocket. Other modifications of the arrangement are described, and by any of the constructions the circulation may be regarded as trapped, and the heated water directed positively toward the central passage M, while all the colder fluid is returned by the thimbles K to the fire-box section. The guard in Fig. 2 keeps the contents of the jacket free from disturbance, and prevents the setting up of a purely local circulation. Claims: In eleven combination claims, the general arrangement and the details of a boiler with a central water passage, and with external water conductors, substantially as described.—No. 5738. April 15th, 1890. 11*d*.

ELECTRICITY.

Railway Brake.—*H. E. Walter, London.*—According to this invention the speed of trains is reduced by means of the reaction produced by causing Foucault currents to be induced in the rails by magnets carried by the train, with their poles in close proximity to the metals. By these means, it is said, there is obtained a retarding force greater than that of a brake shoe, and the great heat produced is left behind in the rail; also, there is no wear or tear upon either the magnets or the rails, so far as the braking action is concerned. Two or more magnet poles, preferably of opposite polarity, are set in a line parallel with the rail and in close proximity to it, so that magnetic lines of force pass through the rail from one magnet pole to the other. Various other arrangements of magnets are discussed, and the suggestion is made that in order that the magnets may be brought very near to the rails, but may still have a definite clearance, they could be attached to the axle boxes of two pairs of wheels spaced at a short distance apart. Also, the frame carrying the magnets, in this example, might be borne by rubber washers resting on the axle boxes, so that considerable clearance would exist, except when the magnets were energised, whereupon they would draw themselves closer to the rail, compressing the washers, and diminishing the clearance. The magnets could be energised by storage batteries carried in the carriages, or by a dynamo carried by the engine. Claims: An electro-magnetic brake for railways on the principle above described; also the particular arrangements of magnets and accessories described in the specification.—No. 8720. June 5th, 1890. 8*d*.

Electrical Welding.—*Lemp & Schmidt, both of Lynn, Mass., U.S.A.*—The process here described is particularly applicable to the electrical welding or brazing together of separate strips or bars, laid side by side; it consists essentially in feeding the parts through suitable devices to force them together, the heating current being passed longitudinally through the portions of the work which are approaching the pressing devices, so that the heating is extended over some length of metal, which becomes hot before reaching the welding rolls. A greater speed of operation is possible, and the cooling effect of the pressing rollers is less than where the current passes through the bars at right angles with their course. As a source of current it is preferred to employ a transformer having a large number of turns traversed by alternating currents, and a secondary consisting of a slit and heavy bar of copper, the two ends of which form the poles of the apparatus and deliver the current to the work by contact rollers or otherwise. The pressure rollers are of steel, and their supports are insulated. The two bars to be welded pass separately between pairs of contact rollers, and are brought together just before they reach the pressure rollers, the path of the current being from one pair of contact rollers along a length of one bar to its junction with the other bar, and back along the other bar to the other pair of contact rollers; or the bars to be welded may each have a current led along them in the direction of their lengths—*i.e.*, in parallel circuit—the current being led to opposite sides of adjacent bars by one pair of contact rollers, and withdrawn from the same bars further along by another pair of contact rollers. Claims: Welding, soldering, or brazing bars or strips by pressure arrangements, whilst sending current longitudinally through the bars; also the arrangements of rollers, substantially as described above, in combination with a transformer of the type referred to.—No. 3336. February 24th, 1891. 8*d*.

Electricity Meters.—*E. Hartmann & W. Braun, Bockenheim, Germany.*—In the electricity meter forming the subject of this invention a unipolar apparatus on the principle of Barlow's wheel is employed, through the copper disc of which the current to be measured is caused to pass radially, the magnetic field being formed by a powerful electromagnet magnetised by a constant current. The revolutions of the disc under these conditions are proportional to the quantity of electricity passing through it, when, with a constant field, the current to be measured is proportional to the Foucault currents, and in order to comply with these conditions care must be taken that there is nothing to interfere with the formation of these local or eddy currents. It is pointed out that in case the magnetic field presents the same form and extent as the path of the current passed through the said disc, for example, an e.m.f. also results from the rotation of the said disc in the magnetic field, which acts in opposition to and weakens the current to be measured, and in this case the local currents are not produced in full, so that a special brake magnet is necessary; but to obviate this the inventors, by means of lateral enlargements on the pole pieces, enable the local currents to form close up to the passing current, which arrangement is said to give most advantageous results with regard to the aforesaid ratio of the currents. The copper disc is secured to a shaft upon and in gear with which are toothed wheels operating any convenient type of registering mechanism, the current being led to the disc by spring arms or through mercurial contacts into which the disc or parts in connection therewith may dip. To increase the magnetic induction and to obtain uniformity in the magnetic resistance with regard to all the lines of force, the copper disc is perforated with a number of holes, into which are inserted plugs of soft iron. These holes extend radially upon the face of the disc, so that they are found close together at the parts where the greatest resistance to the lines of force is presented. Claims: In electricity meters in which the current to be measured is caused to pass radially through a disc in a constant field, enlargements on the pole pieces as described; also the introduction of pieces of soft iron into the disc.—No. 3609. February 27th, 1891. 6*d*.

Secondary Batteries.—*W. Roberts, Toronto, Canada.*—This invention relates to the form and arrangement of surface of an electrode, to the coupling of these electrodes together in a cell, to their insulation, and to a method of guarding against the possibility of the occurrence of short-circuiting within the cell. The electrode is formed, in the usual manner, of two plates, preferably of lead, which are brought face to face so that star-shaped or other openings in each plate coincide, the metal of the coincident faces of the plates, between the openings, being beveled away so that the entire inner surface of the plates is exposed to electrolytic action, and free circulation of the current over the surfaces in question is afforded, and the oxide of lead between the plates practically forms a continuous sheet, and is prevented from dropping out. The beveling above mentioned exposes a considerable surface area of metal as compared with a correspondingly perforated plane surface. Lugs on one plate of each pair are bent over the companion plate to secure the two together. To insulate and couple the electrodes together, hard rubber bolts are provided, which pass through the plates and also through intermediate hard rubber separating sleeves. The inventor also specifies an arrangement of coupling strips for two or more cells, in which the strips to which the electrodes are secured have their ends turned up and secured together by a threaded bolt and nuts, the turned-up end in some cases being used to make contact with a terminal plate to which wires are secured, also by a screwed bolt and nut. The rubber bolts before referred to, which secure the electrodes together, serve also to keep the positive electrodes above the floor of the cell, to prevent short-circuiting, the negative electrodes being provided with feet which support the whole series. Claims: The beveling of the inner surfaces of plates forming a secondary battery electrode, the outer surface of each plate being a plane surface; the method of securing the pair of plates by lugs; the turned-up ends of coupling strips secured to each other or to terminal plates by screwed connection; the coupling and insulating bolts and sleeves, and the feet in combination therewith, the whole to prevent short-circuiting; also a pair of plates not described above, having uneven inner sides in combination with a central plate having two uneven sides, a paste being placed between opposing plates.—No. 1425. January 26th, 1891. 8*d*.

CHEMISTRY.

Yellow Colouring Matter.—*O. Imray, London.* (*The Farbwerke vormals Meister, Lucius, & Brüning.*)—This invention relates to the production of a yellow colouring matter by the action of tetrazodiphenyl upon orthocresotic acid. For the preparation of the tetrazodiphenyl salt sulphate of benzidine is used in the form of a paste of from 15 to 20 per cent. About 200 parts by weight of this paste, corresponding to 28·2 parts by weight of pure sulphate, are mixed in a suitable vessel with about 350 parts by weight of cold water, and to the mixture are added 29·5 parts by weight of hydrochloric acid of 30 per cent. The mass is cooled down by means of ice to + 10° C., and at this temperature a solution of 14·07 parts by weight of nitrite of sodium, dissolved in from 60 to 80 parts by weight of cold water, is caused to flow in slowly. After having been kept agitated for some time—say, from half an hour to an hour—the benzidine sulphate will have dissolved entirely and the diazotising will be completed. At the same time are dissolved in a vessel of sufficiently large dimensions 31 parts by weight of orthocresotic acid, by means of 19·2 parts by weight of caustic soda of 100 per cent., and about 1,000 parts by weight of cold water. The clear solution is cooled down to + 1° C. by means of ice, and the solution of the tetrazodiphenyl is caused to flow into it under continuous agitation, which is kept up for ten hours, after which time the mixture is heated slowly to 50° C.; it is kept agitated for one hour more, and then the temperature is raised to 60° C. The colouring matter is precipitated by means of common salt and pressed off hot in a filter press. The cakes are submitted to hydraulic pressure and afterwards dried at a temperature between 60° and 70° C. Claims: The production of a yellow colouring matter by the action of a tetrazodiphenyl salt upon orthocresotic acid substantially as described; the yellow colouring matter produced substantially as described.—No. 8506. June 2nd, 1890. 4*d*.

MISCELLANEOUS.

Miners' Lamps.—*A. Howat, Old Trafford, Manchester.*—The improvements embraced by this invention are particularly applicable for testing or trying for explosive gases, and it is preferred to employ a lamp of the construction described in specification No. 17410 of 1889, wherein the wire gauze cylinder is covered with a metal shield or bonnet which rests upon the upper side of the deflector of the lamp. The said deflector forms the roof of the air chamber, the bottom of which is formed by a horizontal ring forming part of the lamp framing, the outer side of the air chamber being formed by a short cylinder dependent from the ring, and the inner side being formed by a longer cylinder. An additional air inlet for gas testing purposes is provided by tubes, the lower ends of which are fixed in the deflector and communicate with the top of the air chamber, and the upper ends terminating in the top of the lamp, and being open to the atmosphere. In the air chamber lies a horizontal ring, which may be raised and lowered from the exterior of the lamp. When it is raised against the roof of the air chamber and maintained in position by a suitable catch, it closes the lower ends of the additional air tubes, and consequently all the air supplied to the burner has to enter through the ordinary inlet. But when the lamp is used for gas testing, the ring is allowed to fall upon the top of the high collar, closing the ordinary annular inlet, so that the air supplied to the lamp is drawn into the annular air space through the special air tubes, and the presence of any explosive gas will be readily detected. Claims: The combination of the ordinary air inlet at or near the bottom of the air chamber, with an additional inlet for supplying air to the upper part of the chamber, and means such as the movable ring for opening and closing either inlet; also the means for raising and lowering the ring by a rocking arm operated by a rod which is retainable by a catch.—No. 7749. May 19th, 1890. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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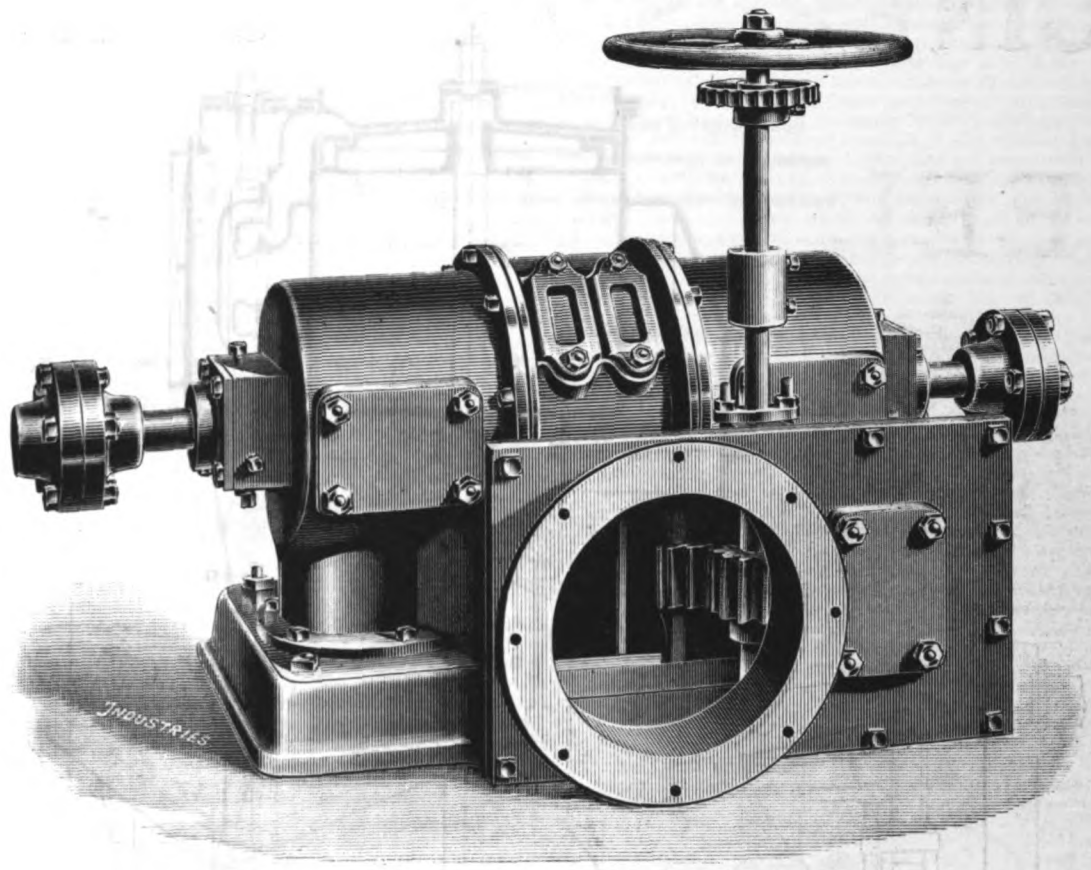
THE "LITTLE GIANT" TURBINE.

The horizontal turbine we illustrate herewith is a double-wheel one, having two tiers of buckets, side by side, keyed to the same shaft, both running in the same case, but discharging into separate draught tubes. The case is cast in one piece, is a scroll in form, and is provided with two planed foot-plates. To each side of the case bearings are attached for the wheel shaft, these bearings being adjustable to compensate for wear, and to keep the wheel running true in the case. On the outer ends of the wheel shafts are seats for couplings. The lower faces of the discharge hoods are planed true with the foot-plates of the case, forming thus one continuous face, to which a strong iron bed-plate is attached, with openings to correspond with the same in the discharge hoods. On the underside of the bed-plate, and around the discharge hood openings, is a suitable face with bolt holes to match the holes in the discharge hood flange, the bolts in this being long enough to attach the flange of the draught tube. The simplicity of the gate arrangement is worthy of attention, as there is but one gate, which may be easily kept in order. There are many situations where a turbine placed upon a horizontal shaft can be used at better advantage than on a vertical shaft. By using a horizontal shaft and placing the turbine shaft some distance above tail water, nearly the whole effect due to the head can be obtained by using an air-tight tube for a discharge tube, the lower end of which extends into the tail water. This mode of setting a wheel admits of placing a pulley directly on the turbine shaft and having belting to the line shaft. This turbine is altogether constructed so as to form a strong and compact motor. It is well adapted for electrical work, as it allows the dynamo to be attached direct to the turbine shaft, and thus dispenses with pulleys, belting, or gearing. The sole agent for it in this country is Mr. S. Howes, 64, Mark Lane, London, E.C.

THE DUTCH ROYAL STEAM PACKET COMPANY'S STEAMER "VAN GOENS."

We illustrate on our two-page supplement, in Figs. 1 and 2, a sectional elevation and awning-deck plan of one of three steamers built for the Royal Steam Packet Company at the "Koninklyke Fabriek van Stoom E. A. Werktuigen," Amsterdam. The above company obtained a concession for carrying passengers and cargo in the East Indies, between the different ports of the Archipelago, starting on the 1st January last. Sixteen vessels were taken over from the old line to be reconstructed, whilst thirteen new ones were built in Holland. The new boats are built after three types, called A, B, and C, according to their respective sizes and the distances run, and are all named after the late General-Governors of Netherlands, India. The A type vessels were built by the Royal Shipbuilding and Engineering Company "de Schelde," at Flushing, and are named "Both," "Reaal," "Coen," and "Maetsuicker." The B type vessels, one of which is shown in our illustrations, are the ten-mile steamers, "Van Goens," "Reynst," and "Speelman," built at the Royal Factories at Amsterdam, and the twelve-mile steamers "Carpentier" and "Van Diemen," built by the Dutch Steamship Company "Feyenoord," Rotterdam. The C type vessels consist of the "Van Rhiebeeck," built by Messrs. J. & K. Smit, Kinderdyk, the "Reyniersz" and "Zwaerdekroon," built by the Shipbuilding and Engineering Company "de Maas." All the above vessels are either of steel or iron. One of the C type, however, was composite built, in order to ply in waters where docking is difficult. Messrs. Huygens & Van Gelder, at Amsterdam, constructed this vessel, named "Camphuys." The illustrations we give in our two-page supplement represent the "Van Goens." She is one of the ten-mile B type boats. Her dimensions are: — Length, between perpendiculars, 220ft.; breadth, moulded on frames, 30ft. 10in.; moulded depth to main-deck, 15ft. 9in.; height of awning-deck above main-deck, 7ft. 3in.; load draught, forward, 11ft., aft, 12ft. 6in. The steamers are all built to the highest class of "Veritas" special survey. They are of the awning-deck type, and are schooner rigged, with two so-called pole masts. This class of boat is fitted for 22 first-class, 18 second-class, and about 200 third and fourth-class passengers. The accommodation for the passengers has been carefully considered, with special reference to a first-class passenger service in a hot climate. Saloon and state-rooms for first-class passengers are perfectly lighted and ventilated. The fittings and decorations of the saloon are all in the same style. The sides or walls are of polished oak, divided by balusters into a series of panels having blue and brown tiles from the well-known earthenware manufactory at Delft, and painted after the most talented Dutch artists. The table, of polished oak, in the first-class saloon can be divided into a number of small card tables.

THE "LITTLE GIANT" TURBINE.



General View.

The floor is not carpeted, but Brussels strips extend in the passages of the saloon and cabins. The state-rooms are exceptionally commodious and comfortable, and are supplied with Crosbie's patent iron bedsteads and spring wire mattresses. Every first-class cabin is fitted for two passengers; one of the two berths, however, can be folded up against the wall if not used.

The second-class accommodation is placed forward, and the rooms are neatly finished in wood, without tiles, being also airy and well lighted. The third and fourth class passenger accommodation being for the use of soldiers and natives, is on the main deck. The spaces are well ventilated and lighted, and are disposed for hammock berths, if wanted, although it is the custom of the natives to lie on the deck on their own mats.

The accommodation for the captain, officers, engineers, and crew is also extensive, and suitable to the climate. As it is the intention to carry soldiers, if necessary, every ship is provided with a powder and shell room.

On account of the dangerous harbours in the islands of the Archipelago, the vessel carries a steam launch, with two 26ft. sloops, specially arranged for carrying cargo, and for being towed up the rivers by the steam launch. A lifeboat, a cutter, and a gig complete the life-saving apparatus of the vessel. Duinker's patent disengaging screws are applied.

A refrigerating and freezing room, a number of fresh-water tanks, and a filter secure to the passengers agreeable living even in the most desolate places of the Archipelago.

The engines are of the triple-expansion surface condensing type, having cylinders 17in., 26in., and 43in. diameter respectively, with a stroke of 39in. The high-pressure cylinder has a piston valve, and the intermediate and low-pressure cylinders have flat valves, the steam expansion being controlled by link motion. The cylinders are not steam jacketed, but are fitted with cast-iron liners. The condenser is cast with the engine framing and fitted with 592 brass tubes of $\frac{3}{4}$in. outside diameter, giving a cooling surface of 1,466 square feet. The air pump is 17in. diameter, with a stroke of 19$\frac{1}{2}$in. There are two single-ended return tubular boilers, 11ft. 3in. internal diameter and 9ft. 9$\frac{3}{4}$in. long, with two Purves' ribbed furnace tubes in each. The heating surface of each boiler is 1071·5 square feet, and the grate area 35 square feet, the working pressure being 160lb. per square inch. The propeller is of the Griffiths' type, 10ft. 9in. diameter, having four steel blades, and a pitch variable from 16ft. 6in. to 18ft. 6in. The ship is built to run at an average speed of 10 knots, and in her trials made an average of 12·65 knots per hour., the engines developing 846 i.h.p. A considerable share of the success of these vessels is, we are informed, due to the exertions of Mr. J. F. J. de Bruyn Kops, who superintended the construction of the ships, and to Mr. R. A. Meyer, who superintended the construction of the engines.

NEW RADIAL REVERSING VALVE GEAR.

The gear illustrated on page 506 belongs to that class of radial gears actuated by the connecting rod, and is the invention of Mr. James Dunlop, of 138, Aitkenhead Road, Glasgow. The chief features of the invention are the links connecting what is termed the actuating link to the valve rod, and the method of controlling the same by the double connection to the reversing lever. By referring to Fig. 1 it will be seen that the valve lever A, being controlled by a link B from an arm on the cross-head, is thereby caused to move in unison with the piston. The correcting link C being so proportioned as to form, in conjunction with valve lever A, a parallel motion, the vibrating link D will vibrate equally on either side of its middle position, its vibrations being timed with the piston, while their extent is regulated by the connecting rod. As the lengths of the valve lever A on either side of its fulcrum on the vibrating link D are so proportioned that the end nearest the fulcrum travels the amount of lap and lead, this travel will be constant and in direct opposition to the piston. For the purpose of actuating the valve in such a manner as to admit of reversing and of varying the amount of its movement, the actuating link E is controlled at its adjustable end by a link H from the reversing lever, the distance it is moved to one side or other of its middle position being practically the same as if that distance was one arm of a bell-crank travelling the required travel of the valve, the length of the other arm being equal to the length of the actuating link E, and travelling the amount of the vibration of the link D, the motion being reversed as it passes from one side to the other of its middle position. It will be noticed that the connection between the adjustable end of this actuating link E and the valve rod consists of the corrective link F and valve connecting link G, the point where they join being controlled from the reversing lever by the link I, which is jointed to the lever at a lesser radius than the link H. One purpose of this second connection to the reversing lever is to angle the corrective link F in such a

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NEW RADIAL REVERSING VALVE GEAR.

(*For description see page* 505.)

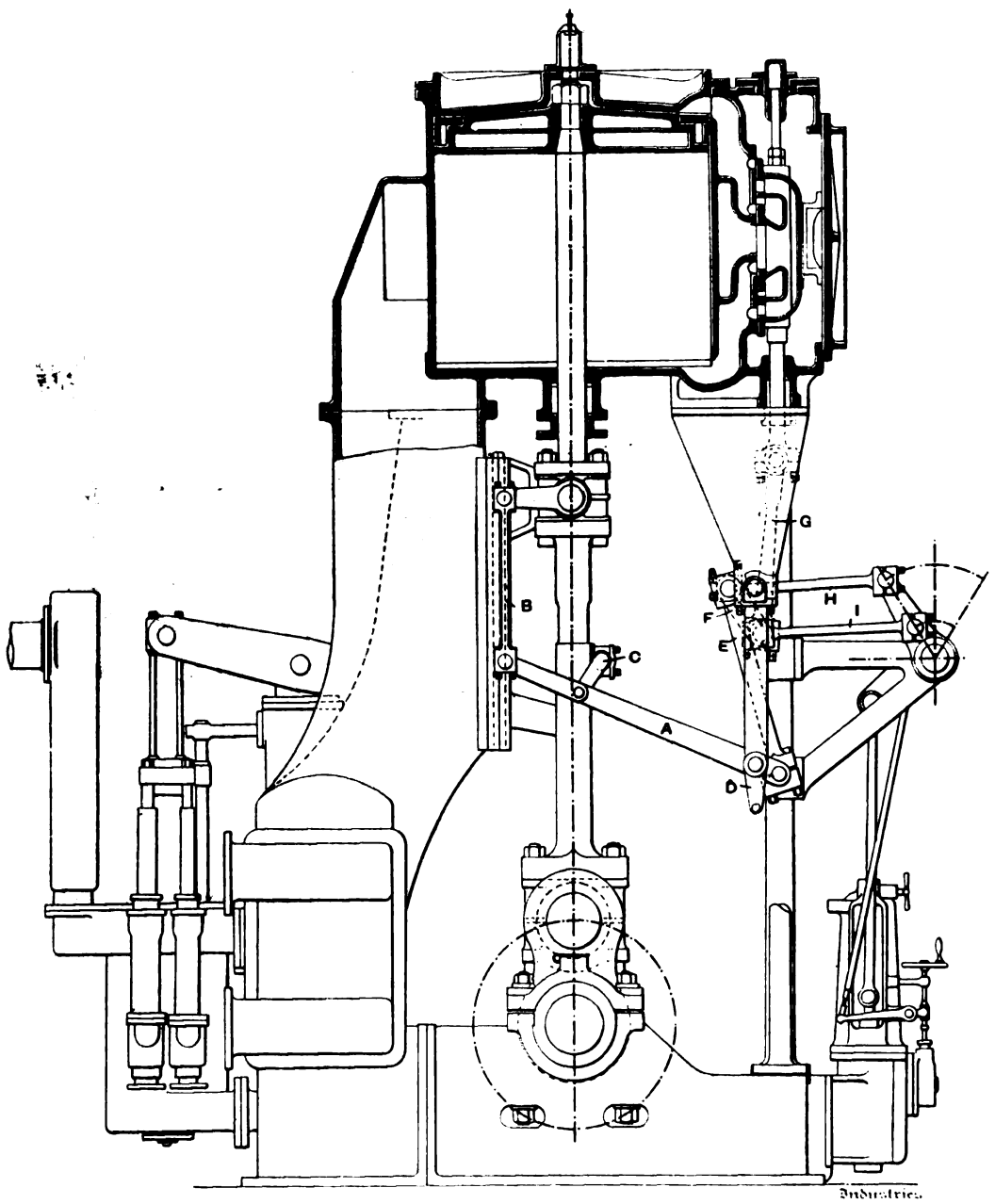


FIG. 1.—GENERAL VIEW OF GEAR.

manner as to compensate for the arcs described by the ends of the actuating and valve connecting links. Another important feature is that the connection to the valve rod is more direct than in other radial gears. As a direct result of this arrangement, it may be expected that the wear and tear will be greatly reduced, and also the first cost. As regards the steam distribution, it is exceedingly good, as the valve openings and cut-offs are practically equal for both ends of the cylinder under all conditions of working.

Mr. Dunlop has several modifications of this gear suited for application to locomotive, marine, and other engines, including a variable expansion arrangement intended principally for compound locomotives.

RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

(*Concluded from page* 484.)

REPORT UPON TRIALS OF THE S.S. "IONA."

Subsequent Trial by Chief Engineer.—After the trial above described had been carried out, the "Iona" made a voyage up the Mediterranean, and on her return journey from the island of Serpho to Rotterdam, on 15th August 1890, when the vessel was off the coasts of Tunis and Algeria, the chief engineer of the vessel, Mr. J. Fiddes Brown, carried out a trial on his own account. The weather was fine throughout the trial, with light head winds, but the vessel was rolling somewhat during the latter part. The mean draught during the trial was about 20ft. 9in. The trial commenced at 5.33 a.m., and was continued until 4.26 p.m. by chronometer, thus lasting for 10 hours 53 minutes, or 653 minutes. As in the Committee's trial in July, the coal was twice weighed, the difference between the two methods of weighing being only 1·2 per cent., which is accounted for by the difficulty of weighing accurately during the rolling of the vessel in the latter part of the trial. The total coal used was 10,631lb., or 16·3lb. per minute. Indicator diagrams were taken from each end of each cylinder every half-hour throughout the whole trial. Two Richards indicators were used; one was kept constantly on the high-pressure cylinder, while the other was changed between the intermediate and low pressure cylinders. The indicators were attached to the cylinders by the usual long pipes and bends, and top and bottom diagrams from the same cylinder were taken on each paper. In this way twenty-two complete sets, or sixty-six separate papers, with two diagrams on each, were obtained. The maximum indicated horse-power from any one set of diagrams was 730, taken at 1 p.m.; and the minimum from any one set was 683·5, taken at 3·30 p.m. The revolutions were counted once in each quarter of an hour, and the mean of all the observations gave an average speed throughout the trial of 63·9 revolutions per minute. The mean barometric pressure throughout the trial was 30·10in. of mercury, or 14·8lb. per square inch. The mean pressures in the first and second receivers were respectively 41·5lb. and 1·8lb. per square inch above the atmosphere. The mean readings of the water gauges connected with the forced draught apparatus were as follows:—

Position of Gauge.	Pressure.
On air-trunk near fan	1·03in. of water
On air-trunk at back of boilers ...	0·78in. ,,
On ashpits, mean of four gauges...	0·32in. ,,

The mean speed of the fan engine was 218·5 revolutions per minute, and the indicated horse-power developed was 2·6. As

* Report prepared by Professor Alexander B. W. Kennedy, F.R.S., Chairman of the Committee, for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 31st ult.

TABLE II.

COMPARATIVE RESULTS OF TWO TRIALS OF THE STEAMER "IONA."

Trial made by	Research Committee.	Chief Engineer.
	1890	1890
Date of trial	13 & 14 July	15 August
Duration of trial ..... hours	16	10·88
Type of engines	Triple	Triple
Cylinder diameter, high-pressure...in.	J 21·68	J 21·68
,, ,, intermediate ...in.	N 34·02	N 34·02
,, ,, low-pressure ...in.	N 56·95	N 56·95
Stroke, length ....in.	39	39
Boilers, number of main boilers.....	2	2
,, single-ended or double-ended	Single	Single
Furnaces, total number	4	4
Heating surface, total .....square feet	3,160	3,160
,, ,, tubes.....square feet	2,590	2,590
Grate area (actual) .....square feet	42	42
Total heating surface to grate area ratio	75·2	75·2
Tube surface to grate area .....ratio	61·7	61·7
Grate area to flue area through tubes ratio	2·3	2·3
,, to area through funnel ratio	1·4	1·4
Mean Pressures.	Lbs. per square inch.	
Mean boiler-pressure above atmos. ...	165·0	162·0
,, admission ,, high-pressure cylinder above atmosphere ...	142·5	147·8
,, effective ,, high-pressure cylinder	46·65	47·33
,, ,, ,, intermed. ,,	20·44	20·21
,, ,, ,, low-pres. ,,	7·16	7·96
,, ,, ,, total reduced to low-pres. cyl..	21·13	21·95
,, exhaust ,, low-pres. cylinder below atm.	12·74	12·8
,, vacuum in condenser below atm.	13·88	13·76
Revolutions per minute, mean ...revs.	61·1	63·9
Piston constant, high-pres. cyl. h.p.	4·41	4·61
,, ,, intermediate ,, h.p.	10·82	11·32
,, ,, low-pressure ,, h.p.	30·54	31·98
Indicated horse-power, high-p. ,, i.h.p.	205·6	221·0
,, ,, inter. ,, i.h.p.	221·2	231·7
,, ,, low-p. ,, i.h.p.	218·6	255·0
,, ,, mean tot. i.h.p.	645·4	707·7
Coal burnt per minute .....lbs.	15·7	16·3
,, per hour .....lbs.	942	978
,, per sq. ft. of actual grate area per hour ....lbs.	22·4	23·3
,, per sq. ft. of total heating surface per hour.....lbs.	0·298	0·310
,, per i.h.p. per hour ...lbs.	1·46	1·38
Carbon-value of 1lb. of coal as used lbs.	1·02	—
,, equivalent per i.h.p. per hour .....lbs.	1·49	—
Feed-water per minute .....lbs.	143·6	—
,, per hour .....lbs.	8,616	—
,, per sq. ft. of total heating surface per hour.....lbs.	2·73	—
,, per lb. of coal.....lbs.	9·15	—
,, per lb. of coal from and at 212° F. .....lbs.	10·63	—
,, per lb. of carbon-value from and at 212° F. lbs.	10·42	—
,, per i.h.p. per hour ...lbs.	13·35	—
Calorific value of 1lb. of coal as used Th. U.	14,830	—
Percentage of calorific value of fuel taken up by feed water.....	69·2	—
,, ,, carried away by furnace gases	16·2	—
,, ,, lost by imperfect combustion ...	0·0	—
,, ,, used in evaporating moisture in coal	0·0	—
,, ,, unaccounted for	14·6	—
Heat taken up by feed-water per min. Th. U.	161,100	—
,, turned into work per minute Th. U.	27,590	30,250
,, taken up by feed-water per i.h.p. per minute Th. U.	249·6	—
Efficiency of boiler .....per cent.	69·2	—
,, of engine .....per cent.	17·1	—
,, of engine and boiler combined .....per cent.	11·8	—
Mean velocity of steam through water-surface in boilers per minute .....feet	1·61	—
Space occupied by boilers per i.h.p., cubic feet	4·15	4·15
Weight of engines, boilers, &c., with water, per i.h.p.....tons	0·31	0·31

J = Jacketed. N = Not jacketed.

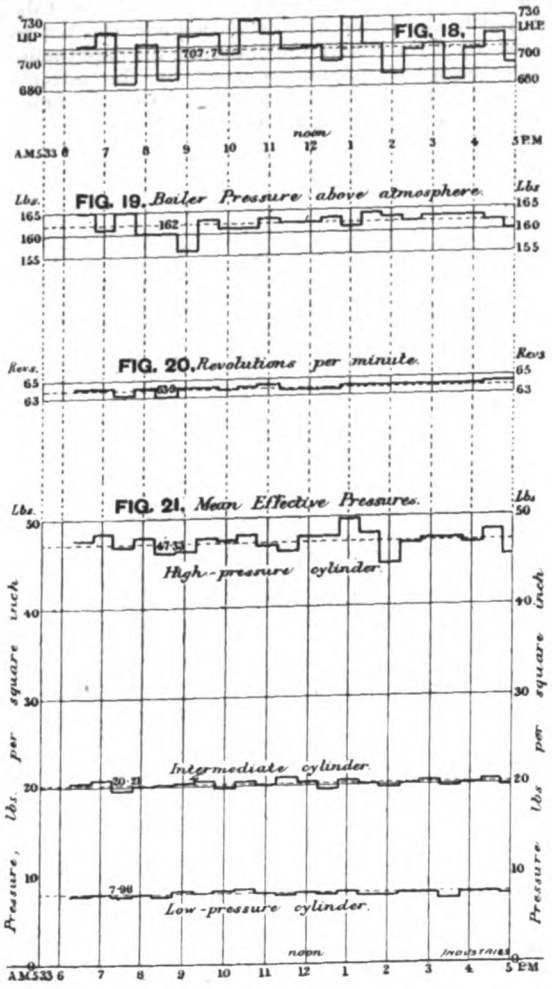
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Comparative Results of Two Trials of the Steamer "Iona."

Trial made by	Research Committee.	Chief Engineer.
Clearance volume, high-p. cyl. ...p.c.	12·41	12·41
,, ,, inter. ,, ...p.c.	10·11	10·11
,, ,, low-p. ,, ...p.c.	7·64	7·64
Clearance surface, high-p. ,, sq. ft.	12·75	12·75
,, ,, inter. ,, sq. ft.	29·14	29·14
,, ,, low-p. ,, sq. ft.	49·5	49·5
Speed of vessel, mean, during trial, kts.	8·6	9·0
Mean temperature of outer air, ...F.	62°	91°
,, ,, chimney gases F.	452°	[672°]*
,, ,, feed-water ...F.	106°	157°
,, ,, boiler steam...F.	373°	371°
,, ,, circul. water F.	55·8°	78·6°
,, ,, discharge ,, F.	77·5°	94·4°
Forced Draught Pressures.	Inch of water.	
In casing, near fan	+0·87	+1·03
In casing, at back of boilers	+0·34	+0·78
In ashpits, mean of four gauges	+0·17	+0·32
In funnel.....	−0·25	—

* Indicated by a pyrometer in uptake of furnace.

in the Committee's trial in July, steam was supplied to the fan engine from the donkey boiler. The mean temperature of the gases in the uptake of the furnace, as indicated by a pyrometer placed at a height of 6½ft. above the level of the firebars, is given as 672° Fahr. The principal results of the August trial are given in Table II., along with those of the Committee's trial, and it will be seen that these two sets of results agree remarkably well. The only essential difference between them is that in the August trial the coal is given as 1·38lb. per indicated horse-power per hour, whereas in the July trial it was 1·46lb. per indicated horse-power per hour. The same description of coal was used in both



of the trials. In the August trial the feed-water was not measured, and the drain and jacket water was delivered direct into the hot-well instead of being allowed to collect gradually in measuring tanks before being mixed with the feed-water. In consequence mainly of this, the feed-water entered the boiler at a mean temperature of 157° Fahr., whereas in the July trial the mean feed-temperature was 106° Fahr. The difference between the amount of heat taken up in the boiler by 1lb. of water in the two trials is 4·6 per cent. of the larger amount. The difference between the two fuel consumptions is 5·5 per cent. of the larger amount. These two results strikingly corroborate each other, and show how exactly it is possible to estimate beforehand the actual saving due to the heating of the feed-water. The consumption of coal in the August trial, if calculated for the conditions under which the July trial was carried out, would be 1·45lb. of coal per indicated horse-power per hour. The continuous variations of boiler pressure, cylinder mean effective pressures, horse-power, and speed during the August trial are shown above in Figs. 18 to 21.

Speed of Vessel.—Besides careful measurements from the ship's chart, taken by Captain Cranston at regular intervals throughout the Committee's trial and embodied in the ship's log, a continuous registering log was employed to estimate the speed of the vessel, and the reading was noted every half-hour during the

RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.

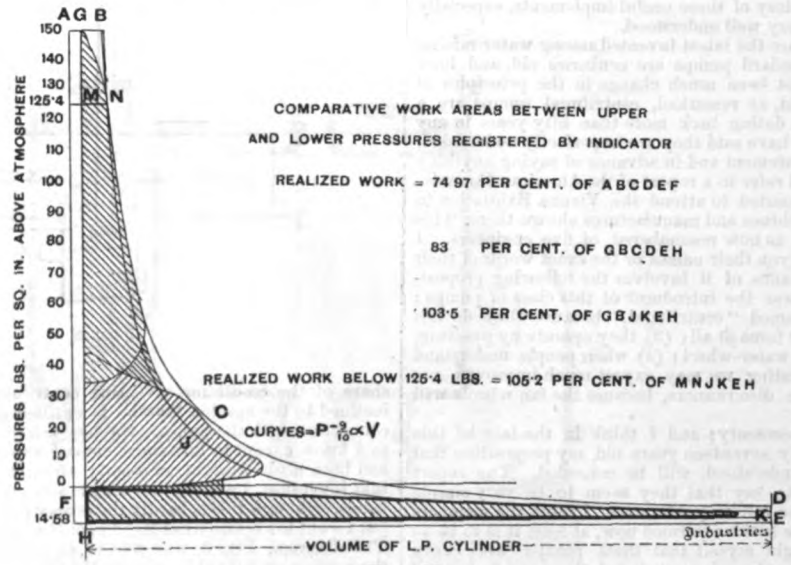


FIG. 22.

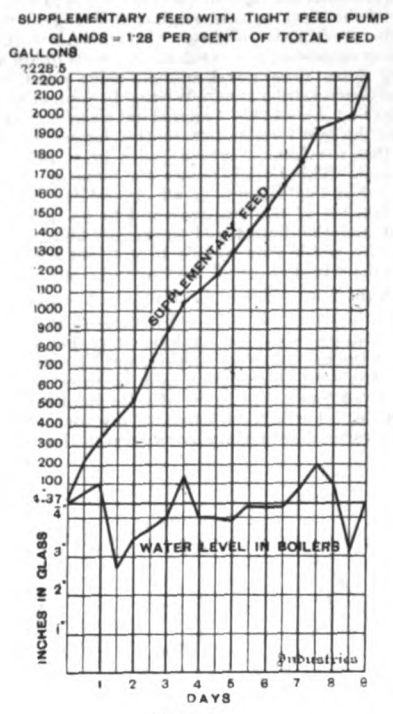


FIG. 23.

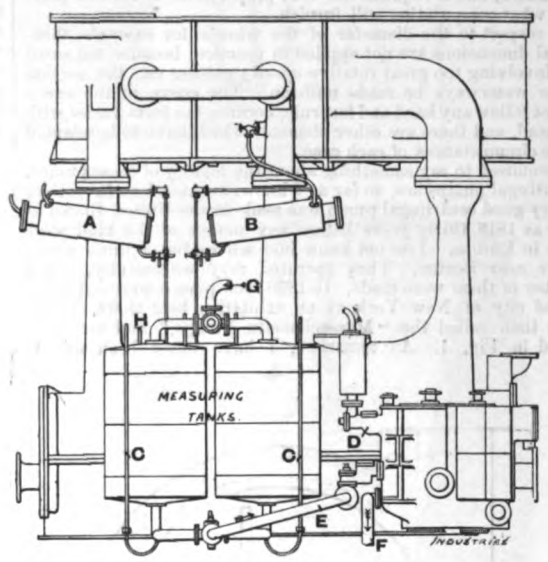


FIG. 24.

Extract from Ship's Log.

Time.	Headlands, &c., and Weather.	Distance in Nautical Miles. By Log.	Distance in Nautical Miles. From Chart.
13 July			
1.0 p.m.	Passed Shields Pier. Set log at zero. Light S.W. wind. Smooth sea.	0	0
6.0 ,,	Passed Whitby Lighthouses. Fresh S.W. breeze. Smooth sea.	39·8	40·0
6.30 ,,	Off Robin Hood Bay. Trial began.	44·5	—
9.30 ,,	Passed Flamborough Head. Fresh S.W. breeze. Slight head sea.	69·5	70·0
14 July			
3.40 a.m.	Passed Outer Dowsing Light-vessel. Fresh S.W. breeze. Slight head sea.	122·5	123·5
4.20 ,,	Passed Dudgeon Light-vessel. Rising wind. Moderate sea.	128·0	130·0
7.0 ,,	Passed Hasborough Light-vessel. Strong S.W. wind. Slight head sea.	150·8	155·0
8.50 ,,	Passed Newarp Light-vessel. Strong S.W. wind. Slight head sea.	167·5	167·0
9.45 ,,	Passed Middle Cross Sand Light-vessel.	173·0	174·0
10.30 ,,	Off Yarmouth. Trial ended.	179·5	—
10.50 ,,	Passed Corton Light-vessel.	182·0	181·0

trial by the captain or the officer on watch. The extract from the ship's log herewith, relating to the time of the trial, has been kindly furnished by Captain Cranston.

The distance recorded by the registering log during the trial was therefore 179·5 — 44·5 or 135 nautical miles in 16 hours, which is equivalent to a mean speed of 8·4 knots. The distance traversed by the ship during the trial as measured from the chart was 138 nautical miles, which is equivalent to a mean speed during the trial of 8·6 knots. There is added to this report Table II., showing the leading results of the trial of the "Iona" carried out by the Committee on 13th and 14th July, 1890; and beside these are placed the corresponding figures for the subsequent trial made by the chief engineer on 15th August. There is also added an appendix giving a list of the members of this Institution and others who have taken part in the Committee's trial.

Fig. 24 gives a general view of the arrangement of the measuring tanks as used in the Committee's trials in July, and Figs. 22 and 23 are diagrams connected with the chief engineer's trial made in August of last year.

Appendix.

Staff of Observers.

* Members of the Institution are marked with an asterisk.

One watch was taken by Mr. A. G. Ashcroft, along with Messrs. A. Brownsword, W. A. Cloud, W. Kennedy, L. A. Legros,* P. S. S. Pilcher, and E. C. de Segundo. The other watch was taken by Professor Kennedy,* along with Messrs. H. F. W. Burstall, H. R. J. Burstall,* J. T. Ewen, S. B. B. Hebb, J. S. Ruell, and J. H. Sharman. Mr. C. J. Wilson collected the gas samples during the whole of the trial. Mr. John R. Fothergill,* who is the superintending engineer for the owners, and Mr. Thomas Mudd,* the manager of the Central Marine Engine Works, were both on board; and Mr. J. Fiddes Brown, chief engineer of the ship, as well as his staff, gave every possible assistance in the work. The Committee are much indebted also to Captain Joseph Cranston and his officers for their courtesy throughout the whole of the operations.

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THE BALANCING OF CENTRIFUGAL PUMPS.*

BALANCING Centrifugal Pumps is the announced theme for my remarks, but before entering upon that subject I think it will be a matter of interest to the members to say something of the nature, origin, and history of these useful implements, especially as this matter is not very well understood.

Centrifugal pumps are the latest invented among water-raising machines. Other standard pumps are centuries old, and for a long time there has not been much change in the principles of their construction, but, as remarked, centrifugal pumps are a modern invention, not dating back more than fifty years in any recognisable form. I have said they are imperfectly understood, and to support this statement and in advance of saying anything of their history, I will refer to a report of the American Commissioners who were appointed to attend the Vienna Exhibition in 1873, to report on machines and manufactures shown there. This commission consisted, as now remembered, of five engineers. I am not able to give you their names or the exact words of their report, but the substance of it involves the following propositions:—(1) Appold was the introducer of this class of pumps; (2) they were mis-named "centrifugal," because they do not operate by centrifugal force at all; (3) they operate by pressure, the same as a turbine water-wheel; (4) when people understand their method of operating we may expect much improvement; (5) they should have disc runners, because the fan wheels will soon wear out.

Comment is not necessary; and I think in the face of this information, now only seventeen years old, my proposition that the pumps are not understood, will be conceded. The report mentioned goes on to say that they seem to be very simple machines, involving no intricacy whatever. I think the members of that commission are better informed now, at least it is to be so hoped. I once thought myself that these pumps were very simple machines, but when I commenced the manufacture of them here in California, nine years ago, I soon found to my astonishment they were not simple machines at all, but, on the contrary, very intricate machines, involving many peculiar principles and conditions that nobody would suspect until they tried the experiment of working them under high and low heads, and other varying conditions. While the theories and principles of constructing such pumps seem to be reliable and correct mathematically, the theoretical rules cannot in many cases be applied in practice, and it requires different proportions of various parts from what computation will furnish.

In respect to the diameter of the wheels, for example, theoretical dimensions are not applied in practice, because too small and involving too great rotative speed; neither can the section of the waterways be made uniform. The curve of the vanes cannot follow any hard and fast rule, because the form varies with the head, and there are other elements which have to be adapted to the circumstances of each case.

I promised to say something about the history of these pumps. Centrifugal pumps are, so far as I know, an American invention. A very good centrifugal pump was made in the United States as early as 1818, thirty years before any pumps of the kind were made in Europe. I do not know just where, but I think somewhere near Boston. They operated very successfully, and a number of them were made. In 1830 such pumps were exhibited in the city of New York at an exhibition held there. They were then called the "Massachusetts Pumps," and are illustrated in Fig. 1. As remarked, I have never been able to

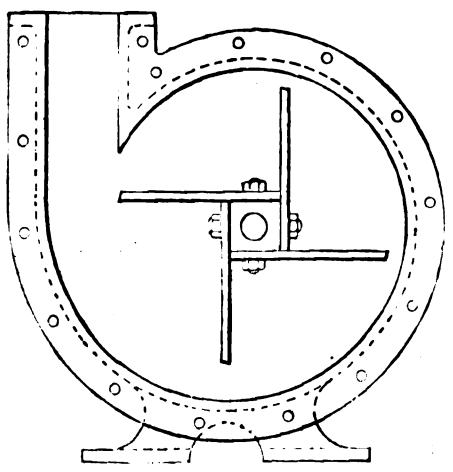


FIG. 1.

find out who was the inventor of the original "Massachusetts" pump. It was perhaps an "evolution" of a neighbourhood. [Since the above was written, Mr. J. E. Hodgkin has shown conclusively, from printed descriptions of the celebrated French engineer and mechanician, Papin, that he invented centrifugal pumps, and was familiar with their action in 1689, more than 200 years ago, but no practical use followed his discovery. This machine of Papin's was the one known as the "Hessian Suck."]

In 1839 Mr. Andrews, of New York, improved the pump by applying the volute or spiral casing. This added a good deal to the efficiency at low heads, but nothing perhaps at high heads.

About that time Mr. James Stuart Gwynne, of London, now of the firm of Messrs. Gwynne & Co., in the same city, while at Pittsburgh, Pa., had his attention drawn to this "Massachusetts" centrifugal pump, and made at least one pump there that was sent to a mine in New Jersey.

* Abstract of a paper read by Mr. J. Richards, of San Francisco, before the Technical Society of the Pacific Coast.

About 1846 Mr. Gwynne went back to England, taking with him the centrifugal pump, called in England at that time the "American pump." He commenced its manufacture there, and very successfully. At the Exhibition of 1851 he was met in competition by Mr. Appold, whom the American Commissioners to Vienna claimed to be the first inventor of these pumps. I will mention here that in England Mr. Appold comes in for a great

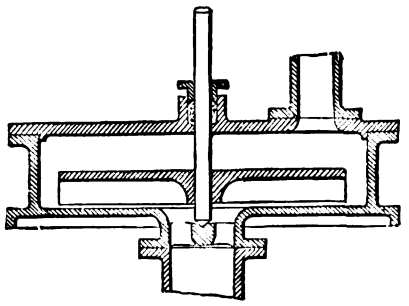


FIG. 2.

share of the credit for inventing centrifugal pumps; but I am inclined to the opinion that he is entitled to very little credit in connection with the pump. He has never done anything so far as I know except to introduce curved vanes. Previously these had been made straight, or nearly straight. As to the value of that invention, I will digress a little and say something about the vanes, although this is hardly the proper place to introduce them; but I want to explain what Mr. Appold had to do with these pumps. The diagram, Fig. 3, was sent to an engineering journal about three years ago for publication by Mr. Charles Brown, of the firm of Messrs. Sulzer Bros., of Winterthur, Switzerland, which I believe is one of the foremost machine shops of the world; I also think Mr. Brown one of the most eminent engineers living at the present time. In the construction of recent Government works in Italy, which are very extensive, he was selected by Sir William Armstrong & Co. to put down their novel and extensive plant, which was done in a very successful manner. Writing in September, 1886, Mr. Brown states:—"About 1856 I carried out a series of experiments to determine the best form and proportion for centrifugal pumps, and found that the form of vanes had a great influence on the speed required. The sketch shows the form of vanes experimented on. The total lift was in all cases 45ft. The inner and the outer diameter of the disc was as 1 to 3—that is, the inlet pipe was 10, and the diameter of the runner 30in., or those proportions. The water rose to this height, but without any discharge, and the wheel required a velocity in feet per second = $\sqrt{2gH}$ with the form of blade A. B required considerably more. C required still more. D required a velocity = $\sqrt{2gH} \times 0{\cdot}82$. This you recognise as not the Rankine curve, but an approximation. D was the best in every respect, and I continue to use it."

I have introduced this matter here to show you how little Appold's curved vanes had to do with the improvement of centrifugal pumps. I will remark that in my own experience the shape of the vanes does not involve a great deal when considered

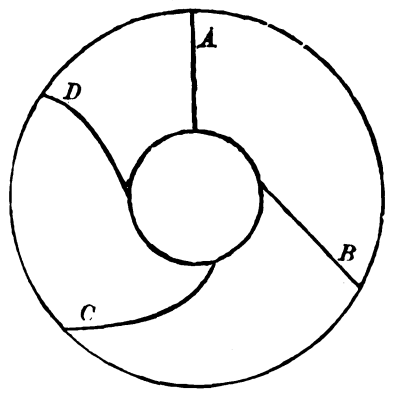


FIG. 3.

irrespective of the head. If a pump is working against a low head, I think that a flat radial vane is nearly as efficient as a curved one. The greater the speed of the wheel in proportion to the water, the nearer the vanes should terminate in a tangent.

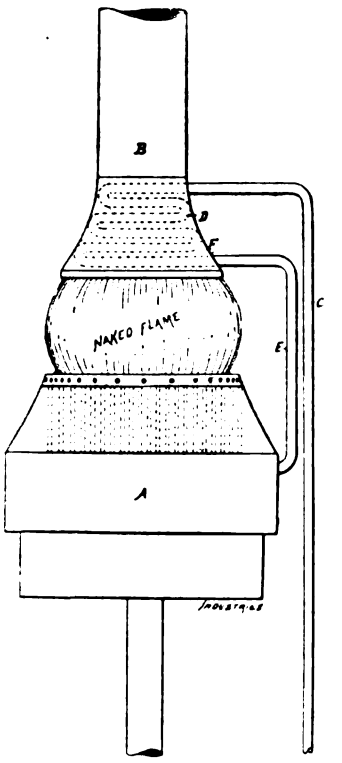
One more point in the history of centrifugal pumps deserves some attention, and that is the experiments of Sir Henry Bessemer, of steel fame. He was, as you perhaps know, for a long time identified with the designing of sugar machinery, and I believe is the true inventor of the centrifugal extracting machine. During his experiments with the extractor in London, he was led to the centrifugal pump. He invented and patented a system of centrifugal-acting pumping machinery, in which he ignored entirely the tangential energy of the water as it leaves the wheel. He thought that was of no use. We have an American invention of the same pumps fourteen years before Mr. Bessemer's. It is shown in Fig. 2, and was invented by Mr. Blake, of Connecticut, in 1831. All that Sir Henry Bessemer did was to modify the pump in various forms—ingeniously in some cases—to be driven by wind, water, or steam. He wrote a long essay upon the subject. His pumps never had much efficiency for low heads; at high heads they might have done very well.

I will remark here that this long and tedious development of the centrifugal pump was characteristic of a past period; such a condition could not exist in our time. If this class of pumps were discovered at this day, they would no doubt receive more development in a single year than in the forty years that is covered by the facts recited. We have a proof of this in dealing with so intricate and intangible an element as electricity. We have seen it, in all of its extensive uses put on a scientific basis, reduced to an exact art within a period of ten years or so.

(To be continued.)

THE IMPROVED "WIGHAM" BURNER.

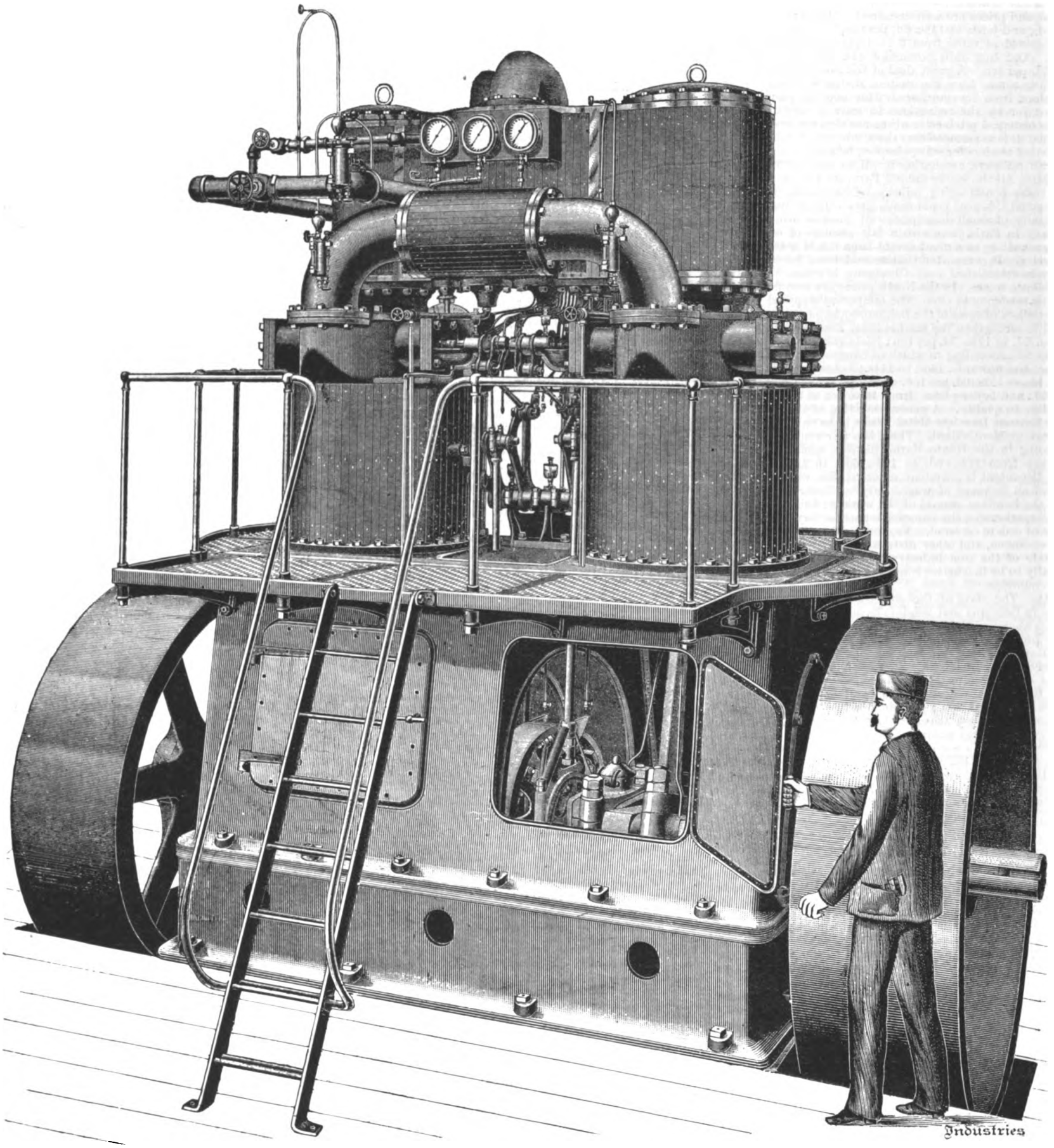
THE new gas burner illustrated herewith is the invention of Mr. J. R. Wigham, of 33, Capel Street, Dublin, the well-known lighthouse engineer, and is somewhat similar to those already in use in lighthouses. No chimney glasses, liable to breakage, and consequent destruction of the light, are required in connection with this burner. For ordinary or fair weather purposes 28 jets are employed, and these can be instantly increased in number to 48, 68, 88, or 108 jets, as the weather requires it. In the original burner of this description this was accomplished by means of mercurial cups and joints which acted as taps for admitting or cutting off the supply of gas. In the new burner the increase of light, according to the state of the weather, is effected by hollow two-way cocks, to which we shall refer later on. The flame combustion takes place in an atmosphere of air highly heated by the products of combustion, the heat being conducted by the metal work to a chamber F, from which it is in turn supplied to the heart of the burner. The brilliancy of the light is further increased by the use of solid naphthaline placed in a copper receiver A. The flue B, which carries off the products of combustion, is provided at its lower extremity with a bell-mouthed copper chamber F, through which the gas for supplying the burner is caused to circulate by means of tubes C, D, and E, the latter of which conducts the hot gas into the top of the receiver A containing the naphthaline. The hydrocarbon vapour given off by the latter is thereby absorbed by the heated gas, thus becoming enriched prior to entering the burner.



Supposing during foggy weather that the whole of the 108 jets are ignited, and that on the cessation of the fog the 28-jet burner only is required, the arrangement of the hollow two-way cocks enables the light-keeper to reduce in a moment the quantity of carbon necessary for the large burner to that necessary for the proper combustion of the smaller burner. These hollow cocks are in communication with a chamber of cold gas, not enriched, which is drawn upon by a small turn of the cock to the extent required to give the proper illuminating power to the burner. This system is not only effective to the extent explained, giving, we are informed, double the power of the most powerful gas burner now used in lighthouses, but is exceedingly economical, for instead of requiring cannel gas, which is expensive, gas made from ordinary coal may be used. At present, under the gas system of lighthouse illumination, three kinds of coal are used—viz., cannel coal, banking coal for keeping up the heat in the retorts, and house coal for the light-keeper's use; but under this system one kind of coal, Newcastle or Wigan, is only necessary, the coke from which will keep up the heat in the retorts.

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TRIPLE EXPANSION ENGINE FOR ELECTRIC LIGHTING PURPOSES.



General View.

TRIPLE-EXPANSION ENGINE FOR ELECTRIC LIGHTING PURPOSES.

The accompanying illustration represents a vertical triple-expansion engine of somewhat novel construction, designed by Mr. S. Wilcox, of the Babcock & Wilcox Company, and A. Goubert, of New York, for electric lighting purposes. The engine has four working cylinders; the two low pressure ones, 33in. diameter, are single-acting, and have fixed above them the high and intermediate pressure cylinders, 13¼in. and 21in. diameter respectively, both of which are double-acting. The admission and exhaust ports of the high-pressure and intermediate cylinders are controlled by piston valves admitting steam at the centre and exhausting at the ends. The steam, prior to its admission into the intermediate and low-pressure cylinders, passes through receivers. Corliss valves are provided for regulating the supply and exhaust in the low-pressure cylinders. The engine has a stroke of 21in., and when running at 200 revolutions per minute, with steam at 160lb. per square inch, it is capable of developing 500 brake h.p. The valve mechanism is arranged internally. The governor, attached to the crank-shaft, has been ingeniously devised, so that while the balls are perfectly free to move the eccentric under normal loads and conditions, the resistance of the valve mechanism cannot react through the eccentric to move the balls. As will be seen from the illustration, the moving parts are encased, light doors being provided in order to enable the attendant to get at the moving parts. The doors are large enough to allow of the removal of the low-pressure pistons. The total height of the engine is 14ft. 4in., and the floor space occupied outside of the fly-wheels is 15ft. by 7ft. 2in. We are indebted for our illustration to our American contemporary, *Power*.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 26th May, 1891.

The Iron Market.—The general demand continues to be good, and prices are well sustained. Bars are quoted at 140s. 6d., and joists at 148s. 6d. per ton, but much business is transacted at rates from 3 to 4 per cent. below these prices. Old iron rails command 84s. 6d., and castings 112s. 6d. per ton. A great deal of the iron lately brought into Paris comes from the eastern districts, instead of, as heretofore, from the northern. This may in part be accounted for by the reductions in railway rates, and the more economical production of the metal in the first-named districts. It is announced that the Minister of Public Works has invited tenders for rails, sleepers, fishplates, &c., for the Corsican railways, amounting in all to over 3,000 tons of material. All the works around Paris are very busy, especially those constructing railway rolling stock, for which the demand this year is unusually great. The shops making a specialty of small descriptions of work, of which there are many in Paris, have also a fair amount of orders on hand, emanating to a great extent from the War Office and Admiralty. It is reported that several blast furnaces will shortly be established near Cherbourg in connection with the Diélette mines. In the North prices are very firm, with a strong tendency to rise. The temporary stoppage, owing to the strikes, of some of the Belgian works has undoubtedly helped to strengthen the market here. Best bars are quoted at 120s. 6d. to 124s. 6d. per ton; joists vary from 124s. 6d. to 128s. 6d., according to width of flanges; puddled sheets of 3mm. and upwards, 140s. to 144s.; below 3mm. in thickness, 148s. to 152s. 6d. per ton. Steel plates are 160s. 6d. to 168s. 6d., and boiler plates from 160s. 6d. to 209s. per ton, according to quality. A general meeting of the Syndicate of the Eastern Districts Metal Trade is to be held on the 30th inst. at Montbéliard. There is a fair amount of business doing in the Haute-Marne district, where prices for bars vary from 124s. 6d. to 128s. 6d. In the Ardennes much discontent is prevalent amongst the workmen, who demand an increase of wages varying from 15 to 50 per cent.; the hands at several of the works in this district are on strike, otherwise the situation is satisfactory, there being plenty of orders on hand. From the Meurthe-et-Moselle, Loire-et-Rhône, and other districts, report speaks well of the state of the iron industry, which at present appears generally to be in a better condition in France than in most other countries.

Coal.—The state of the coal trade is very good; the strikes in Germany and Belgium have caused orders to flow in more abundantly than ever. No augmentation of prices seems probable, but there is no doubt that the present quotations will be maintained for a long time to come.

Copper, Tin, Lead, and Zinc.—The following were the official quotations on the Paris market during the past week for copper:—Best Chilian bars, £56 10s.; ordinary Chilian bars, £54 10s.; Chilian ore in plates and ingots, £56 10s.; and best selected, £58 15s per ton. Tin has undergone an augmentation in price of 20s. a ton on English, and 40s. a ton on other marks. The prices quoted were:—Banca, £101 16s.; Billiton, £99 16s.; Detroits, £98 16s.; and Cornwall, £103 6s. There has been no change in the price of lead, but zinc has improved slightly in value, and raw Silesian was quoted at £25 3s. per ton.

BERLIN, 25th May, 1891.

Import and Export of Iron.—The import of pig iron into Germany during the month of March showed a considerable falling off, which may be accounted for partly by inactivity of trade in Germany, and partly by the fact that Great Britain has little surplus of iron, and that the stocks in that market are steadily diminishing. In the first quarter the import of pig iron amounted to 39,580 tons, against 88,000 tons in the corresponding period of the previous year. The returns for March were made more favourable through the business in rails, of which 4,288 tons were sent to the Netherlands, 5,244 tons to Switzerland, 3,240 tons to Roumania, and 4,934 tons to this district, whilst the export of pig iron was nearly equal to that of last year—viz., 31,273 tons. The export of wrought was very much higher than for some time previous, 1,102 tons being despatched to Italy, 2,006 tons to the Netherlands, 1,589 tons to Roumania, 2,140 tons to Russia, 1,570 tons to Switzerland, 1,515 tons to the United States, and 3,615 tons sent here for other countries. 1,227 tons of wrought iron were despatched to British India, which has hitherto been regarded as an exclusively English market; 135 tons of wire nails, and 89 of hardware were exported from Germany to British India. The export of wire, though fairly satisfactory, was not so large as that during February, which amounted to 15,756 tons. During the first quarter the export of iron wire amounted to 39,576 tons, against 29,767 tons in the previous year. Although this amount is below the average, there is at least a temporary stoppage of the decrease which occurred during last year. During the first quarter 10,496 tons of wire nails were despatched against 8,976 tons in the previous year.

Manufacture of Explosives.—The smokeless powder made according to Nobel's discovery by the Nobel Dynamite Trust Company has been already produced in sufficient quantity for experimental purposes. Extensive works have been erected for producing it in considerable quantities. After the contracts with certain works for the supply of nitro-glycerine had expired at the end of 1890, the company entered into new contracts with other companies. According to the present supply of orders, a good business year may be anticipated. For a long time past the Rhenish-Westphalian dynamite works have been slackly employed, as the demand from South America, especially from Chili and the Argentine Republic, has fallen off, owing to the unsettled state of affairs.

The Coke Industry.—Ninety new coke ovens are to be built this year, in addition to the sixty already existing, at the Egmont Mine, near Fellhammer, in Waldenburg (Silesia), and a chain railway is to be laid between the Egmont and Mayran pits.

Trials of Cement.—According to experiments recently carried out at Moscow, in order to compare the strength of Russian and German cement, it was shown that Russian cement had a strength of 3,000lb. to 4,500lb. per square inch, and Stettin Portland cement from the Delbruck manufactory had a strength of 5,250lb. The trials were made on cement which had been laid two years ago.

VIENNA, 25th May, 1891.

The Iron Market.—After a long period of inactivity, the Austro-Hungarian iron market shows signs of improvement. This may be attributed to the building season being now at its height. The home market is now in a more favourable condition as compared with the foreign market. The rolling mills are well employed at remunerative prices. Iron for building and constructive purposes is in brisk demand, and manufactories of plate and sheet iron are doing a fair business. There has been an advance in the price of tin of 3s. 10d. per 100kgr. The State Railways Company held its general meeting last week, and the report as to its mining works was very satisfactory. The company's coal mines at Brandeisl made an output of 1,165,000 tons, and there was a net profit of £66,295 9s. The iron works of Reschitza and Annina produced 98,285 tons of ore, the largest output yet recorded, and 75,600 tons of pig iron, against 59,000 tons in the previous year. The iron and steel works produced 39,615 tons, an increase of 4,418 tons, and the rolling mills produced 22,000 tons. The profit of this section of the company's works amounted to £81,601. Last year the Vicanna machine works of the State Railways Company built 62 locomotives and 155 waggons, and made a profit of £42,796 12s. The company will pay a dividend of 16s. on each share of £19 8s.

Traffic on the Austrian Railways.—Statistics have been published comparing the traffic in the year 1863 with the traffic in 1890. In 1863 each passenger carriage carried 4,326 persons on an average, but in 1890 it carried 7,063 persons, an increase of 63 per cent. Each goods waggon in 1863 carried 375 tons, but in 1890 it carried 874 tons, an increase of 133 per cent. The following table gives the results for each railway:—

Railway.	Number of Carriages. 1863.	1890.	Increase per Cent.	Passengers (thousands). 1863.	1890.	Increase per Cent.
Northern	386	728	88	1,864	5,783	210
Carl Ludwig ...	104	345	241	329	1,272	286
North-Western	88	122	39	293	1,044	256
WestBohemian	80	108	35	279	788	182
Aussig-Teplitz	20	94	370	161	1,370	751
Bustichrad ...	18	224	1,144	85	1,193	1,303

Railway.	Number of Goods Waggons. 1863.	1890.	Increase per Cent.	Tons (thousands). 1863.	1890.	Increase per Cent.
Northern	5,576	14,106	153	1,647	9,569	481
Carl Ludwig ...	1,484	3,811	157	255	1,407	490
North-Western	480	1,342	179	206	1,368	564
WestBohemian	800	1,439	80	219	1,811	727
Aussig-Teplitz	195	4,784	2,353	390	7,300	1,771
Bustichrad ...	246	5,219	2,021	581	5,296	812

It is evident from these figures that the home establishments for the loan of waggons are doing a prosperous business, and are beginning to increase their stock of waggons, as they ought to have done some time ago, instead of increasing their profit. On comparing the year 1889 with 1890, there is an increase of 17 per cent. on the passengers and 7 per cent. on goods on the Austrian railways. The total rolling stock was as follows:—

	1889.	1890.
Locomotives	3,518	3,732
Tenders	2,862	3,045
Passenger carriages ...	7,269	7,687
Goods waggons	81,630	87,072

BRUSSELS, 26th May, 1891.

The Iron Market.—The disturbed condition of affairs prevents any recovery in the market, and there are few new orders. Constructive works alone are fairly well employed. There is some demand for joists, but not to the extent which is usual at this season. The strikes have been stopped owing to the action of the Central section in Parliament, and there is an evident recovery of the iron and coal market in the districts of Liége, Charleroi, and Mons. There are no important alterations in prices. Joists are quoted at £5 4s.; angles, £5 6s.; sheets—No. 2, £6 4s.; No. 3, £7; No. 4, £9 12s.; foundry pig iron—Luxembourg No. 3, £2 4s. 9d.; Charleroi, £3 6s. 5d.; forge pig, £2 1s. 6d.; red-short iron, £1 19s. 2d. Steel rails, heavy sections, £5; small sections, £5 14s. The Belgian Government is about to award contracts for about 200 railway sidings, at an average price of £13 2s., and 200 crossings, at £9 6s.

The Coal Market.—The stoppage of the production has caused a rise of prices, which has, however, been checked by the import of coal from abroad. Stocks are now almost exhausted, and prices remain as follow:—Coke, 14s. 5d.; small sorts, 9s. 7d.; close burning coke, 8s.; lump coal, 9s. 7d.; steam coal, 11s. 2d.; household sorts, 16s. to £1 1s. 7d. The contract for the supply of coal to the Brussels gas works will be awarded on the 27th inst., the annual consumption of coal amounting to 90,000 tons, with a value of £80,000. Notwithstanding the fact that the town authorities have recently placed an order for 30,000 tons of coal with English merchants, it seems probable that they will continue to invite foreign competition, as they have drawn up conditions of tender with that object. Belgian coal merchants have agreed to demand a remunerative price, which will probably be approved by M. Aerts, the general manager of the gas works.

The Glass Trade.—Attempts are being made by manufacturers to obtain remunerative prices, and a meeting will be held this week in order to come to some agreement. There is some improvement in the demand for imported glass. Prices remain firm without alteration. The market for plate glass is unaltered. There is a fair supply of orders, but no strong demand. The furnaces on the Wilson system are coming into use in the glass districts. These furnaces are intended chiefly for the use of coal of inferior quality. Their management is easy, but it is necessary to regulate the supply of air in order to mix the fuel properly.

Electric Lighting.—The scale of charges for the electric lighting of Brussels is about to be published. This scale has been carefully drawn up by M. Wybauw, who has visited some of the principal towns which are lighted electrically. M. Van Rysselberghe is still trying to bring forward his scheme for the electric lighting of Antwerp, and has obtained the assistance of some eminent engineers. M. Backeljan, however, the chief government engineer in that town, has worked out a scheme for utilising the tide of the Schelde as a motive power in order to provide Antwerp with a system of compressed air at a pressure of six atmospheres, and has asked for a concession similar to that already granted to the Popp system at Paris.

Lavoisier's Medal.—The Société d'Encouragement pour l'Industrie Nationale has awarded its gold medal to M. Solvay for his share in the development of the ammonia soda industry. This medal is only awarded in each sixth year, Ste. Claire Deville, Weldon, and Michel Perret being former recipients. The distinction is the greater as Schloesing, who is usually regarded by the French as the discoverer of this process, is himself a member of the committee.

DÜSSELDORF, 26th May, 1891.

The Iron Market.—The production of pig iron in Germany during the month of April amounted to 354,350 tons. The amount of puddled iron and spiegel iron was 141,321 tons; Bessemer iron, 33,815 tons; Thomas iron, 134,226 tons; and foundry pig iron, 44,988 tons. From January 1st up to April 30th, 1891, 1,404,383 tons were produced. Prices were as follow:—Spiegel iron, £2 17s. 9d.; puddled iron, £2 11d. 11d. to £2 12s. 11d.; Luxembourg iron, £1 19s. 2d.; foundry iron, No. 3, £2 7s.; bar iron, £6 12s. 2d.; ordinary plates, £7 2s. to £7 11s. 9d.; boiler plates, £8 6s. 6d. to £8 11s. 4d.; thin sheets £6 17s. to £7 6s. 11d.

The Coal Market.—In the Rhenish-Westphalian coal market there is a firm and continuous demand, and new orders have ceased to be received at the mines, since the mines are in arrear in working off outstanding orders. The forwarding of coal is proceeding satisfactorily everywhere. Prices are as follow:—Gas coal, 11s. 9d. to 13s. 9d.; coal for coke, 8s. 10d. to 9s. 4d.; lump coal (small), 15s. 8d. to 16s. 8d.; foundry coke, 15s. 8d. to 17s. 8d.; blast furnace coke, 12s. 9d. to 13s. 9d.

Underground Railway in Berlin.—Mr. Poetsch, the eminent mining engineer, has brought forward a project for an underground railway in Berlin. He intends to excavate the sixty entrance shafts by the application of the freezing process invented by himself.

Railways in Germany.—According to statistics recently published the length of the German railways in the year 1889 amounted to 41,793 kilometres, of which 24,968 were in Prussia, 5,421 in Bavaria, 2,380 in Saxony, 1,500 in Wurtemburg, 1,432 in Baden, 1,472 in Alsace-Lorraine, and 4,620 in the other German States.

AMSTERDAM, 25th May, 1891.

A Dutch Exhibition in London.—The success of the various international exhibitions held in the Metropolis during the last few years has suggested the idea of a Dutch Exhibition, and a committee is now considering whether the scheme be feasible.

New Steamer.—The Royal Steamboat Company at Rotterdam has just had completed for its passenger service up the Rhine to Mannheim a new steamer, the "Wilhelmina." It is of the saloon type, and has been successfully launched off the yard of Messrs. Fop Smit, at Kinderdijk.

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THE TIN TRADE.—The Produce Clearing House at Rotterdam has introduced contracts registration for time bargains in tin, either at Rotterdam or at Amsterdam. Quotations will be settled daily at 2.45 p.m. Four different contracts will be filed, one for delivery of Banca, the second for delivery of Blitong, the third for delivery of Straits tin, and the fourth for delivery of either at the option of the seller. Contracts are for 300 blocks of Banca and Blitong tin, for 10,000kgr. in the case of Straits and combined lots.

THE NEW STEAMBOAT SERVICE BETWEEN HOLLAND AND ENGLAND.—The existence of the Zeeland Steam Navigation Company—which must not be mistaken for the Zealand Steamship Company, whose steamers ply between Queenborough and Flushing—is now fully assured, and the whole capital has been amply subscribed. The service between Flushing and Hull will probably commence on the 1st day of January next. The steamers are being built at Messrs. Dobson's yard in Newcastle-upon-Tyne. Each will have a capacity of about 800 tons, and will be fitted with triple-expansion engines, capable of producing an average speed of more than 11 knots an hour.

NEW INDUSTRIAL REVIEW.—The "Arti and Industriæ" Association of the Hague has decided to publish a quarterly review for the promotion of the interests of industrial art in Holland.

STOCKHOLM, 23RD MAY, 1891.

EXPORTS OF WOOD PULP.—The exports of wood pulp during the first four months of the present year are the heaviest on record. They amount to—

Chemical wood pulp, dry.....	7,346,000	kgr.
Chemical wood pulp, wet ...	3,132,000	"
Mechanical wood pulp, dry ..	7,222,000	"
Mechanical wood pulp, wet ...	4,072,000	"

as compared with an aggregate of 18,437,000kgr. during the same period of 1890, 14,314,000 kgr. in the same period of 1889, and 8,110,000kgr. in the same period of 1888. The exports of matches amounted to 4,295,000kgr., against 3,686,000kgr. in the same period of 1890, 4,109,000kgr. in the same period of 1889, and 3,869,000kgr. in the same period of 1888. The exports of timber were, on the whole, decreasing, as compared with the corresponding figures for last year.

SHIPBUILDING.—The steamer "Wasa" has been thoroughly overhauled at the Finnboda slip, only the old hull, engine, and boiler remaining. The steamer is 183ft. long and 25ft. broad. There is now accommodation for 115 first and second class passengers, of whom 70 are first class. The steamer is intended for the Stockholm, Helsingfors, and St. Petersburg trade. The steamer "Norra Sverize" has been thoroughly repaired at the Bergsund shipyard.

NEW WARSHIP.—The Swedish Government has accepted the tender of the Bergsund Engineering Company for the building of the new warship "Thule" for a sum of £73,611. Offers had also been received from the Matala and the Kockum Engineering Companies, but the tenders from these two firms were at least £5,555 above the one accepted.

CHRISTIANIA, 23RD MAY, 1891.

NEW PAPER MILLS.—The low prices which have for some time ruled on the wood pulp market have led to the erection of manufactories for the further handling of this raw material, more especially for paper making. Another new paper mill is the one projected at Embretsfos, fifteen miles from Drammen, which seems naturally well adapted for cheap paper manufacture. There is an ample supply of timber for wood pulp, and it can be floated direct to the works. There is plenty of water power both for the wood pulp and the paper manufactory, and a dam has been built across the river, having a length of 164 yards and a height of 11 yards. The river carries a volume of water equal to 2,380 cubic yards per second, and, owing to the building of the dam, there is now a direct fall of 17ft. The timber can now be floated straight to the works, entailing an annual saving of £1,100. The present wood pulp manufactory has nine turbines and eight grinding appliances, capable of turning out the very finest wood pulp. The present production is sufficient for two large paper making machines. The annual production of paper for newspaper is estimated at 5,000 tons, and the capital of the new company will be £83,333.

THE NLEFOS-STREUGEN CANAL.—As the works proceed on this important canal, it becomes evident that the original estimate of cost was altogether faulty. In addition to £38,888, by which the estimate had to be increased some time ago, there has been a further increase of £27,555. The cost is expected to amount to £152,000.

MADRID, 25TH MAY, 1891.

AMALGAMATION OF SPANISH RAILWAYS.—The amalgamation of railways causes much excitement, and the question whether there is to be a period of hostility with regard to tariffs on the railway systems controlled by the Rothschilds and the Pereires is much discussed. Possibly there may be an amalgamation of all the Spanish lines. The Government is able to put a veto on the present proposals, as the terms of the concessions do not admit of amalgamation without the consent of the Government. It seems unlikely that the Government would refuse such a demand on the part of the Rothschilds.

THE HERRERIAS SILVER LEAD MINES.—Active progress is being made with the installation of powerful pumping plant for the purpose of clearing the mines in this district of water. Work has been stopped for some years past through the flooding of the mines, and it is expected that the mines will be again in working order in the course of two or three months.

ELECTRIC CABLE TO PORTO RICO.—The laying of an Atlantic cable between Spain and the island of Porto Rico is again under discussion. The Minister for Colonial Affairs has stated in the Cortes that he is considering the conditions on which to invite tenders. It seems that some new cable manufactory has made a proposal with reference to this matter. The contract will not, however, be awarded without an opportunity of competition being given to firms of sufficient standing.

MAIL SERVICE TO THE CANARY ISLANDS.—The fortnightly postal service to the Canary Islands has been given to the Barcelona Company, which has had the contract for some years past. There is a yearly subvention of £9,600. A new steamer of 1,300 tons, with a speed of 11 knots, is to be placed on the service, together with a steamer of 1,100 tons.

LABOUR MOVEMENT AT BILBAO.—After an agitation which lasted for some days, the whole of the miners are now quietly at work again. They seem to have felt that it was against their interests to strike during the period of depression which is affecting the shipments of iron ores. It is stated that the export of Bilbao ore has declined fully one-third during the first four months of this year, as compared with the corresponding period of last year.

FIRE AT THE NERVION SHIPBUILDING YARD.—The sum of £65,000 has been paid by the insurance company in settlement of the damage done by the recent fire in this shipbuilding yard. It seems evident that Sir Charles Palmer is still connected with this business, as he visited Bilbao in order to make arrangements rendered necessary by the fire.

ROME, 25TH MAY, 1891.

MINING IN THE PROVINCE OF CAGLIARI.—During the year 1890 the mines in active operation were 86, of which 75 were lead, zinc, and silver, 2 manganese, 3 antimony, and 6 coal, lignite, &c. The output of these mines in 1890 was in excess of the production of the preceding years, for whilst the total output in the previous campaign had been 144,882 tons, value £666,849, that of 1890 amounted to 149,146 tons, valued at £822,677, thus showing an increase of £155,828 in favour of 1890. This increase is principally due to the greater and more extensive production of zinc (or calamine) ore, antimony, silver, and coal. At the mines 10,301 miners and workmen were employed, of whom 9,479 were males and 822 females.

SALT IN SARDINIA.—The product of the salines in Sardinia amounts to an average of about 115,000 tons per annum, but the quantity of salt made in 1890 was much below the ordinary average owing to bad weather. In the course of 1890 there were 71,278 tons of salt shipped to foreign ports, and 58,874 tons were sent to Genoa, Naples, Leghorn, &c., on account of the Government. By persons who have some experience in the salt trade it is believed that by the fact of the company, which has the working of the salines having undertaken to furnish yearly—from 1891—95,000 tons of salt to the Italian Government, there will arise some little difficulty in obtaining the salt for foreign demands, especially in the year when there is a bad crop; this inconvenience, however, might be avoided by enlarging the area of the salines, and thus increase the product.

ZURICH, 26TH MAY, 1891.

A NEW CENTRIFUGAL FAN.—Mr. Carl Wenner, of this city, has just brought out a new compound centrifugal fan for delivering a high-pressure blast. It consists of three fans, each provided with an annular series of vanes, and mounted so that each series revolves independently of the other and in the same direction about a common axis, but the different series rotate with different angular velocities, which are so related that their circumferential speeds are about equal.

NEW ALPINE RAILWAYS.—A concession has been applied for to enable a railway to be constructed up the Matterhorn, to consist of three sections. Another Alpine railway proposed is the Government Railway, which is a combination of a wire-rope line and rack railway, and is to lead from Riffelalp-Riffelberg to the summit of the Gornergrat (10,286ft.). A third Alpine railway planned in the Canton of Wallis is the Lauterbrunnen and Visp Railway, specially intended for tourists.

UTILISATION OF THE WATER POWER OF THE RHÔNE.—As is well known, the water power of the Rhône is being largely utilised for industrial purposes in the neighbourhood of Geneva. Colonel Turettini, chief engineer of the St. Gothard Tunnel, who carried out the works, has recently issued a report as to the state of the work. The canal on the left bank is provided with 20 turbines, working up to 4,400 h.p. During the past year 216 motors, totaling 1,565 h.p., have been driven from the works. The smallest, of ½ h.p., have been used to run sewing machines, while the largest (625 h.p.) has driven the electric light installation for the town of Geneva.

NEW YORK, 16TH MAY, 1891.

NICARAGUA CANAL.—The party of engineers, including Mr. Warner Miller (president), Mr. Menocal (chief engineer of the Nicaragua Canal), and about twenty engineers and scientists, which went to Nicaragua in April, 1890, to make a thorough investigation of the entire line and to inspect the work already done, returned to New York on the 6th inst. on the United States gunboat "Petrel." The result of the investigation of the line and the work done was entirely satisfactory, and all are thoroughly convinced of the feasibility of the enterprise. The work done is confined principally to the harbour of Greytown, where a breakwater extending 1,000ft. into the sea has been built, so that now there is a depth of water of 14ft. in a locality which was formerly entirely blocked by a bar. The line of the canal has been cleared of the dense vegetation which covered it from Greytown over a distance of ten miles. The company has six large dredges, two of which are at work, and three others will be ready in a short time. The canal has been excavated to a distance of half a mile, with a width of 270ft. and depth of 17ft. The depth is to be increased to 30ft., which is the proposed depth of the canal. A railroad for the transportation of men and machinery has also been constructed parallel with the line of the canal for a distance of ten miles, so that work may be carried on simultaneously at different points along the line. In addition, machine shops and storehouses, docks and wharves, fifty buildings, including offices and quarters, have been built by the company. Mr. Miller expresses himself thoroughly satisfied as to the ultimate success of the enterprise, and believes that the cost will be less than the estimates given.

ARMOUR PLATE EXPERIMENTS AT ANNAPOLIS.—The three days' tests of armour plates at the naval proving grounds have been completed. Three kinds were tried—Harvey nickel, nickel and steel, and steel plates. The steel plates were shattered, the nickel and steel perforated, but the Harvey nickel plates pulverised the projectiles, and were not punctured at all. Each plate had twenty 6lb. projectiles from a Hotchkiss gun fired at it at a distance of 35ft., striking the plate at a velocity of 1,800ft. per second.

RAILROADS.—The big train shed of the Pennsylvania Railroad at Jersey City will be completed in a few days. The span of this shed is 256ft., which exceeds that at St. Pancras, in London, by 17ft. About 6,500,000lb. of iron were used in its construction.

PHILADELPHIA, 15TH MAY, 1891.

BRIDGE BUILDING.—The Philadelphia Bridge Works of Messrs. Cofrode & Taylor, at Pottstown, have recently received a number of large orders. The company is about to build twenty girder and truss bridges on the Port Reading extension of the Philadelphia and Reading Railroad; three large plate girder bridges for the Rome, Watertown, and Ogdensburg Railroad, recently purchased by the New York Central; and three bridges, two of which are to have six tracks, for the Central Railroad of New Jersey. The company has also received orders for new bridges at Trenton, N.J., for the Pennsylvania Railroad, and for a large iron machine shop at Jersey City.

NEW SYSTEM OF ELECTRIC TRACTION.—The Weddell-Enty system of storage battery traction has been tried on the Lehigh Avenue Passenger Railway in this city. The storage battery, which was invented by Messrs. Enty & Phillips, of New York, is radically different from the lead battery of Planté and Faure. The cell consists of a sheet-iron box lined with tin, into which is placed a finely perforated sheet of iron also lined with tin and bent in such a way as to make eight or ten cells. Into this are placed sheets formed of braided copper wire, the interstices of which are filled with oxide of copper. These sheets are coated with a porous coating of cotton to insulate them from the sheet-iron cells into which they are placed. The fluid used in the cells is called "zincate of potash," and is made of the oxides of zinc and potash. A number of zinc plates are then placed in the box. The poles of the battery are the iron box and the copper plates. The first action which takes place when the battery is set up is the reduction of the copper oxide into metallic copper which is of a spongy nature, the oxygen attacks the zinc and the solution is strengthened. When a current of electricity is passed through the cell the solution is decomposed and the action is reversed, depositing metallic zinc on the sheet-iron plate and re-oxidising the spongy metallic copper. On discharging the zinc is again oxidised at the expense of the copper, and thus the secondary current is produced. The cells have a capacity of 500 ampere hours, and each cell weighs 30lb., 100 being required to propel a car at any ordinary speed. An efficiency of 80 per cent. is claimed for this form of storage battery. The dynamo and motor used in the Weddell-Enty system are of the multipolar type, the armature enclosing the field magnets.

DISCOVERY OF A NEW COAL FIELD.—A vein of anthracite coal, 6ft. thick, has been discovered on the Cook Farm, which geologists have claimed to be outside the coal belt. The Lehigh Valley Railroad, which is at present being built towards Dunshore, passes near the new coal field, and another line which has been surveyed also passes close to the Cook Farm. Tunnel Colliery, one of the first to be opened, and one of the oldest in the anthracite region, has been entirely worked out. Until recently, it was one of the most important in the region, employing 200 men and shipping 60 cars per day.

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THE "STANLEY" BOILER.

DESIGNED BY MR. H. B. BUCKLAND, ENGINEER, NEWCASTLE-ON-TYNE.

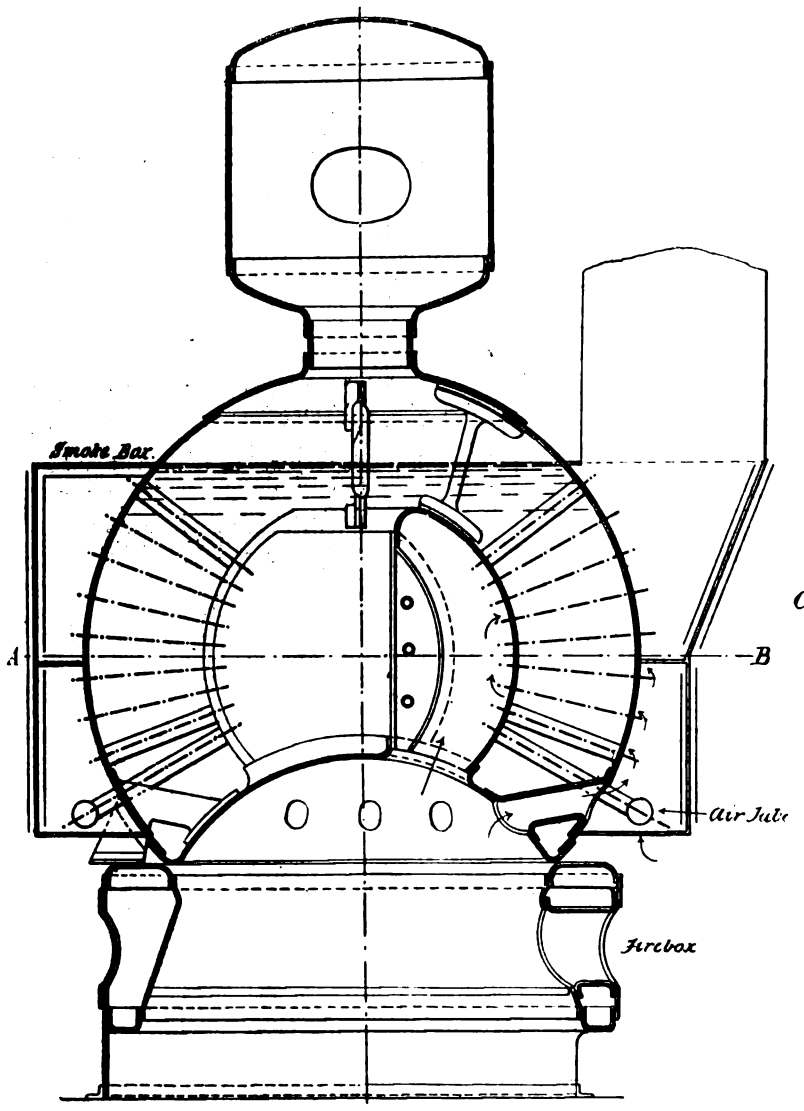


FIG. 1.—SECTIONAL ELEVATION OF BOILER.

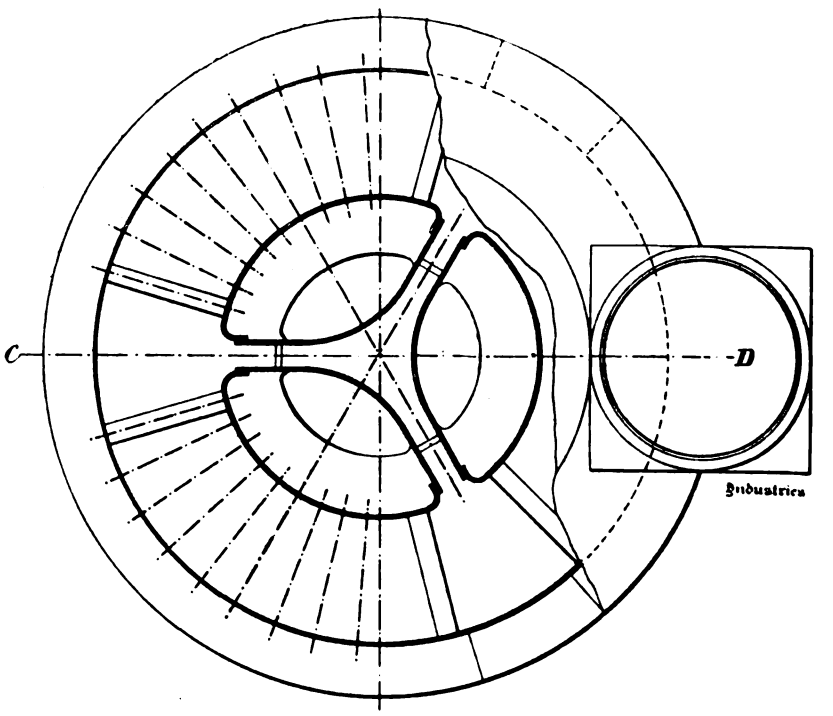


FIG. 2.—SECTIONAL PLAN THROUGH *A B*.

THE "STANLEY" BOILER.

IT is the opinion of many engineers that not much additional progress will be made in marine engineering until a decided advance has been made in the design of the steam generator. With the ordinary multitubular circular boiler the limit of working pressure appears to have been about reached. In fact, to construct boilers of the ordinary design of and over 200lb. working pressure, either the boilers must be small in diameter or excessively heavy in their scantlings. It is not, therefore, surprising to find that attempts are being made to introduce new designs. Most of these do not get beyond the "proposed" stage, but to this the "Stanley" boiler, designed by the patentee, Mr. H. B. Buckland, of Newcastle-on-Tyne, of which we give illustrations in Figs. 1 and 2 above and in Fig. 3 on page 513, is an exception. It will be seen that the "Stanley" boiler is spherical, the lower portion being reversed to form the crown of the furnace, the combustion chambers, three in number, taking away direct the greater part of the gaseous products and passing them through the upper tubes into the smoke boxes, and hence to the funnel. Large lower tubes are also provided in the lower portion of the boiler to take away part of the gases, which are returned through the ordinary tubes into the combustion chamber. The sides of the furnace and bottom are a distinct structure, so that the boiler has practically a "dry-bottom," the lower water spaces forming a feed-heater, any steam generated passing direct through piping to the steam dome or receiver. This arrangement is claimed to be very advantageous, as the sediment deposited in boilers is often mischievous in its action, and in the "Stanley" boiler, as all the feed-water is first passed into the lower structure or foundation of the boiler proper, no deposit is likely to be made in the latter, and it will be much more economical to renew the foundation portion of this boiler than to effect repairs to an ordinary marine boiler injured by overheating of plates, or by pitting, due to feed-water deposits. In any case, it is probable that the longevity of the main portion of the Stanley boiler will exceed that of the present type of marine boilers.

On the 21st inst. the first of these boilers was subjected to an experimental trial, under the supervision of Mr. B. G. Nichol, Newcastle-on-Tyne, in the presence of a number of engineering experts, including representatives of Lloyd's Register of British and Foreign Shipping and of the British Admiralty. Our illustrations represent this boiler, which is 14ft. 3½in. high, 7ft. 6in. diameter, or 8ft. 10¾in. diameter to the outside of the smoke boxes. It contains 252 tubes 2¾in. external diameter, 1ft. 7½in. long, 84 tubes being fitted to each of the combustion chambers. To each of the latter there are also fitted three tubes for admission of air, each being fitted with an apparatus for regulating the quantity admitted. The furnace was bricked round, reducing the diameter of the fire-grate to 4ft. 3in., equal to an area of 14·18 square feet. The chimney, 2ft. 6in. in diameter, 26ft. 4in. high above the fire-bars, is common to all the combustion chambers. The boiler has been constructed by Messrs. J. Eltringham & Co., Stone Quay, South Shields, to the designs of Mr. Buckland, and is constructed for a working pressure of 85lb. per square inch, and has been tested by hydraulic pressure to 170lb. per square inch. The experimental trial was, to suit the convenience of visitors, of short duration—viz., 1⅓ hours—and was primarily for the purpose of testing the amount of evaporation that could be obtained in a given time. The results as to economy of fuel were, as will be seen, not unsatisfactory, having in mind that the boiler was unlagged and not under cover. The trial was carefully carried out; the water was measured by meter; the temperature of the feed (52° Fahr.), taken at frequent intervals, not varying; and the fuel (Davison's West Hartley coal) carefully weighed. The level of water and the condition of the fires was the same at the beginning and conclusion of the trial. The steam evaporated escaped freely into the atmosphere, no pressure being shown on the gauge, and in 1½ hours 4,210lb. of water was evaporated and 537lb. of coal consumed. This is equal to 2,806lb. of water and 358lb. of coal in one hour, or 7·84lb. of water per 1lb. of coal equal to 9·14lb. of water per 1lb. of coal from and at 212° Fahr. The coal actually used was not analysed, but an analysis of coal from the same colliery is as follows:—

Carbon	81·5
Hydrogen	5·2
Nitrogen	1·5
Oxygen	6·2
Sulphur	1·1
Ash	4·5
Total	100·0

This analysis gives a theoretical efficiency of 15·115lb. of water per lb. of coal from and at 212° Fahr.

Reverting to the actual results obtained, it will be found that 197·81lb. of water were evaporated per foot of grate surface and 25·24lb. of coal per foot of grate surface was consumed in one hour, which is in excess of results with ordinary marine boilers under ordinary conditions. The weight of the boiler, including funnel, fire-bars, and mountings, is 7½ tons, weight of water nearly 4 tons, whereas the weight of any ordinary marine boiler of 9ft. 9in. by 9ft., about equal in efficiency, is 12 tons, for the same pressure of steam. At the ordinary pressure for triple-expansion engines—160lb. per square inch—Mr. Buckland estimates that the actual weight of a "Stanley" boiler, without water, and of the same size as that already constructed, would be 8½ tons, whereas an ordinary marine boiler of equal efficiency would be about 17 tons. Probably before long something definite will be known as to the behaviour of Mr. Buckland's boiler at sea, as the one we now describe and illustrate is to be fitted in the steamer "Napier," owned by Messrs. Jas.

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Wait & Co., Newcastle-on-Tyne, as an auxiliary boiler, being connected to the main engines, and taking the place of the donkey boilers.

Some of the questions to be solved are, Will the boiler prime? is there sufficient steam space? and will the relatively small top surface of the water not lead to considerable ebullition? It appears probable that Mr. Buckland is working in the right direction, and with experience minor improvements will suggest themselves. At the conclusion of the brief evaporation trial the safety valve was set to 70lb., and without forcing the fire this pressure was obtained in twenty minutes, steam having appeared prior to the trial in seventy minutes from starting the fires, so that an hour and a half sufficed to raise steam of 70lb. pressure.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, May 29th, at 9 p.m. Lecture on "An Astronomer's Work in a Modern Observatory," by Mr. David Gill, F.R.S. Saturday, May 30th, at 3 p.m. Lecture on "The Scientific Study of Decorative Colour," by Professor A. H. Church, F.R.S.

BALLOON SOCIETY.—Friday, May 29th, at 8 p.m. Lecture on "Smokeless Fuel," by Mr. J. Coley-Bromfield.

NEXT WEEK.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, June 1st, at 8 p.m. Papers to be read: "Gum Arabic and its Modern Substitutes," by Dr. S. Rideal and Mr. W. E. Youle; "On the Quantitative Analysis of Light and Colour, founded on the Tintometer Colour Scales," by Mr. J. W. Lovibond.

SOCIETY OF ENGINEERS.—Monday, June 1st, at 7.30 p.m. Paper to be read: "Portable and Pioneer Railways," by Mr. John Kerr.

PRICES CURRENT, 27TH MAY, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 10 0	.....	7 0 0	London.
" Angles	6 12 6	.....	7 2 6	"
Crown Sheets	7 0 0	.....	7 10 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			7 5 0	"
" Ship and Girder			6 10 0	"

PIG IRON.

Middlesbro' Warrants, No. 3		41/10½	Cash.
Scotch Warrants, m/n		53/9	"
Hematite Warrants, m/n		53/3	"
Stocks in Stores. Scotch	511,246—Inc. for week	1,949	Tons.
Middlesbro'	121,864—Inc. "	3,326	"
Hematite	143,397—Dec. "	2,827	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	63/-	.....	57/-	f.o.b. Glasgow.
Gartsherrie	60/-	.....	56/-	" "
Summerlee	60/6	.....	56/-	" "
Langloan	62/-	.....	57/-	" "
Glengarnock	61/-	.....	53/-	" "
G.M.B. ex store	53/9	.....	53/9	" "

METALS.

Spelter: Ordinary	£24	10	0	to	24	15	0
Copper: British Cakes and Ingots	56	10	0	"	57	10	0
" Chili Bars, G.O.B.'s	53	15	0	"	54	5	0
" Other sorts, G.M.B.'s (equal to Chili Bars)	53	15	0	"	54	5	0
" Manufactured (strong)	64	0	0	"	64	10	0
Lead: Common Pig	13	7	6	"	13	10	0
" English Sheet	14	2	6	"	14	5	0
Tin: Straits	91	10	0	"	92	0	0
" Australian	.....				.....		
" English Ingots	96	0	0		.....		

THE "STANLEY" BOILER.

DESIGNED BY MR. H. B. BUCKLAND, ENGINEER, NEWCASTLE-ON-TYNE.

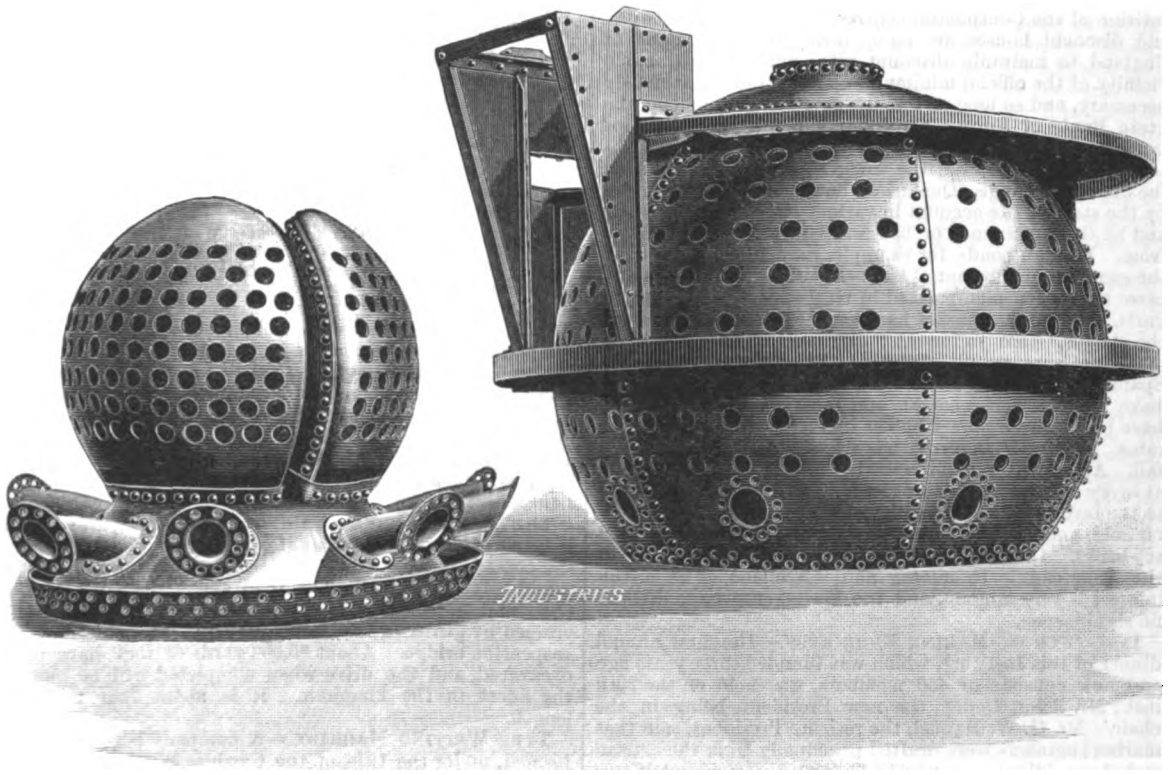


FIG. 3.—VIEWS OF COMBUSTION CHAMBERS AND SPHERICAL SHELL.

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER has shown a decidedly stronger tone during the past week. Chili bars have advanced considerably, owing to the scarcity of cash warrants offering and the diminishing stocks. Quotations to-day are £53 15s. to £54 5s. cash, with strong market. Large purchases of Anaconda matte are reported recently, thus reducing stocks. Manufactured firm, at £64 to £64 10s., "strong," according to specification.

TIN: Flat, with tendency to lower prices.

LEAD: Quiet, with values unchanged.

SPELTER is decidedly firmer, and considerable business reported.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	.....	—	.....
" " Liquid	gal.	.....	—	.....
" Citric	lb.	0 1 7½	—	.....
" Oxalic	"	0 0 8½	—	.....
" Sulphuric	ton	.....	—	.....
" Tartaric	lb.	0 1 3	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 8½	—	.....
" Muriate (Grey)	ton	.....	—	.....
" " (White)	"	25 0 0	to 30 0 0	
" Sulphate	"	10 15 0	—	.....
" Liquor	lb.	.....	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	"	.....	—	.....
Bisulphide of Carbon	"	.....	—	.....
Borax	"	.....	—	.....
Bensole (90 %)	gal.	.....	—	.....
" (50/90 %)	"	.....	—	.....
Copper Sulphate	ton	16 15 0	—	17 0 0
Copperas	"	.....	—	.....
Kieserit	"	.....	—	.....
Lead: Nitrate	"	.....	—	.....
" White Sugar	"	.....	—	.....
" Brown "	"	.....	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
" Caustic	ton	.....	—	.....
" Carbonate	"	.....	—	.....
" Chlorate	lb.	0 0 5½	—	.....
" Prussiate (Yellow)	"	0 0 10½	—	.....
" Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 4	—	.....
" White	"	0 3 0	—	.....
Salts: Epsom {Bags	ton	.....	—	.....
{Casks	"	.....	—	.....
" Glauber	"	.....	—	.....
Sulphur: Sublimed Flowers	"	.....	—	.....
" Recovered	"	.....	—	.....
Soda: Ash	deg.	0 0 1 11/16	—	0 0 1 3/4
" Caustic (White 70%)	ton	.....	—	.....
" " {" 60%)	"	.....	—	.....
" " {Cream 60%)	"	.....	—	.....
" Crystals	"	3 2 6	—	3 3 0
" Bicarbonate	"	.....	—	.....
" Hyposulphite	"	.....	—	.....
Solvent Naphtha	gal.	.....	—	.....
Tartar, Cream of	cwt.	4 19 0	—	.....
Zinc Sulphate	ton	.....	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Carbolic acids are very sluggish; the production of crude is considerably reduced, but this has no effect upon prices. Benzoles also are quiet. Sulphate of ammonia is again rather easier. Sulphate of copper is a little firmer on spot; higher prices are asked for forward delivery, but there are few buyers. Arsenic, after a rapid decline, is now steady. Borax is firmer. Sulphur is still in short supply.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	35	0	0
" Ceylon	"	29	10	0
Cottonseed	"	21	10	0
Cod	"	24	0	0
Lard	"	34	10	0
Linseed	"	22	5	0
Olive, Spanish	"	45	0	0
Palm, Lagos	"	26	0	0
Rapeseed: English	"	31	0	0
Seal: Pale	"	26	0	0
" Brown	"	.....		
Sperm	"	50	0	0
Whale	"	22	0	0
Turpentine	per cwt.	1	9	3
Coal	per gal.	.....		
Petroleum (Refined)	"	0	0	5½
Spirit		0	0	7½

MESSRS. PONTIFEX & WOOD, LIMITED, of Shoe Lane, London, E.C., have just issued a new edition of their horticultural implement list, in which particulars are given of garden engines, small pumps, &c.

MESSRS. MACARTHUR & JACKSON, of Glasgow, have sent us a copy of their pamphlet on "Lubrication and Lubricants." The pamphlet, which contains chapters on the colour, smell, taste impurities, specific gravity, and body of lubricants, should be found useful.

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HOME INDUSTRIES.

LONDON, 28th May, 1891.

The Money Market.—Money continues to pour into the Bank in considerable quantity, and the situation has been greatly ameliorated in consequence. But lest the advantage so gained should be lost through the competition of the Continental centres for the gold, the banks and discount houses are co-operating with the Bank of England to maintain discount rates within a reasonable vicinity of the official minimum. This policy is obviously necessary, and so long as the struggle for gold among the State Banks of Europe continues, a much lower level of rates cannot be looked for here. The settlement has absorbed attention during the greater part of the week on the Stock Exchange. Quotations have been more influenced by the state of the account in various classes of securities, and by the contangoes or backwardations resulting therefrom. Foreign bonds, for example, have been steadied by the exaction of substantial backwardations, which in many cases have been manipulated in view of the settlement in Paris. There the market has been so long influenced by the "bulls," that to reduce "differences" and avoid too much pressure strong efforts are being made to buoy up Spanish, Portuguese, and kindred stocks. Home railways have been dull in general, and most of the movements have been caused purely by the incidence of carrying over rates. Brighton Deferred has been subjected to a heavy fall. Americans remain sensitive and irregular, for while at every opportunity prices rise in Wall Street in response to the favourable local conditions, the continued shipments of gold, and the nervousness so induced, cause repeated set-backs. Canadian railway stocks follow the course of the Americans. In mining and miscellaneous securities interest is very languid, and the movements have little or no significance.

Institute of Marine Engineers.—The first annual dinner of this Institute, which was founded three years ago and now consists of 450 members, was held on the 20th inst., Mr. Peter Denny, the new President, being in the chair. Mr. G. W. Manuel, the retiring President, said that marine engineers were drafted principally from the artisan and the middle classes, who had a fair education, but it was after leaving school that their practical education really began; and it was necessary that during their apprenticeship as engineers, and during their period of servitude as junior engineers, which was the best time for the mind of the young engineer to embrace those higher branches of education which could not be acquired at school, that the practical aid which the Institute was capable of affording should be furnished. Mr. Denny in his inaugural address traced the development of the marine engine from the year 1845, when the consumption of coal, he said, might be estimated at not less than 5lb. per horse-power per hour. A few years afterwards this was reduced to 4lb., and by the reintroduction of surface condensation the consumption fell to 3lb. The corresponding consumption of the compound engine might be put at 2½lb. for some years after its introduction. In 1874 Dr. Kirk designed the first marine engine expanding steam successively through three cylinders. These engines were made by Messrs. John Elder & Co., and fitted on board the "Propontis." They worked at 160lb. boiler pressure, the steam being supplied by a set of the late Mr. J. M. Rowan's water tube boilers. The engines gave every satisfaction, and worked with great economy, but failed to attract the attention they deserved. However, shortly after 1884, the triple-expansion engine became common. With this type of engine and 160lb. boiler pressure the consumption of coal may be taken at 1·7lb. per horse-power per hour. In other words, with triple-expansion engines we get a horse-power for about one-third the coal required in the year 1845. The tendency is still to increase pressures, and Messrs. Denny & Co. have for some years been constructing, both for new vessels and for altering the machinery of old ones, cylinders on the quadruple-expansion principle, expanding the steam successively through four cylinders, with 180lb. boiler pressure.

The Surveyors' Institution.—At the annual dinner of this Institution, held on the 25th inst., the President, Mr. R. C. Driver, occupied the chair, and among those present were Lord Basing, Sir Robert Rawlinson, K.C.B., Mr. P. E. Cunliffe, Sir Henry E. Cartwright, and Mr. E. Ryde, Mr. E. P. Squarey, and Mr. D. Watney, past-presidents of the Institution. Lord Basing said that, as chairman of the Royal Commission on the subject of tithe redemption, he had received much assistance from the Surveyors' Institution. Mr. Squarey said that since 1869 the number of members had risen from 200 to 2,000, and seventeen provincial committees had been formed throughout England and Wales. During the present year seventy candidates out of ninety-two had passed the examinations conducted by the Institution. Sir Henry Cartwright said that the real object aimed at by the Institution was the protection of the public through the formation of an educated body of men as surveyors, and the elevation of the profession. The transactions of the Institution were of much benefit to the younger members of the profession.

The Royal Agricultural Society.—At the fifty second anniversary meeting of this Society, which was held on the 22nd inst., under the presidency of the Earl of Ravensworth, the Earl of Feversham was elected President for the ensuing year. The newly-elected President said that the Society had taken an active part in promoting the many improvements in agriculture which had been made during the past fifty-two years, and had thus benefited the agricultural industries of the country. The half-yearly report showed that the assets of the Society amounted to £35,176 at the end of 1890, as against £38,056 at the end of 1889. The Society's forthcoming country meeting at Doncaster promised to prove of great interest and exceptional magnitude. The total entries of live stock (horses, cattle, sheep, and pigs) were 2,240, as compared with 1,769 at Plymouth, 4,014 at Windsor, 1,875 at Nottingham, and 1,833 at Newcastle. The number of samples analysed in the laboratory on behalf of members from December to the end of April had been 727.

The Institution of Naval Architects.—The gold medal of the Institution has been awarded to Professor V. B. Lewes for his paper entitled "Boiler Deposits," read at the recent meeting.

MANCHESTER, 28th May, 1891.

The Engineering Trades.—Owing to the holidays, which in this district are very prolonged, there is little activity in engineering circles. Business is at a standstill, although most works are well supplied with orders. The complaint is, however, more frequently made that orders are not coming in so rapidly as they were. It is true that there is not yet much room for complaint, but it is significant that the number of firms finding forward work more difficult to obtain is increasing. The tendency towards a quieter state of things is unmistakeable in some directions, but it will be many months yet before it is fully felt in the Lancashire district.

The Marine Drive at Douglas.—The roadway which is being made from Douglas Head to Port Soderick along the coast is making rapid progress, one portion of it being practically completed. The road skirts the edge of the cliff, and in some places is overhanging. Ravines are crossed by girder or trestle bridges, and in one case by a suspension bridge. About 80,000 yards of rock have been excavated, and the drive when completed will be one of the finest in the kingdom. It is about four miles in length.

Type Writing Machine.—A company is about being formed, under the title of the Gardner Writing Company, Limited, to acquire the patent rights of a machine invented by Mr. John Gardner, of Manchester. The machine is of a much simpler character than those ordinarily employed, having but 13 keys, which, however, by an ingenious arrangement, can be made to print 52 distinct characters. The keyboard is entirely within the control of the operator, covering only a small area, and both capital and small letters and figures can be written. The type is formed on a small cylinder of vulcanite, and the letter passes, on its way to take its position, an inking band, after which the paper is pressed against it by a plunger. The strength of the blow on the paper is always even. The alignment is perfect throughout, and the character of the printed letters is distinct and free from blurring. The cost of the machine is low, and as it does a great variety of work it is equal in most respects to the larger machines in the market.

The Linen and Jute Trades.—There was only a poor attendance in the warehouses on the 26th inst., the weather keeping buyers away. Even those who visited the market did not operate freely, and this hesitation was a serious matter for heads of the fancy departments, although the heavier branches were not so much affected. It would appear that during the season heavy goods have sold more freely than lighter makes, both in the home and shipping trades, and, although the new American duties press more severely on coarse fabrics than on finer makes, shipments of the latter have fallen off of late, while those of the first-named articles have increased. The reason for this, it is thought, may be found in the fact that the American market was flooded with the better classes of linens last year, and that there has not yet been time to clear off stocks. Prices of both yarns and cloth keep very firm. There has been a fractional advance in quotations of bleached goods, and manufacturers still express themselves dissatisfied with the rates obtained. On the whole, it may be said of the market that, under the present conditions, it is impossible to speak with accuracy as to the outlook in the home trade, the close of the holidays not being sufficiently remote. There are a few American buyers in Manchester this week. For South America there is not much business.—At the seventeenth ordinary general meeting of shareholders in Messrs. Barlow & Jones, Ld., to be held to-morrow, a dividend at the rate of 10 per cent. per annum will be declared for the half-year ending March 31st. During that period the profits amounted to £20,203. The available balance is £23,463, of which £2,000 is to be added to the reserve, which will then stand at £56,000. The firm's Prospect Mill No. 3 is completed, and the addition to the weaving department at the Cobden Mill is at work.

GLASGOW, 28th May, 1891.

Pig Iron.—Though perhaps it is too soon to say that the reaction after the recent forced advance in prices has fairly begun, the lifelessness which characterised the opening of the warrant market this week would seem to indicate that the iron required speculatively for immediate delivery has all been bought, and that the top of the tide has been reached. The normal demand for trade purposes continues to be sluggish, and the prospective increase in production due to the blowing in of furnaces, owing to the inducement of high prices, indicates a fall. On the other hand, if the warrants now held in London for iron bought at moderate prices before the recent rise be strongly held, the price, abnormal as it is at the moment, may be prevented from breaking for a time. There is, however, the contingency of the market being depressed by speculation as artificially as it has been raised during the past few weeks. The condition of affairs suggests caution on both sides of the account, and buyers and sellers are at the moment reluctant to commit themselves forward. During this week only small parcels of warrants have changed hands. Prices are still firm.

The Recent Railway Strike.—Following the example of the North British Railway, the Caledonian Railway Company has announced certain concessions to their servants. The chief point in the new arrangements is the admission of the principle of the ten hours working day, the system to be carried out so far as practicable. The principle of overtime is also conceded—overtime henceforth to be paid for time above 72 hours per week. For Sunday labour, wages at the rate of time and a half are to be paid. The statement of the general manager also mentioned that the staff of the company had been increased by several hundred men. It is to be hoped that these concessions will conduce to the stability of the relations between the company and its employés.

Miners' Wages.—The wages agitation has so far met with a wholly unfavourable response from the coalmasters. A conference of miners' delegates from Stirlingshire, Mid and East Lothian, and Ayrshire was held at Glasgow on the 25th inst., when it was decided to await the result of further agitation. It has been agreed to contribute to the strike funds of the Belgian miners, who are at present on strike.

Paisley Harbour.—The new harbour in the River Cart at Paisley was formally opened on the 25th inst., on the arrival of the first deep sea steamer which has used the harbour. The vessel was the "Josef," owned by Messrs. Donald & Taylor, Glasgow, which carried a cargo of wood from the Baltic for Paisley consignees.

Paisley Waterworks.—The scheme for supplying the town of Paisley with water from Camphill Reservoir has now been completed, the extension of the reservoir having been finished. The supply is equal to a delivery of 6,000,000 gallons per day. The works were formally opened on the 26th inst. The engineers are Messrs. Leslie & Reid, Edinburgh, and the contractor is Mr. R. B. Stewart.

Business Announcement.—The Patent Sand Moulding Machine Co., Ld., have removed from 95, Bath Street, to Kilbowie Iron Works, Kilbowie, near Glasgow.

(From our own Correspondents.)

LIVERPOOL, 27th May, 1891.

Birkenhead Railway Improvements.—Since the opening of the extension of the joint railway system to West Kirby and Heswall, the traffic has so much increased that further developments of the system have been in progress for some time, and are now nearly completed. From the Green Lane Station terminus of the Mersey Railway the line rises by a steep gradient to the level of the Chester and Birkenhead line, and from this point to Rock Ferry the original railway embankment has been widened by means of heavy retaining walls, and the heavy masonry bridges have been replaced by iron girder bridges of sufficient width to receive the additional lines of rails, the streets underneath being widened. A new station has been built at Rock Ferry, on the north side of Bedford Road. The building is a handsome structure, faced with Ruabon bricks and local red sandstone. The whole of these works have been designed by Mr. R. E. Johnston, the engineer for the joint railways.

LEEDS, 27th May, 1891.

Technical School for York.—The Technical Instruction Committee of the York Corporation have recommended the Council to establish a technical school. It has also been resolved to communicate with the committees of the York Institute and the York School of Art, in order to ascertain how far, and in what manner, either or both of those institutions can be made available in carrying out the resolution.

The Hull and District Institution of Engineers and Naval Architects.—At a meeting of this Institution, held on the 12th inst., for the purpose of electing the officers and council for Session 1891-2, Mr. C. F. Amos was re-elected President. Some discussion took place upon various matters connected with the management of the Institution in the future.

The Campbell Gas Engine.—A repetition order for these engines has been placed by the War Office with the Campbell Gas Engine Company, Limited, Halifax.

SHEFFIELD, 27th May, 1891.

Iron and Steel.—During this week some interesting reports have been issued by local manufacturing firms. Messrs. Wm. Cooke & Co., Ld., of the Tinsley Iron and Wire Rope Works, report a continued and serious fall in the prices of all classes of iron during the past twelve months, and, there having been no reduction in the cost of

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labour or fuel, the result of the year's working is regarded as unfavourable. There is a net profit of £4,032 13s. 6d.; the profit last year was £10,138. All the reports speak of the reduction in selling values, while fuel and labour maintain their high rate. Prices of raw material are a little higher, especially in the iron trades. The rolling mills are turning out their full capacity of finished material specially adapted to the Sheffield trades. Messrs. Jonas & Colver are laying down plant for rolling their own steel, which is mainly of a special character and for Continental markets. Ordinary merchant iron and steel maintain their price fully, and are ordered freely for immediate consumption.

THE INSULATION OF ELECTRIC WIRES.—Major P. Cardew, R.E., who recently inspected the system of electric lighting in use here, says that the insufficiency of the insulating covering for the wires is a very serious departure from the regulations. He adds that he found a good system of testing was in use, and when the insulation showed any unusual leakage prompt steps were taken to remedy it. The Parliamentary Powers Committee passed a resolution "that all wires for the supply of electric light should be carried underground," which has been forwarded to the Board of Trade.

NORTH STAFFORDSHIRE, 27TH MAY, 1891.

THE IRON TRADE.—There is no improvement to report in connection with the local iron trade, prices showing a weaker tendency. The position is unsatisfactory in view of the high price of raw material. Orders for bars are being accepted at £5 10s. per ton at works, and for pig iron at 42s. 6d. per ton.

THE COAL TRADE.—The cold weather continues, and causes the demand for house coal to be greater than is usual at this season of the year. The prices of manufacturing fuel are weaker, and contracts for supplies over the next twelve months are being entered at prices from 1s. to 2s. per ton below those ruling at this time last year, though there has been no corresponding reduction in the cost of production.

DERBY, 27TH MAY, 1891.

THE QUEEN'S VISIT.—The Mayor of Derby, on whom the Queen was pleased to confer the honour of knighthood in connection with her visit to Derby on the 21st inst., is Sir Alfred Haslam, the inventor and manufacturer of the refrigerating machinery that has practically created a new industry for Derby. Numerous shipping companies, amongst which are the Cunard and the Peninsular and Oriental Companies, are having vessels fitted with refrigerating machinery by the Haslam Engineering Company.

BELLS FOR SYDNEY.—Five bells—one of considerable size—have recently been cast at Messrs. Taylor's foundry, Loughborough, for consignment to Australia. The bells are intended for the Sydney Post Office, New South Wales. The first, second, third, and fourth quarter bells weigh respectively 8½, 11¼, 14¾, and 30 cwt., while the hour bell weighs a little over 5 tons.

CARDIFF, 27TH MAY, 1891.

HEMATITE.—The hematite iron trade shows an improved tone as far as immediate business goes, but buyers do not care to contract for more than a month or two ahead. For steel rails there have been one or two inquiries, quotations for heavy sections ranging from £4 10s. to £4 12s. 6d. Owing to the forthcoming stoppage of tinplate works, the business in Bessemer tinplate bars only covers prompt delivery: prices are quoted nominally at £5 12s. 6d. Shipments of tinplates have been very heavy, dealers apparently using every endeavour to take advantage of the existing tariff. The iron ore market continues strong, and for the better class of Rubio ore prices are maintained at a high level. A few cargoes of second-class ore have been sold at lower figures. Rich manganiferous ore is scarce, and there is not an abundant supply of second class obtainable. Rubio ore, first quality, is quoted at 13s. 3d. to 13s. 6d. c.i.f. Cardiff and Newport, 13s. 9d. Swansea. Imports have been heavy.

COAL AND COKE.—The long continuance of heavy shipments has at last had its effect upon prices, which, after hardening steadily during the month, are now firmly established at about 9d. to 1s. per ton above the value at the commencement of the month. The main reasons for the long existence of such good figures being realised, in face of the depression in such allied industries as the manufactured iron and steel trade and the shipping market, seem to arise from the steady and increasing demand from abroad, together with the proportionately reduced output which colliers choose to supply in times like the present. The question of additional dock accommodation is again coming to the front, and if the present ratio of increase is to be maintained a new dock is an absolute necessity. Prices of steam coal are as follow:—No. 1 quality, 15s. 3d. to 15s. 9d.; No. 2 quality, 14s. 6d. to 15s.; No. 3 quality, 13s. 6d. to 14s. 3d.; No. 4 quality, 13s. to 13s. 3d. Small steam is steady at 7s. to 7s. 3d. f.o.b. There is a better demand for household sorts, No. 3 Rhondda realising 14s. 3d., and No. 2, 12s. 6d. to 12s. 9d. For coke there is more inquiry, and makers are requesting, and to some extent are realising, better prices, on account of the advance in coal. Prices are:—Best foundry, 24s. 6d. to 26s.; foundry, 22s. to 23s.; furnace, 19s. 6d. to 20s. Patent fuel finds a ready sale at 13s. 6d. to 13s. 9d.

BARROW-IN-FURNESS, 27TH MAY, 1891.

HEMATITE.—There is a quieter tone in the hematite iron market, but this is more apparent in prices than in the trade itself. Makers of iron are delivering large parcels, but are confining their make to the output of 39 furnaces, while 38 are standing idle. Last year, in the corresponding week, 46 furnaces were in blast. There is a better prospect of orders from makers of steel and on general foreign account, but the inquiry for forge and foundry qualities, which are mainly required for mixing purposes, is poor. There is still a steady reduction in stocks of hematite warrants. The clearance this week represents from 5,000 to 6,000 tons, and the aggregate of stocks has been reduced to about 140,000. As compared with the statistical position in January of last year, when 380,000 tons of pig iron were held in stock, makers are now in a position to influence the market to a much greater extent than for some time past. Hematite warrants are selling at 53s. net cash, and makers are asking the same figure for mixed numbers of Bessemer iron net f.o.b. The hematite iron ore trade of West Cumberland is very quiet, and the stocks of ore continue to increase.

STEEL.—There is not much life in the Bessemer steel trade, and it is uncertain whether makers will be able to keep their mills in full work throughout the season, as, although orders are fairly held, there is not a prospect of continuous work. Rails of heavy sections are quoted at £4 11s. 6d., light rails at £5 10s., and colliery sections at £6 15s. per ton. In the Siemens-Martin department the only chances of good trade seem to be in the shipbuilding material shops. Plates are firmer at £6 to £6 5s. per ton, and angles at £5 10s., while boiler plates are at £6 15s. Prospects of better trade in shipbuilding material are afforded. Tinplate bars, billets, slabs, and blooms are quiet. Hoops and heavy classes of steel castings are in good demand, and a continuous good trade in the latter departments is expected and practically assured. Messrs. Chas. Cammell & Co., Ld., at their Derwent hematite iron and steel works, Workington, are building the fifth blast furnace, and are stated to intend making spiegel. Hitherto they have bought all their spiegel. Further alterations have been commenced at Harrington Harbour. Messrs. Cammell & Co. are shipping all coastwise steel rails from Harrington.

IRON ORE.—There is a weaker tone in the iron ore trade, and the consumption of raw material is very small compared with the capacity of the mines. Prices are easy at 10s. per ton net at mines for ordinary qualities of metal.

SHIPBUILDING AND ENGINEERING.—The Naval Construction and Armaments Company, Limited, Barrow-in-Furness, have just secured an important order from the Peninsular and Oriental Steam Navigation Company, of London, to build and engine two passenger and cargo steamers of about 6,000 gross tonnage. They will be 385ft. long by 45ft. broad, and 31ft. depth of hold. The engines will be of the triple-expansion type, and develop 2,500 i.h.p. The same company have placed an order with Messrs. Caird & Co., Limited, of Greenock, for two steamers of exactly similar description.

MIDDLESBROUGH, 27TH MAY, 1891.

PIG IRON.—The iron market was thoroughly disorganised yesterday by a resumption of the excitement reported from Glasgow, and a rapid rise in Scotch warrants. When the market opened, 40s. 6d. per ton was asked for No. 3 G.M.B., but when the Glasgow report came to hand sellers raised their rate to 41s., and there were buyers at 40s. 9d., but scarcely any was sold to consumers, the bulk of the sales being to people to make warrants. Over 3,000 tons have been put into Connal's store during the past week. Middlesbrough warrants are 41s. 9d. cash sellers, and 41s. 7½d. cash buyers. Grey forge is quoted at 38s. 6d. by most makers, though in some cases 3d. per ton more has been paid. Local hematite is 52s. per ton for mixed numbers.

FINISHED IRON AND STEEL.—For finished iron and steel the demand is very small, and prospects are not at all encouraging. Common iron bars are £5 12s. 6d.; best bars, £6 2s. 6d.; iron ship plates, £5 12s. 6d.; steel ship plates, £6 2s. 6d.; iron boiler plates, £6 2s. 6d.; steel angles, £5 15s.; all less 2½ per cent. for cash on the 10th of the month following delivery. Puddled bars are £3 5s., and heavy steel rails, £4 10s. net.

SHIPMENTS.—The shipments of pig iron from this port continue satisfactory, 72,062 tons having been sent away this month up to the 25th inst., as against 66,608 tons during the same period of last month. Of the 72,062 tons, 27,078 tons went to Scotland, 7,676 tons to England and Wales, and 37,309 to foreign parts.

WORK AND WAGES.—At a meeting of the mineowners and the representatives of the men an understanding was come to that wages should remain undisturbed until the 6th of July. In consequence of the slackness in the finished iron trade, Messrs. Bolckow, Vaughan, & Co. have given their men at the Middlesbrough and Eston Works fourteen days' notice. This will affect over 1,000 men. The return of the auditors for the Board of Conciliation and Arbitration in the finished iron and steel trades of the North of England, for the two months ending April 30th, has just been published. The result gives, under the sliding scale, a reduction of 3d. per ton on puddling, and 2½ per cent. on all other forge and mill wages, to take effect from the 30th inst. The net average selling price per ton is certified to have been £5 15s. 10d.

SUNDERLAND, 27TH MAY, 1891.

SHIPBUILDING AND ENGINEERING.—There is no improvement in the prospects of these industries. Messrs. Short Bros., Pallion, have sold a steamer of 4,600 tons gross register, which has been built on their own account, to a Belfast firm. The General Council of the Amalgamated Society of Engineers is at present holding its meetings here, and the members take the opportunity of visiting the various shipbuilding and engineering establishments. To-day Roker Pier and the docks were visited. At present the iron gates for the No. 2 Entrance, which were constructed in 1848, are under repair. These gates are nearly 100 tons in weight.

SHIPPING.—Freights have not improved either outwards or homewards, and Black Sea rates have fallen. It is difficult to obtain satisfactory fixtures for prompt vessels, but for August 4s. from New York to Cork for orders is obtainable. The returns of the River Wear Commissioners for April are the most satisfactory of the present year. The coal shipments amounted to 358,880 tons, as compared with 305,975 tons in April, 1890, an increase of 52,905 tons. The revenue from every source but the goods traffic showed an increase, the total being £11,469 14s. 1d., an increase of £978 12s. 5d. Owing to the Whitsuntide holidays last week's coal shipments were only 56,130 tons, a decrease of 27,285 tons as compared with the previous week.

MARINE ENGINEERS.—A conference of shipowners and representatives of sea-going engineers belonging to the ports of Newcastle, Hartlepool, Middlesbrough, and Sunderland has been arranged to meet here on the 8th prox. to settle mutually a uniform scale of wages.

NEWCASTLE, 27TH MAY, 1891.

THE COAL TRADE.—The demand for steam coals is still satisfactory, and there is also a good deal of inquiry respecting gas coals for exportation. Owing to the continuance of cold weather, household coals are in better demand than is usual at this time of year, but sales of bunker coals continue limited. The shipments of coals and coke at Tyne Dock for the week ending the 23rd inst. amounted to 99,534 tons, being a decrease, as compared with the corresponding week last year, of 13,964 tons. This large decrease is doubtless attributable to the intervention of the Whitsuntide holidays.

ENGINEERING.—The dispute between the fitters and plumbers at the Palmer's Engineering Works, Jarrow, is still unsettled, and its continuance is causing much inconvenience to the employers. Messrs. Hawthorn, Leslie, & Co. have since the beginning of the month sent away from their St. Peter's Works large quantities of sectional parts of engines, which are to be fitted in vessels recently launched from Government dockyards. Messrs. Clarke, Chapman, & Co. have just completed a contract for the manufacture of a new and interesting specialty required in the equipment of telegraph cable ships. It is the invention of a gentleman connected with the Eastern Telegraph Company, and is said to be a great improvement upon contrivances of a similar nature that have hitherto been in use. In the locomotive engineering shops there is a fair amount of activity, the works of the North-Eastern Railway Company at Gateshead being particularly brisk.

ELECTRIC LIGHTING.—Messrs. J. H. Holmes & Co., electric lighting engineers, continue extremely busy with steamship installations, and have several vessels in hand on the Tyne, Wear, Clyde, and Mersey. Some of the foregoing are passenger vessels of a first-class type, and one is fitted with no less than 200 incandescent lamps, Suez Canal projector, and arc lamps complete, to meet all requirements of the Suez Canal Company. Among other contracts now in hand are three portable electric lighting sets for different Suez Canal companies. These plants are light, well made, simple, and easy to manage, and are in great request by the engineers of vessels passing through the canal. Messrs. Ernest Scott & Mountain, Ld., are also busy in their electrical department, among other contracts now in hand being a large installation of between 600 and 700 lights for a Glasgow firm, and one for a bondage store in Leith. The firm have just completed an important installation on a Sunderland built steamer.

THE MELINITE AFFAIR.—Messrs. Armstrong, Mitchell, & Co., Ld., have made the following statement with regard to the melinite affair:—"Certain negotiations were entered into between M. Turpin and the Elswick Company for the use of an invention relating to explosives which M. Turpin expressly stated he was at full liberty to sell. Whatever technical information the Elswick Company acquired was given, not by M. Triponé, but solely and directly by M. Turpin, who represented that he was perfectly free from all obligations in any quarter. No experiments carried on by the French Government were ever communicated, either by M. Triponé or M. Turpin, to Elswick."

SHIPBUILDING.—Messrs. Armstrong, Mitchell, & Co. have just put down the keel for a large cruiser ordered by a foreign Government, and the work of this vessel will, with the other work in hand, keep the yard moderately busy for some months to come.

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THE "PERRY" ENGINE INDICATOR.

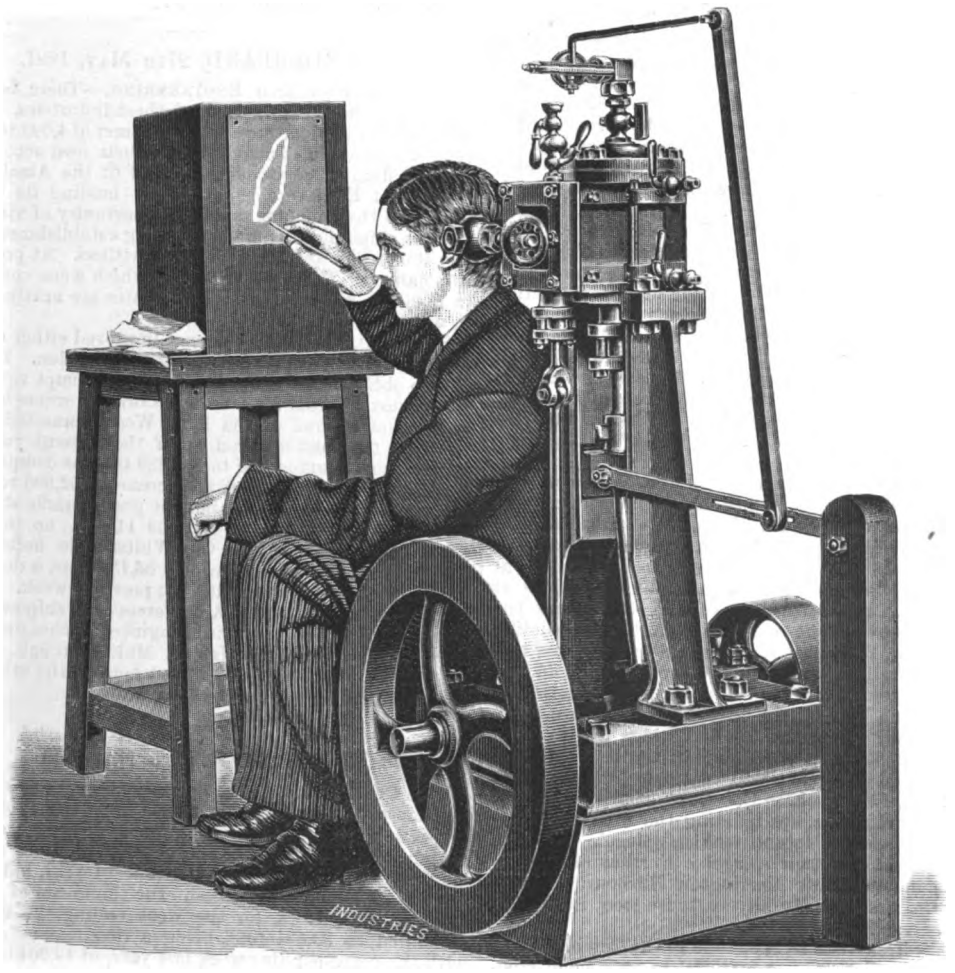


Fig. 1.—General View of Indicator in Working Position.

THE "PERRY" ENGINE INDICATOR.

To some engineers the accuracy of the ordinary engine indicator is a sort of faith; others are, however, a little sceptical. In 1885 Professor Osborne Reynolds read a paper at the Institution of Civil Engineers which did much to disturb our confidence in the general accuracy of indicator diagrams. In it attention was called to several serious sources of error, such as inertia of the moving parts; friction of the piston and the pencil gear; backlash and "give" in the pencil gear; temperature variations in the springs; inaccuracy in the springs; long and tortuous

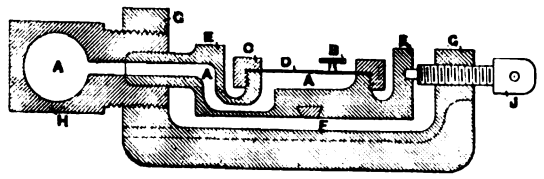


Fig. 2.

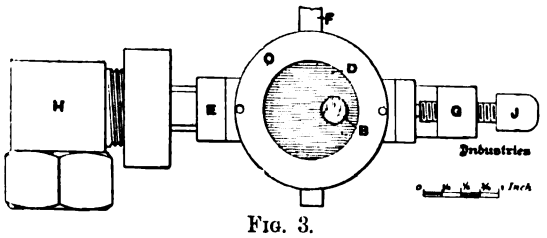


Fig. 3.

steam connections; stretching of the string; and want of correspondence between the motion of the paper and of the engine piston. These disturbing elements give rise to very large errors, and even if we do not estimate them so high as Professor Reynolds, it must be admitted that the steam engine indicator, with the usual arrangements for giving motion to the barrel, is not an extremely accurate instrument, even in its most improved form.

Apart from these features of inaccuracy the engine indicator is, after all, a roundabout sort of instrument to get a desired result. If an engineer wants to know the pressure in a boiler, he looks at a direct reading gauge; but if he wants to know the power developed in an engine, he fixes on an indicator, but this does not show the power at once. The engineer has probably to climb about to fix his indicator on the engine cylinder. If the engine be in a ship, and there is a big sea on, the experimenter in taking a diagram may tear several cards, and probably burn his fingers, and in some cases run a chance of being killed. After all this he has not got the horse-power result, but merely a diagram. Additional observation of the speed must be taken, and the area of the diagram must be measured with a planimeter or other means. After doing all this, a result having some sort

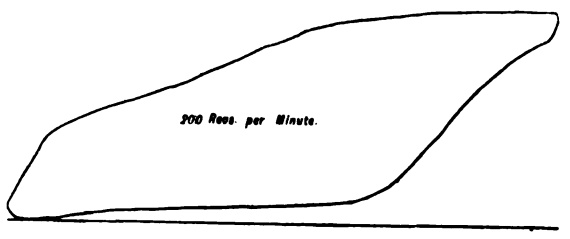


Fig. 4.

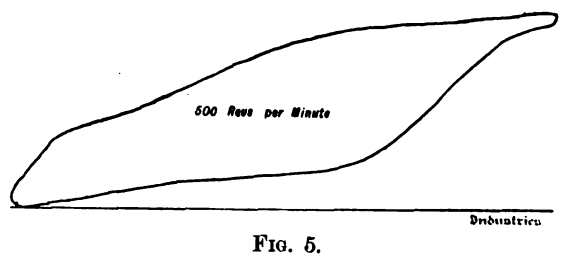


Fig. 5.

of relation with the power in one end of one cylinder is obtained, and several more operations, with their accompaniments, give the final results.

Professor J. Perry, F.R.S., of the Finsbury College, has set to work to improve these roundabout methods, and has produced the very simple and ingenious form of indicator, which we illustrate in Figs. 1, 2, and 3. The piston and cylinder are discarded altogether. Instead of them there is a thin steel drum-head D. The pressure in the box A bulges the disc out a little, like the disc of an aneroid barometer or Schäffer-Budenberg gauge. A mirror B is set about half-way between the centre and the edge. The pressure thus bends the disc and deflects a beam of light in one direction. The drum is moved in another angular direction by means of a lever F, and this moves the spot at right angles to the pressure direction. The result is that the spot traces a true diagram of the working of the engine. The steel disc is so light and strong that its period of vibration is too high for its inertia to affect the diagram, not only of a marine or mill engine, but even to make a perceptible difference on a locomotive, a small gas engine or a high-speed electric light engine. The barrel cord is entirely superseded by a rigid rod or connection which does not admit of stretching or backlash.

The diagram formed by the instrument may be made permanent, as it can be traced over with a pencil. An oil lamp, with a large mirror, gives a very good "spot," and even at the slow speed of 60 revolutions it is easy to trace the form of the diagram. For many purposes, however, a record is not wanted. With the "Perry" indicator the engineer may not only have the water, boiler pressure, vacuum, and other gauges in front of him, but he may have a visible indicator diagram also. He has not to perform a series of operations whenever he wants to know what is going on inside the cylinders of his engine, and he can watch the effects of any alteration of boiler pressure, or of the valve gear, without difficulty or trouble.

Professor Perry read a paper on his indicator at the Physical Society on the 22nd inst., and showed a number of diagrams taken by Mr. Holland, who has been engaged in working out some of the details. Fig. 1 shows a general view of the indicator as attached to a small engine, Fig. 2 is a longitudinal section, and Fig. 3 a plan of the instrument. Figs. 4 and 5 are specimen diagrams taken with it, which were photographed by the light of an oil lamp, after about a minute's exposure.

ROYAL STATISTICAL SOCIETY.

At a meeting of this Society, held on the 26th inst., the President, Dr. F. J. Mouat, F.R.C.S., LL.D., in the chair, a paper was read by Dr. Venn, of Caius College, Cambridge, on "The Nature and Use of Averages."

The general object of the paper was to show that the prevalent habit of almost implicit reliance upon the common arithmetic mean or average of a number of magnitudes, perfectly justifiable as it is in many cases, needs some revision and caution.

Three classes of cases seem to deserve prominent consideration:—1. If we are only concerned with comparative results—and these presumably form the bulk of ordinary statistical inquiry—then almost any kind of average will answer the purpose. That is, the order of arrangement of a number of groups of things, and the question whether these groups are increasing or diminishing in respect of any particular characteristic, are hardly at all affected by the particular kind of average we may choose to employ. 2. If we want accurate quantitative results, then the selection of the kind of average is no longer at our own disposal, but must depend upon the precise object we have in view. The common arithmetic mean *may* be the best, and probably in most practical cases is so, but circumstances can easily be suggested in which some other kind of mean becomes, not merely more convenient, but distinctly more accurate. 3. There is the well-known class of cases—of which the science of mensuration offers the most familiar examples—in which the mean is resorted to in order to discover what is regarded, actually or metaphorically, as the true value. The suggestion is offered that it may depend upon the object we have in view, not merely what kind of average should be selected, but whether there is a necessary gain in employing one at all. We start with a set of discordant values. By taking an average of any number of these, all that we get is a specimen of what is generically of the same kind, though specifically of a better sort. In it, broadly speaking, great errors are less common, and small errors are more common. In the majority of cases this is an unmistakeable gain, but in exceptional cases there may be no gain, or even actual loss.

When, indeed, the "true value," at which the aim is supposed to be directed, becomes purely metaphorical—as in the curve of mortality—it becomes a question whether the resort to a single mean or average is not, for some purposes, not only unsuitable but actually misleading. When the curve of error, instead of being so arranged that the arithmetic mean corresponds to the most frequent result, presents itself in a one-sided form, or still more, in a hump-backed or double-backed form, the common average loses most of its significance and importance. The mere assignment of the average, by itself, may misdirect the attention from some of the most important characteristics of the phenomena.

A discussion followed the reading of the paper.

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THE DUTCH ROYAL STEAM PACKET

CONSTRUCTED BY THE KONINKLYKE FABRIEK

(*For description*

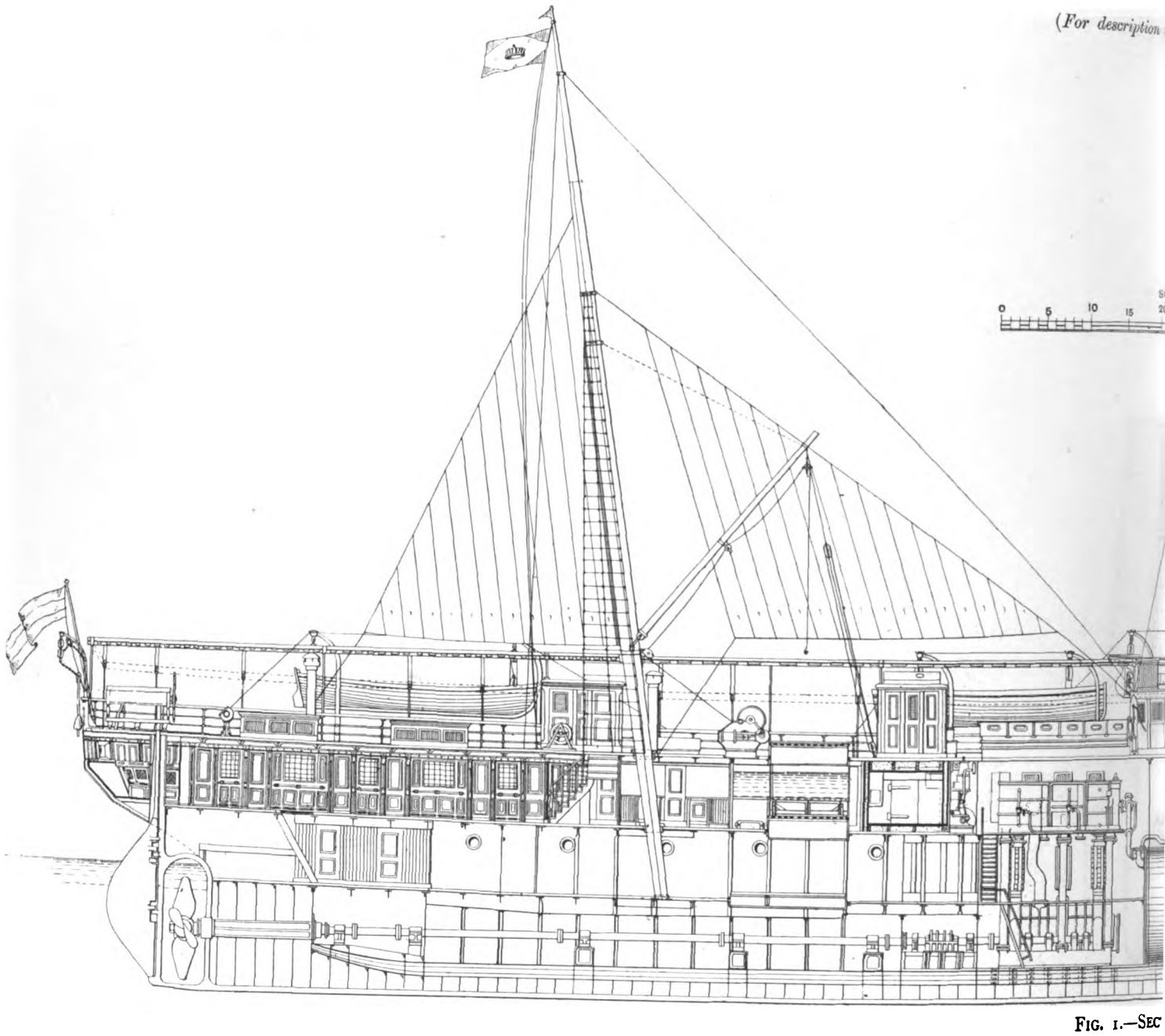


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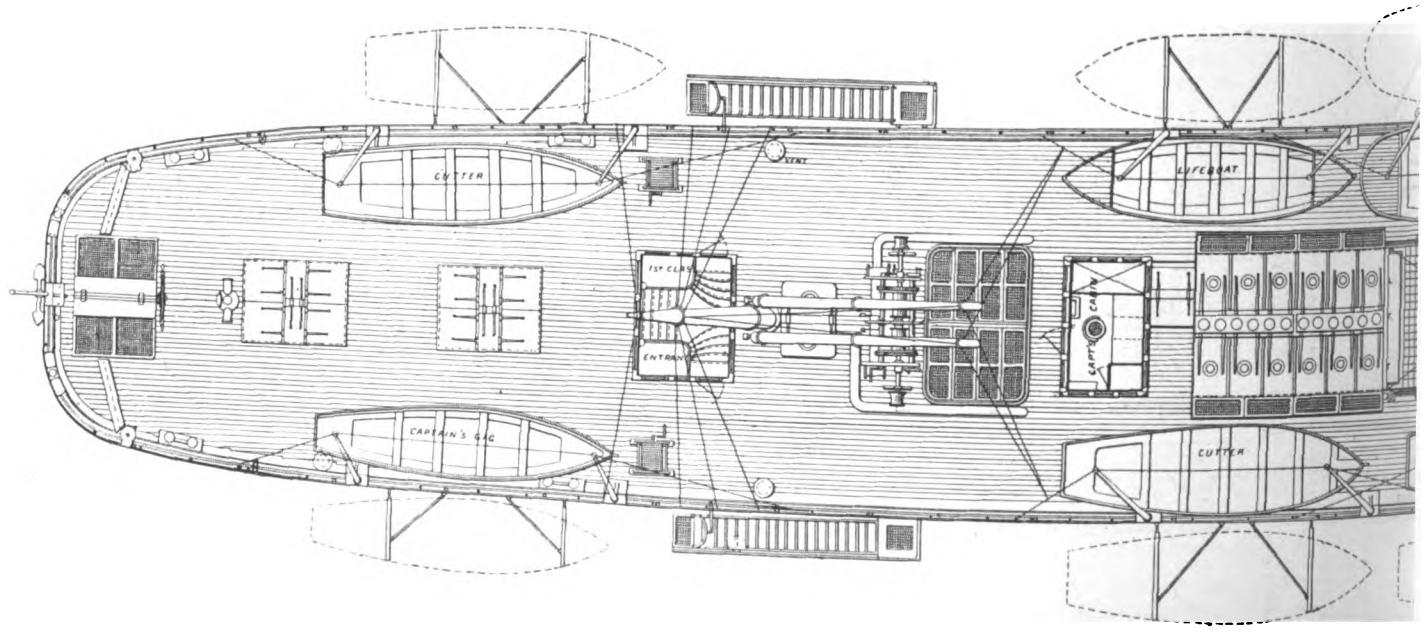


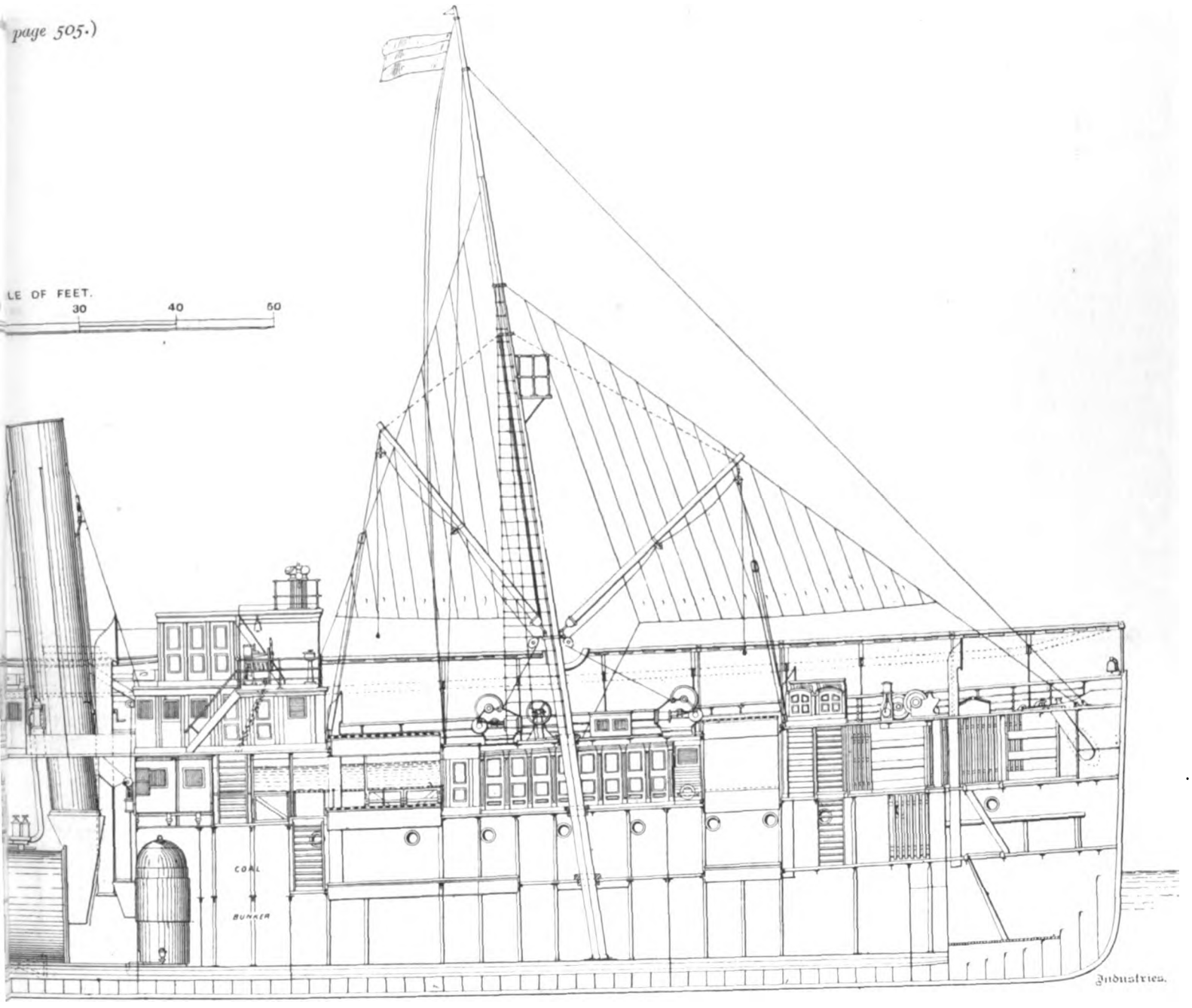
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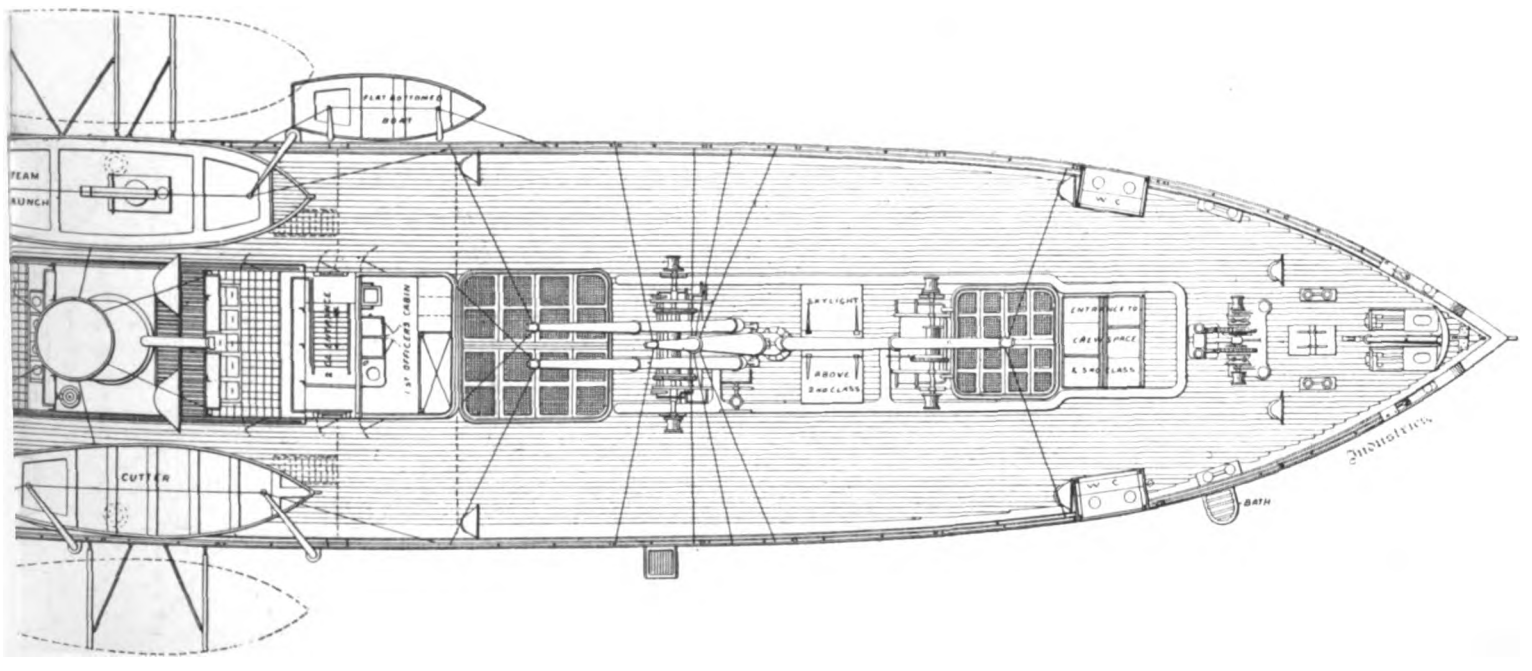
COMPANY'S STEAMER "VAN GOENS."

AN STOOM E. A. WERKTUIGEN, AMSTERDAM.

page 505.)



IONAL ELEVATION.



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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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93, Hope-street, Glasgow.

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(Mr. G. N. Hennessy is Sole Agent for Ireland.)

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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Double-page Supplement illustrating the DUTCH ROYAL STEAM PACKET COMPANY'S STEAMER "VAN GOENS."

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 29TH MAY, 1891.

THE USES OF PETROLEUM IN PRIME MOVERS.

THE interesting and valuable paper on the "Uses of Petroleum in Prime Movers," recently read before the Society of Arts by Professor Robinson, seems to open up a new field in the economical development of prime movers, and although the opinions expressed may in some cases have been a little too optimistic, and founded on the results of experiments which require to be verified, they deserve the careful attention of engineers and of power users. The paper contains a great deal of information with regard to the properties of petroleum, which is very valuable, but into this our present space will not allow us to enter. A few particulars, however, of special interest to engineers, may be noted. The first use of petroleum in prime movers is as a substitute for gas in the internal combustion engine. Here the heat, generated by the combustion of a mixture of oil vapour and air inside the engine cylinder, is used directly to expand the products of combustion, and so drive forward the piston. Professor Robinson is of opinion that, just as the "Otto" gas engine, in the hands of Messrs. Crossley Bros., in this country, has been developed into a reliable and useful prime motor, so to Messrs. Priestman Bros. is due the credit of the further development of the gas engine into the common oil engine, which has now established itself as a still more useful and popular prime motor, since its fuel—ordinary lamp oil—is to be had in every village, and the engine itself can be looked after by unskilled hands. Its record has been so satisfactory that it even excels the parent gas engine in replacing small steam engines, and it is to be found doing good work efficiently at coal and other mines, and lighthouse stations. We need not, in the meantime, go into the details of the action of the engine, as no doubt these are known to many of our readers. We may mention, however, some of the results of experience. Taking an engine of 5 h.p. nominal, having a cylinder 8½in. diameter and 12in. stroke, the compression before ignition is found to be 33lb. per square inch, and the mean pressure throughout the stroke 54·4lb. The speed was 180 revolutions per minute, the air pressure 10lb. per square inch, and the brake horse-power 7·06. The measured oil consumption was 0·85 pint per brake horse-power per hour, and taking this at 5½d. a gallon—the price charged by the American Oil Company—the cost of an actual brake horse-power by this small engine is about a halfpenny per hour, while larger engines give still greater economy. In a still smaller engine, of 1 h.p. nominal, the horse-power actually developed was, on an average, 2·5, with a consumption of 1·07 pint per actual horse-power per hour. Engines of this kind are now being introduced to a considerable extent into all kinds of industrial works, and have been found to be convenient and trustworthy for electric lighting. Mounted on wheels they become useful for agricultural and many other purposes, and they invariably receive an excellent character for their steady and trustworthy running, proving themselves to be the best of their kind hitherto in the market.

Another form of engine described by Professor Robinson was the "Ackroyd" oil engine, which differs considerably in its action from the "Priestman" engine, but which promises well to contest the field with it. In the case of an engine developing 7·6 h.p., the oil consumption was found to be less than a pint per brake horse-power per hour. The oil used was of specific gravity ·854, and was very much like the Scotch intermediate shale oil, but heavier oils might be tried without disadvantage. The "Knight" oil engine, which has been in use for several years, has several novel features in its construction. It is of the three-cycle type, like the "Griffin" gas engine, and has a high piston speed, 300 revolutions per minute, with a 9in. stroke. The ordinary Russian kerosene oil is used, and the consumption is stated to be only a small fraction of a gallon per brake horse-power in actual work. For large powers it is now being generally recognised that the ordinary vaporisers in petroleum oil engines are difficult and troublesome to work with, and that the most practical plan is to convert oil into gas by means of a gas producer. Oil gas, when cooled, can be used with great economy in the engine cylinder, and it is found that a very decided saving in fuel may be effected by the combination of an oil gas producer with the internal combustion engine, in place of the boiler and steam engine, in many places where suitable oil is cheap or plentiful, or where intermittent work is required. On the other hand, more heat may be produced by the direct combustion of liquid fuel with dry steam and air, than by first converting the oil into gas before using it as a fuel. Oil gas is now generally made from Scotch intermediate shale oil, partially refined petroleum, mutton fat, waste grease drippings, and such like heavy oils and fats as are not available for use in the ordinary oil engine cylinder, and may be had at low prices. Various forms of gas producers have been used. Professor Robinson described those designed by Mansfield, Keith, and Thwaite, and pointed out the special uses and advantages of each.

But neither petroleum nor gas engines are likely, at least in their present shapes, to supersede steam engines, and hence one of the most important uses of oil is as liquid fuel for steam raising purposes. Mechanical engineers are well acquainted with the work of Mr. Thomas Urquhart in Russia, in which he has used very efficiently the heavy residuum from petroleum. The quality of this is very good, and rich in heating power. Mr. Urquhart found that whilst the maximum evaporation with this residuum, from theoretical calculation, was 17lb. of water per lb. of petroleum, he could get an evaporation of 14lb. in his locomotives, or 82 per cent. of the total possible evaporation. In this country we have neither had the opportunities nor the necessity for the extensive use of liquid fuel, as coal has been so cheap and plentiful, but still sufficient experiments have been made to show the importance of the matter. Mr. James Holden, locomotive superintendent of the Great Eastern Railway, has been making some experiments, and of the results of these Professor Robinson gives an abstract. If we could depend absolutely upon their correctness, they would be very satisfactory indeed. In using liquid fuel various forms of injectors are used for atomising the heavy liquids into spray, and burning them in a furnace. Of these the best known in this country are those designed by Thwaite, Holden, Bray-Smith,

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and Henwood, all of which were described by Professor Robinson. According to Mr. Holden's experiments the following is a statement showing the comparative consumption of fuels in stationary boilers and locomotives with coal, and liquid fuel with coal—the coal used for lighting up being included in each case. In a small Cornish boiler, when fired with a given coal alone, the consumption was 121·3lb. per hour, and when fired with liquid fuel and coal, the consumption was, liquid fuel 35·1lb., coal 19·2lb., and coke 14·7lb., or a total of 69lb. per hour—a little more than half of the weight of the coal when used alone. With a vertical boiler the consumption, when fired with coal alone, was 77lb. per hour, but with liquid fuel and coal this fell to 38lb. of liquid fuel and 10lb. of coal, or a total of 48lb. of coal per hour. With a stationary boiler of the locomotive type, when fired with coal alone the consumption was 275·1lb. per hour, while with liquid fuel and coal the consumption was, liquid fuel 99·3lb., coal 101·8lb., or a total of 201·1lb. per hour. With an express engine with 7ft. driving wheels, cylinders 18in. by 24in., burning liquid fuel and coal, it burnt, liquid fuel 10·5lb., coal 15·0lb., or a total of 25·5lb. per mile, while the average consumption of coal on nine engines of the same class is 34lb. per mile.

These are remarkable figures, but, like Professor Unwin, who took part in the discussion, we have our doubts as to their correctness, and believe that the calorific effect of petroleum is over-estimated. In fact, the results of all experiments connected with evaporation require to be received with very great care, for they depend to a great extent on the conditions of the boilers and of the steam generated. This is a point to which we would direct the attention of the Research Committee of the Institution of Mechanical Engineers, as there can be no doubt that the use of petroleum in prime movers, either directly or indirectly, has a great future before it, and is likely to have considerable effect on the development of motors of different kinds.

BOILER DEPOSITS.

As we briefly announce in another column, the gold medal which was promised by the Council of the Institute of Naval Architects for the best paper read at the late meeting, by any one who was not a Member of the Council, has been awarded to Professor Vivian B. Lewes, F.C.S., F.I.C., of the Royal Naval College, for the paper read by him on "Boiler Deposits." As we reprinted the paper in full (see *Industries*, Vol. X., page 363), we need not enter into a detailed account of its contents, but in view of the fact that it has been specially marked for honour by the Council of the Institute of Naval Architects, some of its chief points may be noted, and probably discussed by our readers, for it does not follow that Professor Lewes' conclusions will be unanimously agreed to. Until recently the deposits taken into consideration have been those formed from the impurities natural to the water itself; but with the introduction of high-pressure steam a new and highly dangerous form of deposit has been added to the trouble of the marine engineer. After the collapse of the furnaces of certain steamers in 1878, and that without any apparent cause, attention was paid in marine circles to the action which had taken place. The only clue to be found was that a certain amount of oily deposit had formed on the tops of the furnaces, and experiments made by Mr. Dunlop, of Port Glasgow, led to the conclusion that this oil, which had distilled into the boiler from the lubricants used in the cylinder, was so bad a conductor of heat that its formation on the plates allowed them to get superheated, with the result that they were unable to withstand the pressure of steam existing in the boiler, and in this way brought about the collapse. Similar cases of collapse became frequent after that date, no less than thirty vessels being disabled from this cause during the last few years. In his paper Professor Lewes gives an account of a number of experiments and tests with boilers in order that he might arrive at the cause of these collapses, and his work should be carefully studied by marine engineers. They show that a deposit is formed by the combination of the oil with the solid particles of calcic carbonate, calcic sulphate, &c., and that the effect of the oil on the particles is to cause them to rise and fall with the convection currents which are going on in the water, and to stick to any surface with which they come into contact. In this way they deposit themselves, not as in common boiler incrustations, where they are chiefly on the upper surfaces, but quite as much on the under sides of the tubes as on the top, their position being regulated by whether they come in contact with the surface whilst descending or ascending. The deposit so formed is a wonderful non-conductor of heat, and Professor Lewes attempted to determine the effect which it had in allowing excessive heating of the plates to take place, and in retarding the heating of the water. He found that, with the fierce heat existing in the boiler furnaces, given an oily deposit of only $\frac{1}{16}$in. in thickness, the plates will readily be heated to a temperature at which they are totally unable to withstand a pressure of 80lb. of steam, and collapse of the furnace crowns must follow.

Professor Lewes gives some useful information regarding the properties of good lubricating oils, and points out that the great advantages of a good mineral oil cannot be too strongly insisted on, and that any lubricant containing animal or vegetable oils to give it "body" should be unhesitatingly discarded. He also gives instructions for the precipitation of the impurities usually found in the water of marine boilers, for details of which we must refer to the paper. The whole subject, however, is one still requiring further elucidation, and we shall be glad to have the opinion of some of our readers regarding it.

"THE BUILDING OF THE SHIP."

Under the above title the Fairfield Shipbuilding and Engineering Company have printed for private circulation (partly reproduced from our contemporary, *Engineering*) a most interesting account of the development of the large concern which now belongs to them, and which records the achievements of Randolph, Elder, and Pearce, the men who were most effective in promoting that development. Such publications will be of the greatest possible service to the future historians of engineering, for they supply the materials which are necessary for their work, and data on which to generalise. Those who are at present responsible for the works seem to be animated with the spirit of their predecessors, for they are not inclined to consider even the possibility of decline, and say that "it is enough for them to realise that they are within the influence of one of the most vigorous forms of modern industry, glorying in its strength, and ever extending its dominion. Only half a century has elapsed since the main lines of its structure were reached. Genius and enterprise have guided its growth. Never failing to anticipate the requirements of progressive society, and often directing that progress, those to whom the prosperity of Fairfield Works is due have demonstrated, in a manner that overcomes all crazy theory, the power which well-directed capital can wield as an instrument for general good, and the command over the rude forces of nature, which men of pre-eminent ability, industry, and worth can reach."

The immense establishment at Fairfield had its origin on the 30th of September, 1834, in a small millwright's business, which was started in Tradeston, then one of the suburbs of Glasgow, by two skilled workmen, Mr. Charles Randolph and Mr. R. S. Cunliff. For eighteen years the work was carried on in a very modest way, till, in September, 1852, a new era in the firm's history commenced, when Mr. John Elder became a partner, the style being changed to Randolph, Elder, & Co. It was with the accession of Mr. Elder that the firm commenced the construction of marine engines. Two years later it started to make boilers, and six years afterwards, in 1860, shipbuilding was added, less attention being henceforth given to millwright work. The firm latterly confined itself to the more important and probably more remunerative branches of industry, and the fame achieved as shipbuilders and marine engineers is conclusive proof of success. In order to meet the growing demands on the firm, the ground at Fairfield was acquired and laid out in 1864 by Mr. John Elder, with a forethought for the requirements of succeeding years which his successors have not failed to appreciate. In the year 1868 Mr. Randolph and Mr. Cunliff, the two original partners, retired from the concern, Mr. Elder remaining the sole proprietor of the business until his widely regretted death, at the age of 45 years, in London, in 1869. His executors carried on the undertaking for a few months, and on the settlement of affairs the style of the firm was altered to John Elder & Co., the partners being Mr. J. F. Ure, Mr. J. L. K. Jamieson, and Mr. (afterwards Sir) William Pearce. Nine years later, in 1878, the latter gentleman became sole proprietor. In 1885 Mr. Richard Barnwell was accepted as partner, and in the following year the firm was converted into a private limited company, under the title of "The Fairfield Shipbuilding and Engineering Company, Limited." In 1887 Mr. Pearce, who had meantime entered Parliament as member for the Govan Division of Lanarkshire, was created Baronet in recognition of his distinguished services in connection with the naval and mercantile marine. This honour he was not destined long to enjoy, as, on the 18th December, 1888, the company sustained an irreparable loss in his death. Six months after this event the executors obtained the re-registration of the firm, with the same title, but as an ordinary limited company, with a capital of £750,000.

The *brochure* to which we have alluded gives an account of some of the work done by the firm, but its main object is to explain the means by which results in naval architecture and marine engineering have been effected rather than the results themselves. Full descriptions have been published in the engineering journals and in the Transactions of scientific societies of all the most celebrated ships, but there is only meagre information regarding the appliances and the organisation of a shipbuilding yard, and the publication of a description of such an establishment as that of Fairfield is not only instructive, as showing how from small beginnings there may be immense results, but it is also good because it explains the means which are necessary for producing that most complex organisation, the modern high-class ocean steamship.

THE GERMAN EXHIBITION.

Although this Exhibition has been opened nearly three weeks, the whole of the exhibits are not yet fully in position. Those exhibits which it is within our province to describe are not very numerous, and we can only briefly refer to them in this notice. The Sürther Maschinenfabrik, of Sürth, near Cologne, show a complete plant for generating and liquefying carbonic acid gas. This firm also show some small steam engines. Messrs. Reunert & Douglas, of Berlin, exhibit samples of their iron and steel productions, amongst which we may mention a propeller shaft and forged pieces in crucible, Martin, and Bessemer steel. Messrs. Ad. Altmann & Co., of Berlin, exhibit one of their horizontal petroleum engines. It is claimed for this engine, which is also made of the vertical type, that it is of simple construction, noiseless, and that it occupies very little space. Messrs. Gebr. Reinbold, of Mettman, exhibit their compressed polished steel shafting made of the best Siemens-Martin steel, containing from 0·20 to 0·25 per cent. of carbon. H. Meinecke, of Breslau, exhibits his water meters and hydraulic appliances, and also his portable self-registering water meter, which indicates the amount of waste. Messrs. Werner & Pfleiderer, of London, exhibit some bakers' machinery, amongst which we may mention their universal kneading and mixing machine.

Messrs. Gebr. Stahlknecht, of Stollberg, near Chemnitz, exhibits a new machine for lacing Jacquard cards, which it is claimed can do the work of ten workpeople. The machine, which only requires the attention of one person, can lace from 1,200 to 1,300 cards per hour.

Mr. Rud. Ley, of Arnstadt, exhibits his "Thuringia" boot-pegging machine, which has been in successful use for some time.

Naval architecture is represented by five full models of vessels and one half-model. Most of these are exhibited by the Vulcan Shipbuilding Company, of Stettin—namely, the twin-screw steamer "Furst Bismarck," of 14,000 h.p., belonging to the Hamburg-American Packet Company; the corvette "Irene," built for the German Navy; the ironclad "King Yuen"; the screw steamer "Bremen"; and a half-model of the paddle steamer "Kaiser Wilhelm." The Norddeutscher Lloyd exhibit a beautiful model of their steamers "Spree" and "Havel."

Speaking machines are represented by Berliner's gramophone and Edison's phonograph, which are shown in operation.

Legal Proceedings.

THE WENHAM COMPANY, LIMITED, *v.* THE CHAMPION GAS COMPANY AND MESSRS. TODTENHAUPT & CO.

This was an action brought by the assignees of Frank Wm. Clark's patent, No. 2869 of 1881, to obtain relief by way of an injunction and damages in respect of an infringement of their patent rights. The action was tried by Mr. Justice Vaughan Williams, sitting as an additional judge of the Chancery Division. The counsel appearing were—For the plaintiffs, the Attorney-General, Q.C., Mr. W. T. Aston, Q.C., Mr. J. Fletcher Moulton, Q.C., and Mr. W. N. Lawson, instructed by Messrs. J. H. Johnson, Son, & Ellis; for the defendants, Mr. Morton Daniel and Mr. Jenkins, instructed by Mr. Perks.

The Wenham lamp, in defence of which the action was brought, is well-known as a highly successful form of the regenerative gas lamp. As described in Clark's specification, and by the plaintiff's scientific witnesses, it consists essentially of a combination of the following parts:—A gas-admission tube, which depends from the centre of the

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lamp cover, and terminates in a circular burner below. An air tube or chamber shorter than the gas-admission tube, but of larger diameter, is disposed concentrically with it about its lower part. This air chamber receives at its upper extremity the air which is intended to support combustion, and brings it down to the level of the burner, just above which it terminates, being closed by a perforated diaphragm serving to distribute the air evenly over the upper surface of the horizontal flame. About this air chamber is arranged concentrically a still larger tube serving as a chimney, which is carried up past the top of the air chamber, and encloses the upper part of the gas-admission tube. The products of combustion in travelling out of the lamp, therefore, heat first the incoming air and next the incoming gas. For the more perfect heating of the incoming air, it is caused to travel up the outer wall of the chimney as high as the top of the inner air chamber already described by the arrangement of a fourth concentric tube open below, where the air from a surrounding chamber is admitted to the annular space so formed, and closed above, save for three radially disposed tubes, which put it into communication at this topmost level across the chimney with the inner air tube. Lastly, the series of concentric tubes so formed is invested by the outer chamber already referred to, which is formed between the cover of the lamp and an horizontal reflector, which is arranged at a convenient height above the flame. In order that there may be a suitable distance between the reflector and the flame the gas-admission tube and the inner air-admission tube are brought down to a lower level within the lamp than the opening of the chimney or the intake of the outer air-admission tube, which last is disposed above the reflector. A further feature of the combination is the admission of a stream of cool air past the outer rim of the reflector and the glass bowl which encloses the flame and forms the lower part of the lamp. This cool air passes into the lamp across the surface of the glass, which it thereby cools and keeps at a moderate temperature, in spite of the radiation of heat from the intensified flame. The combination may, therefore, be summarised as containing the following elements:—(1) A burner supplied with heated air and heated gas, the heating of these components of the flame being effected by a particular arrangement of the chimney and admission tubes respectively; (2) a horizontally burning circular flame, supplied with heated air from a gauze or perforated diaphragm arranged upon its upper or inner surface; (3) a second and independent supply of cold air directed along the surface of the enclosing glass envelope for the purpose of keeping it cool.

The defendant's lamp, though differently constructed, being formed of a casting instead of wrought metal tubes, and having, moreover, certain convolutions introduced for the purpose of increasing the heating surface, must be taken to fall within the above description, since it has by the decision been found to be an infringement. It was, however, contended on the defendant's part that the arrangement of tubes through which the air passes on its way to the burner in the defendant's lamp was materially different from the patented arrangement. The difference chiefly relied upon was that the annular passage up which the air passes along the outside of the chimney forms no part of the defendant's lamp. The annular passage and the encircling chamber above described as being the two outermost members of the combination are represented in the defendant's lamp by one chamber only. For the plaintiff it was contended that this one chamber was strictly analogous to the annular air inlet of the patented lamp—for the defendant that it was, on the contrary, analogous to the circular space between the lamp cover and the reflector which surrounds the entire system of air passages. In argument also, though not in evidence, it was maintained in the defendant's behalf that the ring burner which he uses is perfectly distinct from that shown in the plantiff's drawing, being so much smaller than the base of the air chamber beneath which it burns that the outer edge of the flame does not sensibly extend beyond the base, and the whole flame consequently lies practically in one horizontal plane. In the plantiff's drawing the nipples, from which of course the flame starts, are shown projecting so far over the base of the air-admission tube that the outer edge of the flame would naturally extend over its edge and curl up round it towards the chimney. It was suggested that this alleged difference was of sufficient importance to be relied upon as an answer to the charge of infringement. There were further defences, founded upon want of novelty, and consequently want of patentable matter, in Clark's invention, and upon certain alleged anticipations.

The learned judge, who reserved his judgment and delivered it on a later day, said that if he were to trust to his own impression he should find for the defendants upon the issue of infringement, since it appeared to him that the defendants had adopted an arrangement of parts differing in some material respects from the patented combination. This he said with special reference to the point above mentioned respecting the size and kind of burner used, and the resulting form of the flame. But he observed that the scientific evidence had been directly and entirely contrary to this view, and although raised by the defendant's counsel in summing up the case, that view had not been put to the plaintiff's witnesses. In these circumstances he considered it his duty to disregard his own opinion, and act as bound by the scientific evidence. Proceeding on this footing, he found in favour of the plaintiff, and that the defendant's lamp had infringed the plaintiff's patent. With regard to the objections raised to the patent on the grounds of want of novelty and anticipation, he did not think that they had been made out, and therefore he gave judgment for the plaintiff company on all the issues of the case.

This case is interesting in many ways. Not only does it show a new judge in the capacity of a patent lawyer, but it raises some very important points of principle and practice. Of the great pains which Mr. Justice Vaughan Williams bestowed upon the inquiry and his very judicial frame of mind, it is impossible to speak too highly, and we shall feel in future a large measure of confidence in his ability to deal satisfactorily with the difficult matters with which patent actions teem. Very striking also is the great and, indeed, paramount importance which was in this case attributed to the scientific evidence. It is widely known that the experts called in the plaintiff's behalf—Sir Frederick Bramwell and Dr. John Hopkinson—are men of the highest eminence, whose opinion is entitled to the greatest weight. But they had not actually pronounced an opinion upon the exact point which, in argument, impressed the judge, and his reason for distrusting his own view was in substance this—that that view had not been discussed with the scientific witnesses. We think that this judicial hesitation was eminently judicious, and that if the expert witnesses had been invited to consider the point, they would not have been greatly affected by the facts put to them or have found much difficulty in satisfying the judge that his doubts were unfounded. At any rate the result illustrates in a striking way the importance of taking the utmost care in the conduct of an action that every point on which a party proposes to rely shall receive full attention. It is pleasant to be able to record that in this instance the expert witnesses have received a striking and well-deserved tribute from an able judge.

Upon the great importance of a well-drawn specification, as illustrated by the decision as to costs in this action, it is the less necessary to remark, because the point cannot fail of making its own impression.

Letters to the Editor.

THE ACKROYD-WILLOUGHBY SMOKE PREVENTER AND FUEL ECONOMISER.

To the Editor of "Industries."

Sir,—Your issue of the 15th inst. (which reached me to-day only) contains an account of another endeavour to solve the smoke problem. May I be permitted to say in a few words that the results do not appear conclusive? The system of heating air to support combustion by passing it through iron pipes placed in the boiler flues is not new, having been originally described, if I recollect right, in a patent of Mr. B. H. Thwaite, some three years ago. The objection to this system is that it practically destroys the draught on the fire-grate if the air is introduced over the grate. I quite fail to see—and I think any one with experience will share my difficulty—how there can be a greater aspiratory pressure when a forced air supply is provided over the grate. How is this phenomenon to be explained? The experiments which are described seem to have proved only one thing—that the system is not smokeless.

It is, moreover, clear that by it there will be less combustion, and, consequently, less steam produced per square foot of heating surface, with the result that the efficiency of the boiler is proportionately reduced. The analysis of the fuel is comparatively useless, as the percentage and character of its hydrocarbons are not given.

Yours, &c.,
Manchester, 21st May, 1891. N.

To the Editor of "Industries."

Sir,—I have read Mr. Crosland's report of the trials of this apparatus printed in *Industries* of the 15th inst., and will, with your permission, make some observations on it.

Every one who has had occasion to scrutinise the evidence furnished by the trials of new inventions, and adduced by inventors to support their claims, must have remarked how frequently such evidence is misinterpreted, and how often results attributed to the application of a patent apparatus have in reality been produced by causes altogether independent of its action. The present is a case in point. In the trials under discussion, black smoke was entirely prevented and the evaporative efficiency of the boiler was increased by 20·5 per cent. when the "smoke preventer and fuel economiser" was in use, and the report attributes both advantages to the action of the apparatus. In reality no such relation of cause and effect is proved to have existed. On the contrary, the evidence tends to show that the great improvement on the second day was mainly, if not altogether, due to a change in the conditions under which the trials were made, and that the same improvement would have followed the same change of conditions if the patent apparatus had not been applied.

Let us consider the question of smoke prevention first. It is easy to see why dense black smoke was made at the first trial. Furnaces with little more than half the usual allowance of air spaces between the bars, loaded, at long intervals, with 200lb., or from eighteen to twenty shovelfuls of coal, and closed by doors apparently air-tight, could not do otherwise than smoke abundantly. Indeed, it would seem that those entrusted with the management of the trial had taken all needful precautions to make smoke in order to prove that there was really something for the "smoke preventer" to prevent. If so, it would surely have been consistent to have taken the same precautions on the second day, instead of reducing the weight of the charges and largely increasing the supply of air. Owing to this inconsistency the trials are altogether inconclusive. They neither proved the possibility of burning 840lb. of coal per hour without smoke with the apparatus, nor the impossibility of so burning 659lb. without it. Experience, however, goes to show that, with a chimney 110ft. high and 5·64 square feet area, it is quite possible to burn 16½lb. of coal, and even 21lb. of coal, per square foot of grate per hour in a reasonably constructed furnace of the ordinary kind, without making either carbonic oxide or dense smoke, especially when the same care is exercised in admitting air through the furnace doors as was used in manipulating the steam jet on the second trial. And thus we are led to the conclusion that the "preventer," if, indeed, it prevented anything at all, prevented only that which, but for the special arrangements made, would not have existed for it to prevent.

And if the claim of 17 per cent. net saving be examined, it will be found equally affected by the change in the conditions under which the trials were made. No one will pretend that a boiler having 1 square foot of heating surface for each lb. of coal burnt per hour will work as economically as one having 2 square feet. The difference in the ratio of heating surface to coal burnt on the trials was not so great as this, but still it was sufficient to affect the rate of evaporation per lb. of coal very sensibly. The heating surface was 941 square feet, and the hourly consumption of coal 840lb. on the first day, and 659lb. on the second. There was, therefore, 1·12 square feet per lb. of coal in the one case, and 1·43 square feet in the other, an increase which at once accounts for about 10 per cent. out of the 17 per cent. net saving claimed for the "preventer."

The remainder of the claim is quite as easily disposed of. Carbonic oxide was made on the first day in sufficient quantity to cause a loss of 818 thermal units per lb. of coal. None was made on the second day, and, with a supply of 20lb. of air per lb. of coal, none would have been made if the "preventer" had not been in action. The heat thus lost was sufficient to have increased the evaporation of 6·64lb. by 0·98lb., or by 14¾ per cent. The evidence, therefore, shows that, if the boiler had been as lightly fired on the first day as on the second, and if the furnaces had not been specially constructed and worked to make carbonic acid gas, the evaporation on the first day would have been about 24 per cent. greater than it actually was, and in excess of that obtained on the second day with the aid of the patent "fuel economiser." Therefore, the conclusion seems to be that the great improvement made was due, not to the action of the apparatus, but to the removal of two adverse conditions which need never have been introduced.

By what process of reasoning can any one persuade himself of the possibility of saving 20 per cent. of coal by putting heat into one part of a boiler which has been taken from another part, for this is really the process by which the evaporation is said to have been increased one-fifth. It is simply robbing Peter to pay Paul. If the heat had been taken from the waste gases in the chimney, some of the saving might have been put to the credit of the apparatus, but I do not think that even then we could admit quite all claimed in the report, seeing that to obtain it practically the whole of the heat passing up the chimney would have had to be absorbed.

Had the conditions of trials been properly arranged, and had the results shown that with the aid of the apparatus it was possible to burn coal smokelessly with less air than without that aid, the "smoke preventer and fuel economiser" might have justified its title. As it is, one can only regret that in making so complete a trial the essential conditions and points at issue should have been so completely overlooked and serious countenance given to a claim which is, on the face of it, absurd.

The report, too, would have been more satisfactory if the usual balance sheet had been given, together with some explanation of the great difference in the quantities of heat unaccounted for on the two days.

Yours, &c.,
Ancient Mariner.

26th May, 1891.

RATING OF MACHINERY.

To the Editor of "Industries."

Sir,—My attention has been called to a paragraph which has been going the round of the Press with reference to the compromise of the Chard Appeals. As this paragraph is evidently inspired, and conveys an entirely erroneous impression, may I ask a portion of your space to state the real facts?

The aggregate amount of the valuations of the various appellants made by the Union valuers was £6,579. This amount has now been reduced, in consequence of the appeal, to £4,899, being a net reduction in rateable value of £1,680. By these figures it will be seen that an attempt has been made to rate these appellants at a sum equal to about 34 per cent. in excess of the amount now admitted to be reasonable. Further justification is hardly needed for the attempt of machinery users to secure the amendment of a law which allows them to be harassed in this manner. The fact that (after spending thousands of pounds of the ratepayers' money in a litigation lasting nearly three years, and embarked upon with the object of maintaining the correctness of this valuation) the Committee have agreed to such terms, not only affords a strong comment on the wisdom of their proceedings, but clearly shows what good ground the appellants had for the resistance they have offered, while the success that has attended their action shows the necessity and value of determined opposition to attacks of this kind.

This Society has been able to afford the appellants valuable assistance, and machinery users similarly affected should at once communicate with me. It is not the manufacturers who have admitted anything by this compromise, but rather their opponents,

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and all attempts to rate machinery wherever made will be contested to the uttermost—these cases were only compromised because the offer made left nothing worth fighting for.

The supporters of what is called "the rating of machinery" have made haste to claim the result of the Chard cases as a victory. They have had more than one such victory recently, including the second reading of the Bill for amending the law as to the rating of factories, when their success was so great that they were unable to raise a debate, and did not divide the House. Their only hope of defeating this Bill now lies in obstructive tactics.

To add to the absurdity of the position into which our opponents are driven, while they talk in the Press and elsewhere about machinery being rateable, there is not one of those gentlemen who can be found bold enough to contend in a court of law that machinery is rateable *per se*, or to give any intelligible explanation of the principles on which they value machinery for rating purposes. In the Tyne boiler case, of which so much is heard, Lord Esher said, referring to the machinery there in dispute, "these are chattels, they are not rateable as chattels which nobody disputes, they are not rateable at all as themselves." No doubt, by miserable quibbling, the appellants in that particular case were defeated, but in future cases this Society will take care that the main issue is not evaded.

The statement that the appellants pay all the costs of the appeals is also misleading. Perhaps some ratepayer in the Union will take the trouble of investigating the amounts which have been paid by the Committee to the Attorney-General and the other counsel, to their late and present solicitors, their surveyors and others, including also the taxed costs they had to pay the appellants at Quarter Sessions, and I think it will be found that the net balance paid by the appellants to the respondents does not exceed 10 per cent. of their total costs.

Yours, &c.,
G. Humphreys Davies,
Secretary.

National Society for the Exemption of
Machinery from Rating,
22, Buckingham Street, Adelphi, London,
26th May, 1891.

THE STRESSES IN BOILER SHELLS.

To the Editor of "Industries."

Sir,—I had hoped that the suggestive paper by Mr. Spence which appeared in your journal on the 18th of March, and the able mathematical investigation by Mr. Slade, on "The Stresses in Boiler Shells," would have attracted the attention of some of your readers, and led to a correspondence on a very important subject, for it cannot be considered at all satisfactory that such a question should be left in the position it has been by the two writers I have mentioned. Mr. Spence is an experienced practical engineer, while Mr. Slade has also had considerable practice, and in addition is an accomplished mathematician, and, therefore, the opinions of both are deserving of careful consideration. At this time of day we cannot allow that theory is necessarily opposed to practice; if it is, one or other, or possibly both, must be wrong, and we should not be content until we have placed matters on a proper basis.

I must say frankly that the manner in which the stresses in boiler shells has hitherto been treated by writers on the subject at least justified Mr. Spence in making experiments to test the correctness of their conclusions. In a paper which he read before the North-East Coast Institution of Engineers last year, he argued that it was unnecessary to make a boiler as strong as if it were an endless ring, and that the resistance due to the connection between shell and ends should be added to the circumferential resistance of the shell, in order to get the true strength of the structure. Of course, if this were true, the strength of boilers, especially of the marine type, would not be, as hitherto assumed, independent of their length, but would depend as much on their length as on their diameter. The ordinary theory is that

$$2ftl = pdl,$$

or,

$$f = \frac{pd}{2t},$$

where f is the intensity of the tensile stress resisting rupture along the longitudinal seams, d is the diameter, l the length, and t the thickness, while p is the uniform internal pressure. There are several assumptions in this theory, and of these the most important is that we are dealing with a tube of endless length, or at least that the influence of the ends on the strength is so small that it may be neglected, and, further, that the thickness is small in comparison to the diameter, which, of course, it always is in ordinary cases. When it is not other expressions are used. Writers on the theory of an engineering subject are too apt to make assumptions, and then to add the still further assumption that their conclusions are infallible laws of nature. A great deal of what has been called the theory of the steam engine has been of this nature; in fact, it is to be doubted whether the so-called theory of the steam engine has not been the means of retarding progress. If what was taught of the action of steam in cylinders had been depended on, the greatest improvement which has taken place in steam engines during the past quarter of a century would not have been carried out, for we were taught that from a theoretical point of view it did not matter whether the expansion of steam was carried out in one or more cylinders. Then, again, the conditions of Carnot's theoretical engine have been applied to actual engines working under very different conditions, and most ridiculous conclusions have been drawn.

I simply mention these facts for the purpose of showing that we ought to approach the subject raised by Mr. Spence with unprejudiced minds, and probably we may be convinced, like him, that the strength of cylindrical boilers is still an unsolved problem, and find that, as he indicates, the true solution of the problem will apply equally to boiler shells subject to internal and to flues subject to external pressure. It does not follow that, because the theory hitherto adopted for the strength of boilers is incomplete, that therefore the conclusions arrived at are wrong, for the omitted elements may balance each other.

I have read Mr. Slade's paper with care, and it seems to show that these conclusions are at least approximately correct, and that it would be highly dangerous for any one to accept Mr. Spence's results, and make boiler shells half the present thickness in the hope of getting the load carried by the ends. Him shortly before his death expressed the opinion that in the present state of our knowledge it was impossible to work out a complete theory of the steam engine. May it not also be true that a marine boiler is so complex a structure, made up of shell, stays, flues, tubes, ends, &c., that all we can expect from theory or calculation is a first approximation to the required dimensions, and that we must depend on experiment for an answer to such questions as that raised by Mr. Spence. He has gone in the right direction, but before the question is decided the experiments must be on actual boilers, and not on models. This seems a work which might be undertaken by the Board of Trade.

Yours, &c.,
M.I.N.A.

Glasgow, 23rd May, 1891.

A DEPARTMENT OF LABOUR.

To the Editor of "Industries."

Sir,—In a letter which I sent to you on the subject of "The Labour Commission," and which you were good enough to publish in your issue of the 24th ult., I suggested that possibly the most tangible result of the Commission would be a department of labour or industry which would look after the interests of all sections of the industrial classes, workers and employers alike, and would also collect information on all points of interest and receive evidence from all parties who were likely to throw any light on any part of the labour problem. Its chief duties would be to collect trade statistics and information regarding the hours of labour in different industries and occupations, the scope and results of the Factory Acts, and the employment of women and children, while it might also take charge of the arrangements connected with arbitration, and the settlement of trade disputes generally, and all proposals connected with these questions.

I am pleased to learn that such proposals are beginning to take definite shape, and that Lord Dunraven is to bring the matter of the organisation of a department of State for dealing with labour questions generally before Parliament at an early date. His Lordship, as is well known, has taken a very active interest in all matters referring to the welfare of the working classes, and, like all who have done so, he finds that the Labour Bureau of the Board of Trade is inadequate to the great importance of the subject. As has been pointed out by you, this is not the fault of those in charge of it, but arises from the fact that the Department is starved. I do not know what steps his Lordship intends to take in this matter, but as the arrangements ought to be gone about with great deliberation and full understanding of all the difficulties of the work, I would suggest that it be made a suggestion to the Labour Commission to inquire and report into the desirability of having a Labour Department. Your article on "Trusts," in your issue of last week, shows the advisability of another suggestion which I made—that is, of investigating the scope of Government interference in special departments of industry when these tend to become monopolies. I pointed out that in those class of syndicates, trusts and "rings," it might soon become necessary to have a policeman on the Board of Directors to look after the public interests.

Yours, &c.,
Economist.

Leeds, 26th May, 1891.

SHIPBUILDING NOTES.

On the 7th inst. Messrs. Sir Raylton Dixon & Co. launched from their No. 2 Dockyard, Middlesbrough, an iron steam trawler, the "Albion," built to the order of the Great Grimsby Albion Steam Fishing Company, Limited, Grimsby. The leading dimensions are:—Length, between perpendiculars, 96ft.; breadth, 20ft. 5in.; depth, moulded, 11ft. 8in. The engines will be supplied by Messrs. Westgarth, English, & Co., having cylinders 11in., 17in., and 28in., by 20in. stroke.

On the 7th inst. Messrs. Sir Raylton Dixon & Co. launched from their No. 2 Dockyard, Middlesbrough, an iron steam trawler, the "Cynthia," which has been built for Messrs. Mitchell & Allen, of Grimsby. The vessel is of the following dimensions:—Length, between perpendiculars, 96ft.; breadth, 20ft. 5in.; depth, moulded, 11ft. 8in. The engines will be supplied by Messrs. Westgarth, English, & Co., on the triple-expansion principle, having cylinders 11in., 17in., and 28in., by 20in. stroke.

On the 9th inst. Messrs. Wm. Simons & Co., Renfrew launched from their works a self-propelling hopper dredger, constructed by them for the Indian Government. The vessel is specially designed for dredging in shoal water. When propelling, the bucket ladder and upper gearing are lowered to the deck level, thus greatly improving the seagoing qualities of the vessel and increasing its stability, and, when dredging, these again are traversed on a diagonal framing to the upper position, enabling the buckets to be projected in advance of the hull. The vessel has a capacity in its hopper to hold 400 tons of dredgings. This is the fifth dredging steamer constructed by this firm for Indian ports.

On the 14th inst. the new steel paddle steamer, "Duchess of Devonshire," recently built by Messrs. Richard & Henry Green, of Blackwall, London, had a successful trial trip. The principal dimensions of the vessel are:—Length, over all, 178ft. 6in.; breadth, moulded, 20ft.; depth, moulded, 8ft. 3in. Her engines, of the compound diagonal type, have been constructed by Messrs. John Penn & Sons, of Greenwich, and gave satisfactory results. The cylinders are 45in. and 22½in., with a stroke of 3ft., indicating 400 h.p., with a speed of 12½ knots. The vessel is built to the order of the Devon Steamship Company, of Exmouth.

A new twin-screw steamer, the Tynwald," was recently launched by the Fairfield Shipbuilding and Engineering Company for the Isle of Man Steam Packet Company. The vessel will ply between the Clyde and the Isle of Man during the summer, and from Liverpool to Douglas during the winter. The engines will be of the triple-expansion inverted type, the cylinders being 22in., 36in., and 57in. diameter respectively. Two double-ended boilers are fitted tandem, and are worked at a pressure of 160lb. to the square inch.

On the 16th inst. the new twin-screw steamer "Kwarra," built and engined by the Naval Construction and Armaments Company, Ld., Barrow, to the order of Messrs. Elder, Dempster, & Co. (who have since sold her to the African Steamship Company, of Liverpool), left Barrow for her trial trip. Everything passed off successfully, and the working of the machinery proved very satisfactory. She was docked in Liverpool the same evening. The "Kwarra" sailed from Liverpool for Lagos on the 23rd inst. on her maiden trip.

On the 22nd inst. Messrs. Wm. Simons & Co. launched complete from their yard at Renfrew the third of three steam hopper barges for the Corporation of Preston. The dimensions of the vessel are as follow:—Length, 130ft.; breadth, 24ft.; depth, 9½ft., and it has a hopper capacity to contain 300 tons of dredgings. The engines will indicate 250 h.p. The two former vessels, which have been launched within the last two months, are now at work at Preston.

On the 23rd inst. Messrs. Murray Bros., Dumbarton, launched the "Clutha No. 10," a twin-screw steamer for the up and down river passenger service of the Clyde Trustees. The dimensions of the vessel are 90ft. by 17ft. by 8ft. 3in. The compound engines are by Messrs. Matthew Paul & Co., Dumbarton.

On the 23rd inst. the Grangemouth Dockyard Company launched the "Meteoro," a twin-screw steamer for Rio Janeiro. The dimensions of the "Meteoro" are 220ft. by 35ft. by 19½ft. The engines have been made by Messrs. Hutson & Corbet, Glasgow.

On the 23rd inst. the Grangemouth Dockyard Company also launched a steel barque of 1,200 tons, built at their yard at Alloa for Mr. A. O. Ludvig, Kragero, Norway.

On the 26th inst. Messrs. Barclay, Curle, & Co., Ld., Whiteinch, launched the "Crondale," a steel sailing vessel of 1,900 tons. The vessel has been built to the order of Messrs. Donaldson, Rose, & Co., Aberdeen.

On the 23rd inst. Messrs. Ropner & Son launched the steel screw steamer "Venus," of the following dimensions:—Length, over all, 324ft.; breadth, 40ft. 6in.; depth, moulded, 23ft. 7in. This steamer has been built under special survey to class 100 A1 at Lloyd's to the order of Messrs. Thos. Robinson, Sons, & Co., of West Hartlepool. The vessel is provided with cellular bottom for water ballast, and is built on the web frame principle. The engines are by Messrs. Blair & Co., Ld., of 1,200 h.p., with two steel boilers working at 160lb.

On the 26th inst. Messrs. Richardson, Duck, & Co. launched from their building yard at South Stockton a steel screw steamer, "Sidney Thomas," of the following dimensions, viz.:—Length, over all, 307ft. 4in.; breadth, extreme, 40ft.; depth, moulded, 21ft. 8½in. This vessel, which has been built for Messrs. Andrew Low, Son, & Carter, London, is classed 100 A1 at Lloyd's. She has a cellular bottom fore and aft for water ballast. The engines, by Messrs. Blair & Co., Ld., of Stockton, are of the triple-expansion type, with cylinders 20in., 36in., and 59in., by 39in. stroke.

On the 26th inst. Messrs. Edward Withy & Co. launched from their yard at Hartlepool the large steel screw steamer "Salopia," built to the order of Mr. George Steel, West Hartlepool, for Messrs. Steel, Young, & Co., of London. This is the one hundred and eighty-second vessel constructed by this firm, and the thirty-fourth built in the Hartlepools for the same owners, thirty of these having been built by Messrs. Edward Withy & Co. The vessel is a fine type of a modern cargo boat, measuring over 300ft. in length, and built throughout of Siemens-Martin steel, and is built to the highest class at Lloyd's. A cellular bottom is fitted all fore and aft for water ballast. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. The vessel will be fitted with triple-expansion engines by Messrs. Richardson & Sons, Hartlepool.

Reviews.

Special Inquiry into the Zone Railway System. Glasgow: James Hedderwick & Co. 1890.

During last year (see *Industrie*, Vol. IX., page 382) we gave a short account of the zone system of railways as described by a special Commissioner of the Glasgow *Evening Citizen*, with the hope that the attention both of the public and of the railway authorities might be directed to the zone system of tariffs, so that they might consider whether it, or some modification of it, is at all suitable to the conditions of this country. We are glad to observe that the letters to which we referred have been published in pamphlet form, and thus rendered more accessible to the general public The pamphlet lucidly explains the arrangements which have been made in Austria-Hungary for the promotion of cheap passenger traffic on remunerative terms, and it also makes suggestions which might be usefully applied in this country, and points out some lessons which might be derived from certain arrangements on Prussian railways which in four years raised the number of passengers carried on State

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railways by about seven millions. It also points out that in some respects the zone system has been adopted in this country, and the writer quotes the arrangements of the Glasgow and South-Western Railway, and urges the directors to proceed a little further in the same direction. We commend the pamphlet to the careful attention of our readers.

Fuels, Their Analysis and Valuation. By H. J. Phillips. London: Crosby Lockwood & Son. 1891.

The author believes that the great progress made in recent years in the adaptation of various kinds of fuel to special purposes is sufficient to warrant the issue of his work, which deals with the methods of analysis and valuation of solid, liquid, and gaseous fuels, and gives a collection of tables showing the composition and consumption of various fuels in use in locomotives, &c. The methods of analysis described comprise the estimation as ash, carbon, coke, sulphur, volatile matter, &c., the flash point in liquid fuels, and elementary gas analysis as applied to gaseous fuels. A short description of Thomson's calorimeter and its use for estimating the calorific value of a sample of fuel is also given. There are a few printers' errors in the book—*e.g.*, that on p. 10, where the tension of aqueous vapour at 15° C. is stated to be equivalent to "12,677 mm. of mercury," which should be corrected in a future edition. We consider it a handy little work, and likely to prove useful to engineers and all who consume fuel for manufacturing or industrial purposes.

An Introduction to the Study of Metallurgy. By W. C. Roberts-Austen, C.B., F.R.S. London: C. Griffin & Co. 1891.

In view of the fact that the value of metals obtained by smelting ores in the United Kingdom amounts to nearly fourteen and a half million pounds sterling annually, it is remarkable that the English literature of metallurgy is so scanty. Besides the classic, but now antiquated, treatises of Percy, we can only recall the useful manual of Phillips and Bauerman. We are glad, therefore, to welcome Professor Roberts-Austen's addition to the limited list. Metallurgy has undergone a remarkable change within the last few years. With the practical disappearance of the older methods of manufacturing steel in favour of the more modern ones, the problems that formerly arrested the attention of metallurgists have now given place to others of greater technical importance. The older questions were based chiefly on empirical reasons, whilst the modern ones have a more scientific basis. By no means the least amongst these is the question of molecular constitution. Chemical analysis is no longer the sole factor. Physical questions, dealing, for example, with the casting, forging, hardening, annealing, and heating of metals, are now receiving much attention, and are leading to the introduction of changes in the methods of manipulation. Such studies, formerly of mere theoretical interest, have acquired practical importance. These facts have evidently been borne in mind by Professor Roberts-Austen in the preparation of his admirable treatise, and in his first four chapters on the relation of metallurgy to chemistry, on the physical properties of metals, on alloys, and on the thermal treatment of metals, he clearly shows what kind of aid the metallurgical art may be expected to receive in future from the sciences.

The author's long experience as Professor of Metallurgy at the School of Mines, or, as it is now called, the Royal College of Science, and as examiner in metallurgy to the Science and Art Department and to the City and Guilds of London Institute, have shown him the defects of the metallurgical text-books in vogue, in which the important metals are dealt with separately and in detail. He has, therefore, adopted a more rational method, by which the subject is treated as a whole. He gives no minute description of processes, but selects for description typical appliances, indicating their use in connection with groups of metals. By thus systematising the study of metallurgy, which has hitherto been a heterogeneous mass of disconnected facts, his book marks an epoch in the history of the teaching of metallurgy in this country. This section of the subject is treated in five chapters, dealing respectively with fuel, with the materials and products of metallurgical processes, with furnaces, with the means of supplying air to them, and with typical metallurgical processes. The last chapter is of interest to the political economist as well as to the metallurgist. It deals with the principles by which the relations of capital and labour are guided, and with the economic conditions under which metallurgical works are carried on.

In the treatment of the subject every care appears to have been taken to secure accuracy. As an illustration of this we notice that some figures relating to furnace charges borrowed from Professor Balling have been recalculated, and some errors that occur in the original German work have been corrected. The same care is noticeable in the numerous reference to authorities, these references forming a bibliography of metallurgy that will render the volume valuable, not only to the student, but also to the metallurgical expert. The book is furnished with eighty-three well-drawn illustrations, and, we are pleased to note, with a good index—unfortunately rare in technical works. As a condensed account of the theory and practice of modern metallurgy Professor Roberts-Austen's work cannot fail to be an invaluable auxiliary to the more exhaustive works on the subject, and students are to be congratulated that the author has been induced to place the results of his ripe experience in an accessible form.

The History and Development of Steam Locomotion on Common Roads. By William Fletcher. London: E. & F. N. Spon. Ipswich: Printed and published by S. H. Cowell. 1891.

It is somewhat curious to note that, among all the books which have been written on different departments of mechanical engineering, the history of the application of steam locomotion on common roads has received very little attention. Mr. Fletcher gives a list of the works from which he has extracted information, but these are for the most part general treatises, which only take up the subject of locomotion on common roads in an incidental manner, and Mr. Fletcher's book may be considered the most complete which as yet has appeared on the subject. Some of the earlier parts of it appeared in various technical journals, including our own, and the author acknowledges his indebtness to these journals for many of the illustrations. The historical method of studying a subject is one of the most instructive, and in no department could it be made more useful than in that of engineering. We would not, of course, advise a search into all the antiquated forms of different kinds of machines, but simply a careful study of typical designs which mark steps in their development, and which record the work of the best and most successful men who have worked in the same direction. By this method we can examine their difficulties, appreciate their obstacles, measure their mistakes and errors of judgment, and mark the steps which led to success.

The book is divided into seven sections:—(1) Introduction; (2) the period of speculation; (3) the period of experiment; (4) the period of successful application; (5) the modern period; (6) practical notes on the design and construction of road locomotives; and (7) traction engine law. The first five of these sections are chiefly historical, and contain much useful as well as curious information. Not only had difficulties of construction to be overcome, but also difficulties occasioned by public opinion being prejudiced against the engines. Mr. Fletcher says that the steam carriages of the early days were hooted and hissed at by road authorities, coach-drivers, publicans, and the multifarious men who delighted in horses, which perhaps was not to be wondered at, seeing that the interests of these men were at stake; but engineers and others, who ought to have known better, joined in the crusade against steam on common roads, from the celebrated James Watt, who actually put a covenant in the lease of his house, Heathfield Hall, that "no steam carriage should, on any pretence, be allowed to approach the house."

Mr. Fletcher gives an interesting account of how these difficulties were overcome, and enters into details of modern designs. This part of the book is, in fact, a treatise on traction engines, for his illustrations are clear and distinct, and his details of dimensions and proportions sufficient to guide design. He has, moreover, a special chapter containing notes on the design and construction of road locomotives, which will be found most useful. He concludes by directing the reader's attention to several unreasonable and almost prohibitive clauses in the Road Locomotive Acts of 1861, 1865, and 1878, now in force.

Mr. Fletcher's book has been printed and published in his own locality, and wants some of the finish which characterises books published in the metropolis, and he explains that it has been written in the intervals of business, and that doubtless some of the faults of the work are occasioned by this circumstance. However, books by practical engineers are always welcome, and we can pardon a few faults in literary arrangement. Mr. Fletcher's book forms altogether a valuable addition to the engineer's library.

Strength and Properties of Materials. By W. G. Kirkaldy. London: Sampson Low, Marston, Searle, & Rivington, Limited. 1891.

This large and handsome volume, containing 216 pages of text, 104 pages of tabulated data, comprising the results of 12,000 selected experiments, illustrated by 47 pages of lithograph-plates, and published at four guineas, may, in a sense, be considered the development of a paper, which the father of the author, Mr. David Kirkaldy, read before the Institution of Engineers in Scotland in 1859, giving the results of some experiments which he had carried out for Messrs. Robert Napier & Sons. These experiments seem to have given the bent to the whole of Mr. Kirkaldy's after career. In 1862 he published a treatise on the "Results of an Experimental Inquiry into the Comparative Tensile Strength and other Properties of various kinds of Wrought Iron and Steel," which contained a vast amount of useful information, and was much consulted by engineers, until the change in the character of the materials made the data antiquated. Shortly after the publication of that work, Mr. Kirkaldy went to London, and established the testing business, in connection with which his name is so well known, and the volume we are noticing comprises a selection of the results obtained during the past quarter of a century, showing the strength and other properties of materials used in construction.

The leading objects of the work are stated to be:—(1) To show the present state and extent of the testing works; (2) to explain the system of carrying out experiments of various classes; (3) to place in available form valuable information and data for professional men, in conjunction with which are explanations of details and comments to extend the practical benefits to be derived from the results set forth; (4) to record what David Kirkaldy has experienced in his professional career, and to establish his labours by giving the reader the means of judging his actions, with the hope that, by making known some of the treatment that he has been subjected to, the support of those who uphold fair-dealing may be stimulated. The first part is not so specific as regards details as we would have liked to have seen it, for while it gives a very good idea of the buildings and of their contents in a general way, it omits to give what would be of the greatest interest to engineers—namely, a description of the splendid testing machine which Mr. Kirkaldy designed and of which he superintended the construction. For this he deserves the very highest credit, for, although many machines have since been made, Mr. Kirkaldy's is not only one of the most powerful in existence, but also one of the best. When we compare it with the simple lever with which he made his experiments at Napier's, we realise the great step which Mr. Kirkaldy took. The system of testing which is carried out for commercial and scientific purposes is fully explained in the second section of the book. The third section is the one which will be of the greatest use to engineers, and which will, therefore, be pursued by them with a great amount of interest, as it contains a number of reports of tests with commentaries on them. The lithographed plates have been very carefully drawn, and are most instructive in many respects, and the conclusions deduced will for the most part be agreed to by engineers. There are, however, some points to which exception will be taken, but into these our space will not allow us to enter. The record of the professional career of such men as David Kirkaldy is always instructive, but we think that some of the personal details and reflections might have been omitted. No doubt, like other men, he has been often misunderstood, and possibly in some cases suffered injustice, but a volume like the present was scarcely the place in which to record grievances. Most of them, we are afraid, had their origin in his uncompromising honesty, and his somewhat rugged Scotch character. We are glad, however, that his work has had such a worthy record, and we hope it will find a place in all standard libraries.

THE TOMLINSON SUB-STATION REGULATOR.

As electrical engineers become more fully alive to the waste of power in transformers kept in circuit all day, the sub-station method of distributing alternating currents is coming more to the front. Mr. J. E. H. Gordon has recently exhibited a most ingenious sub-station regulator. It is the invention of Mr. Thomas Tomlinson, and is designed for cases where there are a number of transformers at each sub-station.

The Tomlinson apparatus, which we illustrate in Fig. 1 on page 522, is provided with four sets of switches, and the transformers are arranged in five groups. One group is permanently connected to the mains, and one more is connected through each set of switches respectively. Suppose that one transformer is permanently connected to the mains, then one would be connected to the first switch, two to the second, four to the third, and eight to the fourth, so that the putting in of each switch doubles the number of transformers in circuit. With a current of 1,500 lamps on a single switch no spark whatever is visible. The switches are thrown over by a sliding carriage in the form of a double wedge, which

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THE TOMLINSON SUB-STATION REGULATOR.

Constructed by Messrs. J. E. H. Gordon & Co., Limited, Electrical Engineers, London.

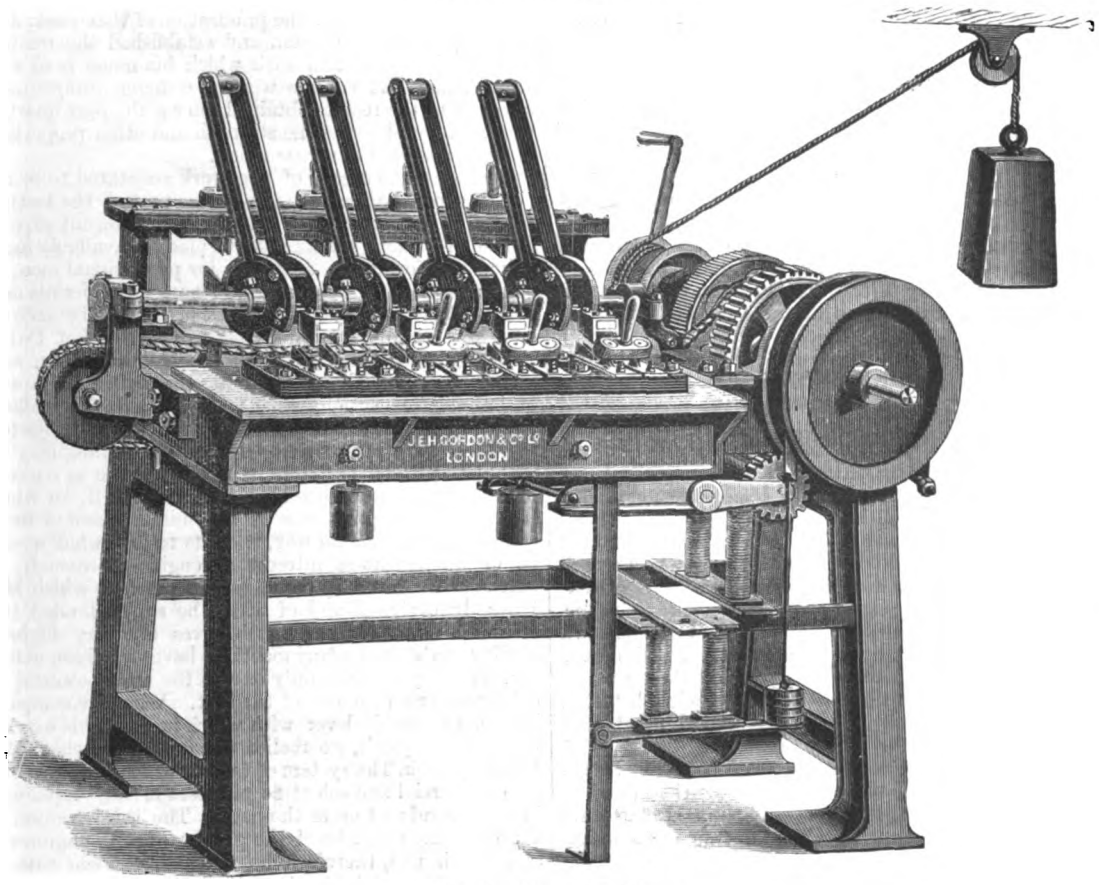


Fig. 1.—General View.

runs backwards and forwards along the bed-plate of the machine, and, as it passes each switch, throws over a tumbling lever, which strikes the switch suddenly in or out of contact.

This carriage is moved by an endless chain actuated by two weights, which are released respectively by two electromagnets. The large weight which takes the transformers out of circuit has to be wound up once a week, and, as it takes out the transformers, it at the same time winds up a smaller weight ready to put them in again. If any failure whatever of the large driving weight occurs, or if the attendant forgets to wind it up, the small weight is always ready to put the whole of the transformers into circuit, and must do this before the apparatus becomes inoperative.

The apparatus has been tried practically through the courtesy of the Brush Company, the Electric Construction Company having also lent transformers for the experiment.

The plant was first run for twenty-four hours with the transformers connected in the ordinary manner, and then for twenty-four hours with them connected through the Tomlinson regulator, and coal and water were measured throughout the experiments. The actual saving in coal was carefully determined, and the use of the regulator showed a saving amounting to an extra dividend of nearly two per cent.

ON SOME POINTS CONNECTED WITH MAINS FOR ELECTRIC LIGHTING.*

My object is to extol the "sweet simplicity" of the two-wire system, the practical security of concentric mains, and the unquestionable economy of the high-pressure principle. I do not intend to discuss overhead wires. I consider them, for high-pressure electric light circuits, an abomination, especially as it is easy to show that ultimate economy is in favour of the underground system. It is only the first capital expenditure that favours overground mains; safety, freedom from accident, ease of repair, and renewals are all the other way. The only limit to the use of extra high pressures, or to the voltage employed, is the efficiency, economy, and durability of insulating materials.

There is one objection to most mineral hydrocarbons—viz., that they require to be encased in lead; but oil has this advantage—that it can be used in iron pipes as in the method adopted by Brooks. Lead covering is expensive, and it adds seriously to the weight of the cable, so as to render more difficult its handling and drawing in and out. On the other hand, lead adds materially to the life of the cable. I have in my possession samples of lead-covered wire which were buried in 1844, and in which the conductor and insulating medium are now as perfect as when made. Lead, however, in some localities, especially in decaying vegetable matter, is itself attacked. When, however, properly protected, it ought to last for centuries. The lead used by the Romans to distribute water in Pompeii is still visible. Lead-covered cables are very largely used in America, Germany, and France, and their employment is rapidly extending in England.

The points that determine the distribution of low pressure are fall of potential, and number of feeding points and distributing stations. We need not consider the heating of conductors. If we take care of the potentials, the waste will take care of itself.

One ton of copper of 1 square inch sectional area covers a length of 192·3 yards, and its resistance is ·0046 ω. Hence, a length of 220 yards weighs 1·13 tons, and its resistance is ·00527 ω. A pair of such mains will weigh 2·26 tons, and their resistance will be ·01054 ω. 1,000 amperes means, therefore, a loss of 10½ per cent. (and 1 kilowatt is wasted in every 43·4 yards), 500 amperes means a loss of 5¼ per cent., and 237 amperes means a loss of 2½ per cent., in such a circuit when the full load is supposed to be concentrated at the end. If we take a fall of potential of 2½ per cent. in each main, which is the recognised maximum waste at full load allowed to comply well with Thomson's law, it means 474 amperes delivered at 100 volts, or 1,600 8 c.p. lamps served. In fact, we may say that two mains of 1 square inch copper will serve 1,600 8 c.p. lamps at 220 yards distance; and this appears to be the commercial limit of the two-wire low-pressure distribution. Of course, if we are content to admit a greater waste, this limit of distance can be extended, and the number of lamps to be served can be increased in the same ratio. The exact waste to be allowed is an economical question governed a good deal by the conditions of the problem, financial as well as engineering. Now, if we add another 100 volts at the points of supply, we can deliver the same energy for the same number of lamps with the same loss at 880 yards; and for every additional 100 volts delivered, we can extend the distance to which the supply can be driven under similar conditions, as the square of the unit distance, 220 yards, for to maintain the same energy the current is *diminished* in the same ratio. Thus 2,050 volts will drive the energy required for 1,600 8 c.p. lamps fifty miles if we use mains of 1 square inch sectional area, and are satisfied to waste only 5 per cent. of the driving energy. Professor John Hopkinson, F.R.S., showed how,* by the use of an intermediate third wire and two dynamos, we could use 200 volts with our present lamps, and therefore we could practically diminish for the same distance the weight of copper used by one-half, or we could make the same weight of copper serve double the distance. The third wire, however, diminishes the effective economy of the plan. Its practical commercial limit appears to be about half a mile; and its disadvantages to be, more dynamos to work, and considerable complication to adjust and regulate the equilibrium of lamps on the circuit.

There is no practical limit to the high-pressure system: 10,000 volts will drive energy from Deptford to London on two mains of ¼ square inch section to serve 50,000 lamps; and 27,000 volts will drive 300 h.p. 112 miles, from Lauffen to Frankfort, on a conductor of ·06 square inch sectional area—*i.e.*, a No. 2 copper wire. But we have to take into consideration the difficulties of the distribution. On the two-wire system this means one central station for each effective area having a mean radius of 220 yards. On the three-wire system this area can be extended to a mean radius of one-half mile; the five-wire system extends the mean radius to one mile; but with the high-pressure system the area is practically unlimited in extent. When the mains and feeders are at high pressure, and the distribution at low pressure by two wires, we must contemplate *sub-stations* serving areas having a radius not exceeding 220 yards, if the lamps be uniformly scattered over the area and our waste energy is kept low.

A transformer sub-station is a very simple and cheap structure. It may be excavated underground, or be in a cellar or in a backyard. The instruments are stationary. They require no oiling, nor adjusting, nor handling, nor even tending. They can be buried in oil and suffer no deterioration. They are simple in construction, and should need no repair. Switches to throw them in and out of circuit may be automatic or manual, and can be operated from outside the transformer room, as is done in Rome. It is impossible to serve economically a wide and scattered district with a mean radius of over one mile by any other means than by high pressure, for we cannot multiply central stations without seriously increasing capital outlay and working expenses; unless, indeed, the density of supply be very great, as it is in some quarters in London and in some of our large provincial cities.

At the meeting of the Institution of Electrical Engineers, held on the 14th inst., a discussion took place on Mr. Preece's paper.

Mr. Swinburne remarked that in 1889 he had discussed the subject of disturbance in telephones with reference to concentric cables earthed at one end. Many persons thought no trouble would arise from such a course. This, he believed, was a mistake, for the outside conductor being near earth had a considerable capacity relatively thereto. If a large current, say, of 250 amperes, was passing, the pressure between the two ends of the outer conductor would be about 210 volts, and this would cause a considerable earth current to surge backward and forward between London and Deptford. The effect of these currents had, he believed, not yet been observed, but it would become noticeable when the load got heavy. Mr. Preece, he said, thought earthing the secondary of a transformer tended to lead the current into temptation, but, as a matter of fact, the temptation was diminished by earthing the middle of the secondary. If this be done neither secondary main could differ by more than 50 volts from the earth potential, whereas, if one end be earthed or neither, the risk and danger were considerably increased.

The further discussion was adjourned.

ON THE MOST ECONOMICAL MODE OF FEEDING A LOW-PRESSURE NETWORK.†

The advocates of alternating transformer systems of distribution appear at last to be in agreement with those who designed low-pressure systems, in that they admit that for the supply of towns of ordinary compactness a low-pressure network must be provided. As it was evident that there is a certain length of feeder at which the low-pressure direct system fails to compete successfully in first cost and that of upkeep with the above-described high-pressure A.T. feeder, I have recently investigated the question in order to find out at what mean length of feeders the low-pressure and high-pressure systems compete on equal terms of first cost, cost of upkeep, and efficiency. The result of my investigation is to show that when a three-wire low-pressure system, distributing direct to 110-volt lamps, is compared with an A.T. system, distributed by 2,000-volt feeders, transformed to supply the same three-wire network, the average annual efficiency of the feeders in both cases being 90 per cent., the low-pressure feeder is cheaper for all distances up to 2,400 yards, each of the feeders being calculated to supply 100 kilowatts; and the annual cost for upkeep, including a sum of 5 per cent. for interest on the capital, will be about £290 per annum. These large figures lead me to compare with them the known cost of upkeep of feeders carrying the same load which are now in use in London. I find that feeders of an average length of 600 yards cost about £300 each, and for interest and upkeep £25 per annum. This comparison shows that if we increase the length of each feeder by 1,800 yards, or say one mile, it increases the supply company's annual upkeep charges by not less than £260 per annum per feeder. If we apply these figures to a company supplying a district of about a square mile, which, if it had within it two generating stations, could feed its network with ten short feeders, and substitute for these two central stations one external generating station one mile distant from the outside

* Abstract of a paper read on the 7th inst. before the Institution of Electrical Engineers by Mr. W. H. Preece, F.R.S., Past-President.

* John Hopkinson, Patent No. 3576, July, 1882.

† Abstract of a paper read on the 21st inst. before the Institution of Electrical Engineers by Mr. R. E. Crompton, Vice-President.

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of the district, the extra cost of upkeep of the ten long feeders will be £2,600 per annum. At a load factor of 10 such a district would sell 876,000 units per annum; therefore, the above sum of £2,600, divided by this number of units, is equal to 0·72 of a penny per unit sold. Now, even at present the cost per unit for coal and ground rent (which are the only two items affected by the removal of the site from a central position to a distant point) only slightly exceeds 1d. a unit, and in all probability during the present year this figure will be brought down to a sum approximately the same as the above-mentioned upkeep of the feeders—viz., 0·72d., which I have shown is the actual cost of upkeep of the feeders only. This shows the absurdity of imagining that any saving can be effected by this mode of feeding a network, and it is quite evident that those who have advocated the system have never seriously looked at the matter from this point of view.

THE MANUFACTURE OF SOAP.

By W. Lawrence Gadd, F.I.C., F.C.S.

X.

(*Concluded from page* 499.)

Apart from the best transparent soaps, some of which are almost everything to be desired, there is no doubt that the best soaps for toilet use are those manufactured by the "milling" process, which has only recently received any attention in this country, although it has been for some time generally adopted on the Continent. The process is practically the same as that followed years ago for the manufacture of the highest priced and

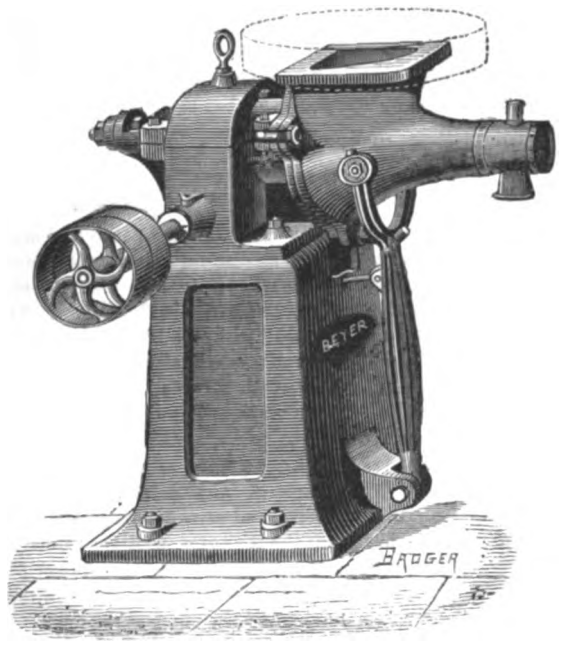


Fig. 15.

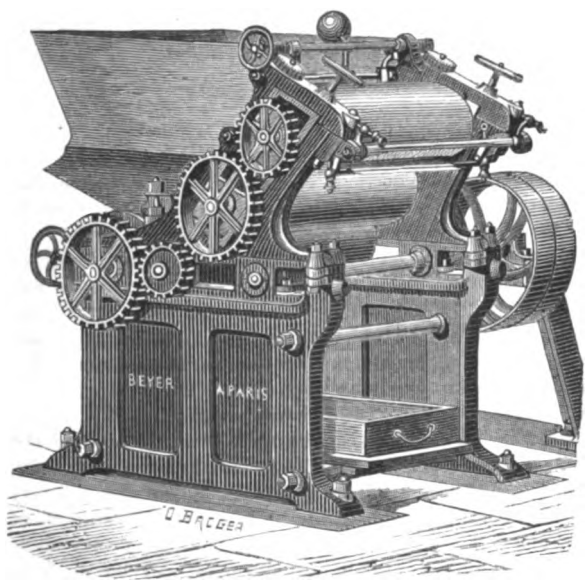


Fig. 16.

best toilet soaps, but with this important difference, that whereas the old result was attained by slow and careful manipulation by hand, in the new process, as its name implies, the skilled workman is superseded by powerful machinery.

Figs. 15 and 17 show the various necessary machines, as made by Messrs. Beyer Frères, of Paris, and supplied in this country by Messrs. Martin Perls & Co., of London. Their use may be briefly described as follows:—The bars of well-made, pure white, curd soap—which should be manufactured from the finest materials, and be entirely free from uncombined alkali and other objectionable substances—are first reduced to thin shavings or shreds by a belt-driven machine containing revolving knives, and called a rotary cutter, the bars being placed in the side hoppers, and the shavings delivered at the bottom of the machine. These shreds are then placed in the hopper of the crushing mill Fig. 17, where they are crushed to a pasty condition by passing several times between heavy granite rollers, while perfumes and colouring matter are at the same time added. In this way a uniformly coloured and homogeneous paste or dough is obtained, which is then transferred to the squeezing machine Fig. 15, where it is forced, by a special form of mechanism, through a tube or cannon, and thereby compressed or moulded into the form of continuous bars, which are made either round, flat, or square by passing through gauge plates of the required shape placed at the mouth of the cannon. The continuous bars so formed are cut into pieces of the desired size, and immediately stamped, the force of the downstroke giving the tablets the required shape and impressions, and also imparting a high finish or gloss to the surface. They are then ready, without further drying or manipulation, for packing or for use.

Fig. 16 shows an improved form of crushing mill, with four rollers; two of these are placed obliquely above the first couple, placed horizontally. The soap shavings are

THE MANUFACTURE OF SOAP.

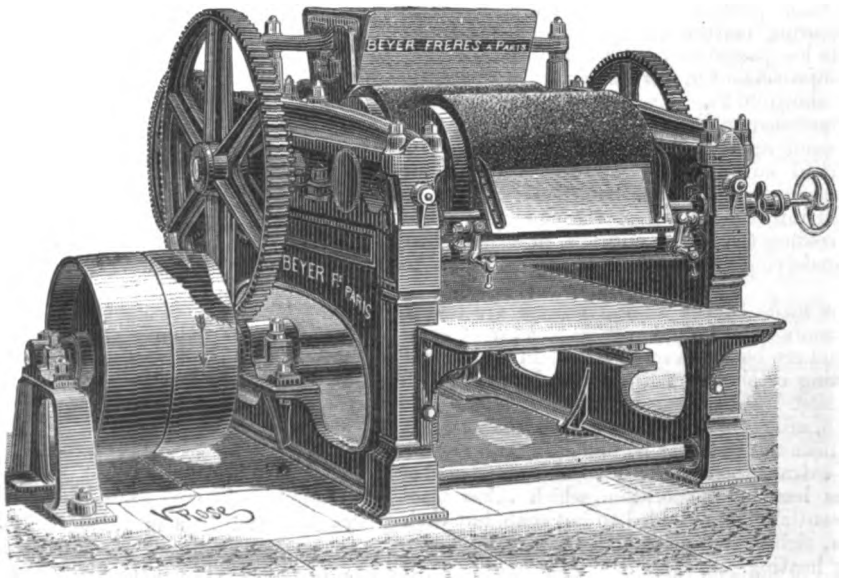


Fig. 17.

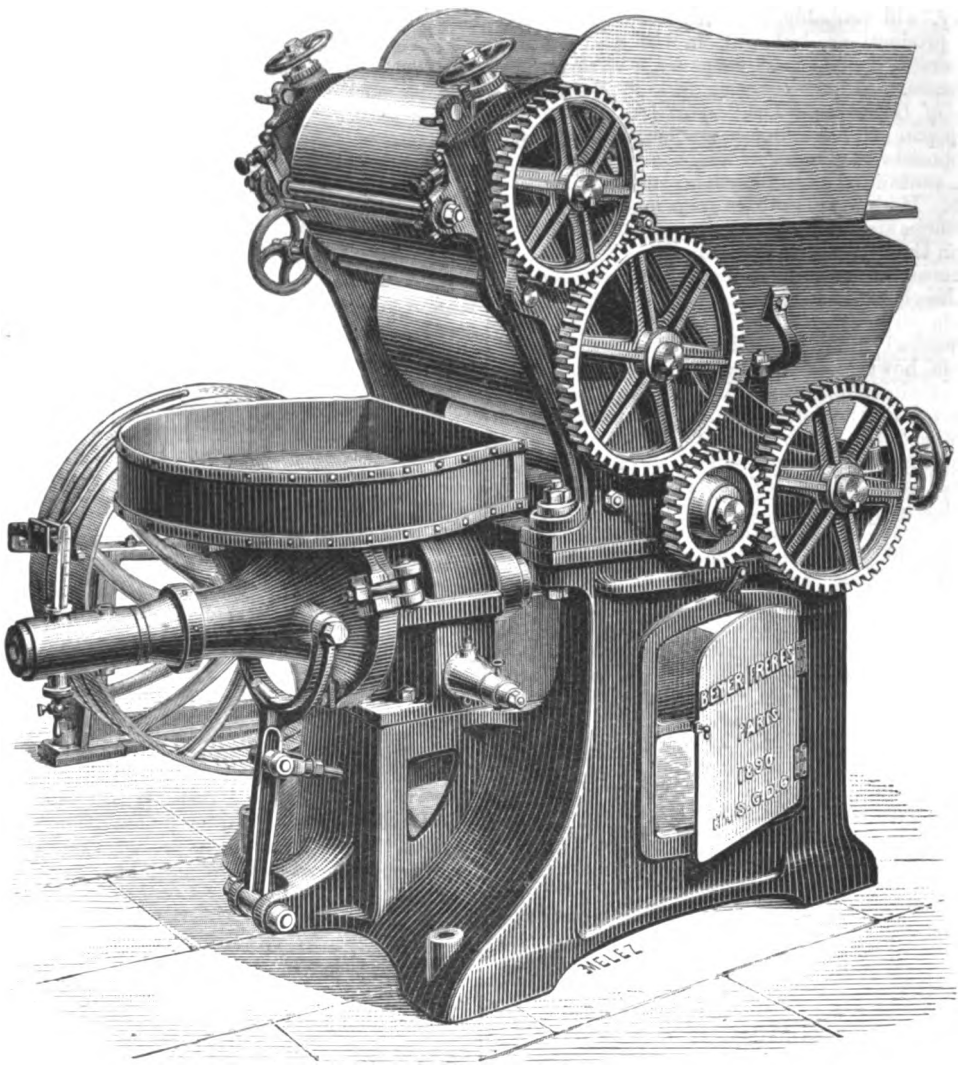


Fig. 18.

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placed in the bottom hopper of this machine, and the paste or dough is worked gradually and automatically upwards through the rollers until it falls into the top hopper, the slide bottom of which is then drawn, and the paste falls into the lower hopper, to be again passed through the same process. This is repeated several times, the colouring matter and perfumes being added after the paste has passed through the mill once.

A further improvement in this machinery, and recently introduced, is shown in Fig. 18, and consists of the aforementioned four-roller, oblique crushing mill, combined with the squeezing apparatus, in one machine. The soap dough is worked automatically upwards through the rollers as described, and, when sufficiently milled, is allowed to fall into the hopper of the squeezing apparatus, thus avoiding the labour and loss of time consequent on transferring the paste from one machine to the other.

Toilet soaps made by the milling process are manufactured in a more scientific manner, have a far superior appearance, and are better in every way than those made by the remelting or similar methods as at present still largely practised. They have a beautiful glossy and wax-like finish, are more delicately and brightly tinted, and the perfumes can not only be added in larger quantity without extra expense, owing to the avoidance of the enormous loss by evaporation, which takes place when the essential oils are added to hot soap, but their odour is finer, richer, and more lasting, because unimpaired by any heating.

The soap, which contains only a minimum quantity of water, is perhaps more pleasant to use than any other, producing at once a fine creamy and persistent lather, and, although only recently introduced to any extent in this country, will probably not only take preference over other productions, but will, in the near future, entirely supersede opaque toilet soaps made by any other existing process.

Recovery of Glycerine.—The "spent lye," drawn out of the soap pan after the first operation, as previously described, consists of a more or less concentrated solution of salt, containing a comparatively small percentage of glycerine. It also generally contains small quantities of soap, resinous and albuminoid matters, and impurities derived from the original fats or oils.

The processes in use, of treating the lye for the recovery of the glycerine—which forms the valuable constituent—are all protected by letters patent, and are generally worked under royalties. The principle of most of them, however, is to eliminate the organic impurities by precipitation with acids and other substances, and to get rid of the large quantity of water, which forms the bulk of the lye, by evaporation; the salt being at the same time precipitated thereby, and from time to time removed and dried for further use in the soap pan. The concentration is effected in various forms of pans, heated by fire, and in cylindrical or other shaped concentrators, in which the descending stream of lye meets a blast of hot air, or is allowed to flow over heated surfaces. When sufficiently concentrated, by any of these means, an impure, dark-coloured glycerine is obtained, which is often sold by the soapmaker in the crude state, but is sometimes further purified at the soapery, generally by heating with animal charcoal and distilling several times with superheated steam.

The large quantity of water which has to be evaporated is the great difficulty in recovering glycerine from spent lye, it often requiring, in an ordinary sized pan, ten or twelve days to concentrate the lye; and there is is little doubt that the future method will be to decompose the neutral fats into glycerine and fatty acids, the former of which will then require little or no purification, whilst the latter will be placed in the soap pan and converted directly into soap.

Notes.

THE COALFIELDS OF TEXAS.

A RECENT report contains some very interesting facts about the coal measures of Texas. The main lead of bituminous coal is first met with in the northern part of the State, and extends south-west from a point on Red River, in Montague county, to the Colorado, being a continuation of the western field, of which it is the southern boundary. This deposit underlies twenty-five counties and covers an area of 12,000 square miles. Thus far, says the *Age of Steel*, this deposit has been unworked, with the exception of that portion located in Erath county, which has been developed on a small scale by the Texas and Pacific Coal Company. The deposit ranking next in importance is on the Rio Grande River, and underlies Medina, Zavalla, Webb, Uvalde, Maverick, and Dimmit counties, embracing an area of 3,700 square miles, and is known to geologists as the Neuces coalfield. The coal mined is of a semi-bituminous character in the lower strata, while in the upper strata it is of the lignite order. The principal developments are at Santa Tomas, in Webb county, near Laredo, and at Eagle Pass, in Maverick county. Splendid deposits of lignite are found in Red River county, extending south-westerly to the Rio Grande, and north-east to the Sabine, in Sabine county, the only developments thus far made being in Rains county. The quantity of coal mined in Texas during the years 1888 and 1889 aggregated 128,216 tons, and its value is estimated at about £68,000.

AN AGRICULTURAL COLLEGE IN VICTORIA.

EARLY last month the foundation stone of a new College of Agriculture was laid at Mildura, in Victoria. This college is being built in connection with the Australian Irrigation Colonies which were founded some years ago by Messrs. Chaffey Brothers, and will play an important part in affording facilities for imparting the necessary instruction in irrigation and its dependent industries in Victoria.

SMALL CELLS FOR ELECTRICAL WORK.

THE demand for a small battery is as great as ever, and there seems a likelihood of one being supplied soon. What is wanted is a cell for laboratory work, which is at once cheap and durable. Some American papers advertise a very minute chloride of silver cell, arranged to give 2 amperes and 1½ volts, presumably on closed and open circuit. Messrs. Hartmann & Braun, Gassner, and others are putting on the market compact "dry" cells. A set of 100 tiny cells in a really portable case would be most valuable for insulation, testing, and similar work.

A SIGN OF THE TIMES.

THE session of the Institution of Electrical Engineers is practically now over, and there is a general feeling among the members that it has been dull and non-productive. Except Mr. Crooke's address, the papers read have not been of first-class importance, and, odd as it may seem, this may really be a very good sign. The members are so busy doing practical work just now that they may have little time to devote to working out new ideas or writing papers about them. If this be the case, may we have another dull session next season!

ENGLISH LOCOMOTIVES IN AMERICA.

THE Webb compound locomotive, imported about two years ago by the Pennsylvania Company as an experimental engine, and which, judging from the newspapers, failed over and over again, seems, according to our contemporary *Industry*, of San Francisco, to be working trains very successfully between New York and Philadelphia. It hauls seven cars, makes seven stops, and does a 90-mile run in 124 minutes, burning, as reported, 25 per cent. less fuel than is used in the other engines. The importation of this engine and the results it has led up to have been features of interest in America. It has caused the above-named company to construct a number of "express compounds," all of which have proved very satisfactory, as is shown in the recent tests on the Baltimore route.

ALABAMA COALFIELDS.

THE three principal coalfields of Alabama are, according to the *Engineering and Mining Journal*, the "Warrior," "Cahaba," and "Coosa," of which all exhibit a south-west pitch or slope. The special features of the "Warrior" field, 7,810 square miles in area, are, first, a tendency in all coal seams to thin going north-west from the south-east outcrop, a line of average thickness crossing the field diagonally in a north-east and south-west direction; second, an increase of hardness in the same direction with a corresponding decrease of coking properties, so that the typical coking and smithing coals are mined along the south-east outcrop, while the best domestic and shipping coals come from the centre and west; third, a nearly constant chemical composition, commercial lots averaging—fixed carbon, 55 per cent. to 63 per cent.; of volatile matter, 28 per cent. to 34 per cent.; ash, 5 per cent. to 10 per cent.; and sulphur, 0·5 per cent. to 2 per cent. The moisture in all Alabama coals is low. The "Cahaba" field, as at present developed, produces the best "all around" fuels in the State, but in the northern end of the basin the coal appears dirty and slaty, and the productive areas in the south end are limited by reason of high dips and the broken and disturbed condition of the measures. The "Coosa" field has only two active operations, which, in point of production, are of minor importance. The coking coals of the district will naturally continue to be drawn from the present developed areas. The needs of the district for domestic and steam coals will best be met by the construction of a north and south railroad from Tuscaloosa, passing through the heart of a rich coal area, where the measures are thickest and coals situated favourably for economical mining.

PELTON WATER WHEELS.

MR. ROSS E. BROWNE, of the University of California, has, according to the *Engineering Record*, published some interesting figures derived from tests of Pelton water wheels made at the University. According to these tests, a wheel 15in. in diameter and 1·5in. wide, working under a 50ft. head, the nozzle being $\frac{7}{16}$in. in diameter, showed an efficiency of 82·6 per cent. When the nozzle was ⅜in. in diameter, the efficiency was 82·5 per cent. On reducing the head to 8ft. the efficiency was 73 per cent. To obtain a high efficiency with these wheels, Mr. Browne states that the bucket surface at entrance should be approximately parallel to the relative course of the jet, and the bucket should be curved in such a manner as to avoid a sharp angular deflection of the stream. The number of buckets should be small, and the path of the jet in the bucket short to keep down the frictional resistance. The discharge end of the bucket should be as nearly tangential to the wheel periphery as is compatible with the clearance of the bucket. The speed of the buckets should be half that of the jet.

IRON AND STEEL WORKS IN CHINA.

As we stated in our issue of the 1st inst., iron and steel works for the construction of steel rails for railways, steel for gun founding, and mercantile iron have been begun near Hanyang on the western bank of the Han River. The masonry for blast furnaces, both by the Bessemer process and by the Siemens-Martin process, is being rapidly constructed, and machinery from England has been ordered. Much of the machinery has arrived at Shanghai, and is only waiting for the river to rise to be brought to Hankow. In February there were two locomotives at the works, and about three-quarters of a mile of railway laid. The works are situated on the River Han, and arrangements are being made to have a jetty on the Yangtze, a little above its junction with the Han. The ground will be raised 6ft. above the highest flood level of the Yangtze. It is contemplated, in the first instance, to turn out 100 tons of steel rails per day, and ultimately to increase the output to 200 tons a day. This is exclusive of mercantile iron and steel for guns. The ground to be covered by the ironworks is 2,728ft. by 500ft., or more than 30 acres. Good iron ore has been discovered at Huang Kang, about 15 miles down the river, and 20 miles inland.

ELECTRICAL SUB-STATIONS.

THOUGH most electrical engineers have come to the conclusion that house transformers are a mistake, there is a difference of opinion as to what a sub-station should be. From an assumption that ordinary small transformers give efficiencies approximating to 98 per cent., there has been an oscillation over to the opinion that even large transformers are so bad that they must be banked. We describe in another column a most ingenious apparatus for cutting transformers in and out. Such an apparatus may be necessary with existing transformers, but if half the brain-work involved in designing it were devoted to the study of transformers, banking, with its attendant evils, would be unnecessary. In designing central stations very serious mistakes may be made by adopting sub-stations of this sort. There can be no doubt that in a very short time even closed circuit transformers will be made so efficient that cutting them out of circuit during the day will not be worth while, and engineers will find they have marred their designs to meet an obsolete requirement. They will then find that they have rents to pay, complicated mechanism to look after, and that the independent feeder system is inapplicable unless they have an attendant at the sub-station. There can be no advantage in banking transformers, and a transformer at the end of a high-pressure feeder, placed in oil in the ground, is capable of controlling the lighting arrangements of a whole town, whatever its size, by means of feeders and networks.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

11th May, 1891.

8039. Lindley, R. H. N. ..... Wheel valves.
8041. Jefferson, Jefferson, & Jefferson ..... Fans or rotary blowers.
8042. Billington & Newton... Asbestos packed cocks.
8050. Robinson, T. ..... Machinery for hoisting.
8053. Hawksworth, C. W. R. An electromagnetic stop motion applicable to machinery used in spinning.
8057. Naylor, C. H. ..... Valve gear.
8060. Downham & McCrannor Drills.
8062. Davis, G. ..... Hydraulic weighing machines.
8063. Russell, E. ..... Railway signalling apparatus.
8067. Kentman & Bach ..... Apparatus for charging and discharging gas retorts.
8069. Capitaine, E. ..... Gas engines.
8070. Crapter, W. ..... Platen printing machine.
8071. Fitzmaurice, C. H. ..... Means for utilising petroleum with steam for heating purposes.
8078. Ellis, J. D. ..... Steam boilers and their furnaces.
8079. Johnson, J. Y. ..... Radial axle boxes for railway or tramway vehicles (*Weidknecht*).
8080. Phillips, W. ..... Air jet draught inducer.
8081. Stone & Clark ..... Meter for measuring liquids.
8086. Collins, E. ..... Apparatus for testing water meters.
8091. Imray, O. ..... Fastenings and supports of railway rails (*Rottes*).

12th May, 1891.

8095. Brock (of the Firm of Denny & Co.) & Weir Marine steam engines.
8098. Taylor, G. P. ..... Divided flexible shaft.
8100. Dunn & McLewin..... Water, steam, or other cocks.
8103. Webster, D. ..... Regulator for reeling machines.
8125. Rogers, C. D. ..... Slotting screw heads and dies therefor.
8129. Richards, W. G. ..... Mould for casting steel wheels.
8145. Bason, R. W. ..... Steam engines.
8146. Boult, A. J. ..... Method and means for retarding vehicles (*Ries*).
8148. Boult, A. J. ..... Riveting apparatus (*Ries*).
8164. Lake, H. H. ..... Air compressors (*Hill*).
8167. Gates, R. D. ..... Concentrating apparatus.
8168. Dalby, W. E. ..... Valve gear for locomotive and other engines.

13th May, 1891.

8178. Pardon, A. J. ..... Brakes for wheeled vehicles.
8186. Heys, W. E. ..... Balance slide valves (*McDonald*).
8190. Wilks, J. F. ..... Signalling apparatus.
8193. Booth, W. ..... Friction clutch.
8199. Broughall, E. H. ..... Machines for drilling the hubs of cycle wheels.
8211. Sherwin, G. E. ..... Cutting tools and holders.
8217. Sennett, A. R. ..... Combustion of smoke in furnaces.
8219. Sennett & Cannon ..... Pumps.
8230. Martin, J. H. C. ..... Wood wool machinery.
8235. Causer, W. G. ..... Hydraulic jacks.
8237. Watts, J. R. ..... Drills for boring and reaming.
8238. Taylor, G. B. ..... Machines for planing metals.
8241. Horn, W. W. ..... Speed indicator (*Berry*).

14th May, 1891.

8249. Pizzey, W. J. ..... Spring rim for wheels.
8251. Barrett & Tichhurst ... Motor engines.
8253. Hadfield, F. J. ..... Vacuum brakes.
8257. Whittaker, J. ..... Taking-up motion for looms.
8262. J. Webb & Co. ..... Back pressure valve.
8268. Wilson, J. H. ..... Bobbins for spinning frames.
8277. Carrick, J. ..... Boiler furnaces.
8289. Hardingham, G. G. M.... Rotary engine (*Cleland*).
8309. Smith, A. ..... Printing machines.

15th May, 1891.

8329. Guthrie, H. ..... Driving chains and wheels.
8355. Liebert, H. (on behalf of John Holroyd & Co., Ld.) ..... Split spiral milling cutters.
8357. Taylor, S. ..... Combustion of fuel in the furnaces of steam boilers.
8359. Dickinson, A. ..... Cable tramways.
8360. Musgrave, Jun., & Crompton ..... Stuffing boxes.
8364. Smith, A. W. ..... Cycle, engine, and other wheels.
8366. Richmond, G. H. ..... Feeding bottles.
8368. Johnson, J. ..... Chain - welding apparatus (*Baker*).
8379. Walther, W. ..... Steam boilers.
8385. Hopkinson & Hopkinson Valves.
8389. Robinson, S. ..... Slide valves.
8396. Stewart & Pugh ..... Machines for producing oval, elliptic, or other work in wood.
8404. Phillips, A. K. ..... Drilling machine.
8409. Price-Williams, R. ..... Permanent way of railways (*Moncrieff*).

16th May, 1891.

8417. Dickinson, E. ..... Propellers applicable to navigable vessels.
8429. Morton & Findlay ..... Steam boilers.
8432. Ridealgh & Brewis ..... Device for facilitating the centreing of work in lathes.
8433. Merrywrather & Jakeman ..... Couplings for hose-pipes.
8435. Merrywrather & Jakeman ..... Rotary pumps.
8438. Cowan & McArthur ... Gas valves for steel furnaces.
8441. Bell, R. ..... Signalling on railways.
8449. Burnet, L. ..... Steam boilers.
8452. Sturgeon & Crampton... Stop valves.
8453. Tracy, L. J. ..... Drum governors.
8454. Duffield, White, Reading, & White..... Faced rail for railways.
8469. Abel, C. D. ..... Gas and oil engines (*The Gas Motoren Fabrik Deutz*).
8471. Shand, W. F. ..... Manufacture of steel.
8486. Lake, H. H. ..... Motors for driving sewing machines (*Caspani*).
8487. Sheldon, A. ..... The manufacture of paper pulp.
8489. Smith, W. F. ..... Lathes.
8493. Dalifol, M. ..... Moulding machines.

ELECTRICITY.

11th May, 1891.

8048. Kennedy, R. ..... Dynamo-electric generators.

12th May, 1891.

8102. Aspinall & Hoy ..... Electric signals.
8126. Philpott, G. J. ..... Compound dynamo - electric generators.
8136. Christiansen, J. ..... Car motors.
8141. Thompson, W. P. ..... Insulated conductors (*Williams*).
8150. Siemens Brothers & Co., Ld. ..... Rotary phase alternative current motors (*Siemens & Halske*).
8152. Siemens Brothers & Co., Ld., & Williamson ... Means for heating metal rods or wires for making nails, screws, key-blanks, &c.
8153. Siemens Brothers & Co., Ld. ..... Means for carrying electromotors on electric cars or vehicles (*Siemens & Halske*).
8163. Dewey, M. W. ..... Electric railways.

13th May, 1891.

8198. Housman, Dixon, & Holden ..... Meter.
8218. Sennett & Cannon ..... Dry batteries.
8225. Aspinall & Hoy ..... Controlling signals by electricity.
8227. Thompson, W. P. ..... Accumulators (*Tudor*).

14th May, 1891.

8256. Renouf, P. L. ..... Electrical brazing.
8323. Goldsmid, J. ..... Thermo - electric apparatus (*Riatti*).

15th May, 1891.

8378. South, H. ..... Resistances.
8390. Takashima, S. ..... Electrical signalling apparatus.
8397. Taylor, W. F. ..... Alternating current dynamo generators.
8412. Johnson & Phillips..... Armatures of dynamo-electric machines.

16th May, 1891.

8450. Snell, C. S. ..... Conductors.
8457. Spokes, G. A. ..... Arc lamps.
8492. Perlovsky, V. ..... Electromotors.

CHEMISTRY.

11th May, 1891.

8064. Gutbier, J. C. F. ..... Vat dyeing process.

12th May, 1891.

8161. Lake, H. H. ..... Manufacture of white lead (*Dahl*).

14th May, 1891.

8311. Chambers, Hodgson, & Hammond ..... Manufacture of white lead.

15th May, 1891.

8344. Bowman, W. ..... The treatment of phosphate of alumina (*Bowman*).
8407. Pitt, S. ..... Blue dyestuffs (*L. Cassella & Co.*).
8415. Warwick, A. W. ..... Extraction of antimony from its ores.

16th May, 1891.

8470. Bamberg, G. ..... Manufacture of silicate of soda and carbonate of soda.

MISCELLANEOUS.

11th May, 1891.

8052. Grayston, A. J. ..... Instrument for ascertaining levels, perpendiculars, and gradients.
8082. Barbat, A. ..... Lubricators.
8083. Mond, L. ..... Manufacturing nickel alloys.
8084. Lockwood, H. ..... Purification of sewage.
8087. Cullen, W. H. ..... Covering for boilers, steam pipes, and other surfaces.
8090. Gehring, G. ..... Enamel for metals.

12th May, 1891.

8115. Draper, J. ..... Preventing incrustation in steam boilers.
8124. Shawcross, E. H. ..... Locking devices for bolts and nuts.

13th May, 1891.

8180. Brown, A. O. ..... Regenerative gas lamps.
8205. Killick, G. E. ..... Pipe joints.
8234. Davis & Baldwin ..... Joint for coupling pipes.

14th May, 1891.

8319. Rigg, J. ..... Packings.

15th May, 1891.

8330. Saville & Hulme ..... Placing tubes on spindles used for spinning.
8358. Gelder & Crosland..... Shuttle pegs for shuttles.
8381. Watson, J. R. ..... Making moulds for casting.

16th May, 1891.

8426. Birch, W. ..... Cleansing sewage.
8474. Radford & Hallam ..... Nut-locking devices.
8496. Price, J. ..... Treatment of sewage.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

7247. Baudouin & Escarpit.
7354. Ford & Ford.
7489. Venvers.
7616. Phase.
7650. Gotz.
7722. Blakeley & Hodson.
7951. Furnival & Furnival.
8136. Brown.
8495. Williams.
8689. Blackmore, Clark, & Standfield.
8882. Toker.
8998. Feather.
9100. Saunders.
9180. Heap & Sharp.
9154. Whitfield.
9238. Agnew.
9348. Rice & Smith.
9390. Lake (*Pruden*).
9442. Best.
9524. Walton.
9610. Canet.
9677. Botton.
9863. Simmons.
9915. Lehmann.
10221. Hanna.
10282. Hayton.
10293. Stuart.
10341. Bruce.
10380. Murrie.
10526. Whittell.
10622. Howarth.
10681. Mercier.
10696. Merrill.
10722. Stead.
10748. Murrow.
10750. Lucas & Lucas.
10769. Bennett.
10803. Pilkington (*Evans*).
10817. Hanson.
10832. Bayly (*Edwards*).
10836. Bayly (*Galle*).
10853. Green.
10857. Munro.
10885. Green.
10908. Pike.
10913. Pratt.
10930. Thomis, Priestley, & Priestley.
10947. Gibbs & Gibbs.
10952. Griffin.
10958. Cockburn.
10980. Ratcliffe.
10988. Morpitt.
10995. Mann.
11014. Bingham.
11042. Gooch, Baker, & White.
11052. Langdon-Davies.
11079. Laing.
11083. Parsons.
11088. Groombridge & South.
11105. Lucas, Lucas, & Bishop.
11118. Dutton.
11120. Rachler.
11138. Downie.
11172. De Kerpredron & Gibault.
11259. Keighley, Keighley, & Netherwood.
11306. Reid, Edmeston, & Edmeston.
11437. Wahlin.
7853. Braum & Ford-Lloyd.
7423. Peters.
7540. Wise (*La Société Japy Frères et Cie.*).
7655. Martienssen.
7739. Von Langer & Cooper.
7974. Fowler.
8213. Fleetwood.
8509. Van Gülpen.
8743. Currie.
8821. Macaulay.
8990. Lake (*Hammond*).
9089. Bayly (*Nutting, Parsons, & Bower*).
9149. Southall.
9200. MacIvor.
9300. Marshall & Wigram.
9377. Boult (*Krisch & Schmidt*).
9517. Hertzberg.
9609. Wilson.
9629. Pilkington.
9680. Bayly (*Bennett*).
9869. Curtis & Davies.
9946. Conrad.
10252. Bayly (*Evans*).
10290. Bell.
10318. Farjasse.
10369. Cumming.
10401. Conrad.
10571. Raworth.
10680. Constable.
10695. Spencer.
10700. Bruce.
10732. Kayser.
10749. Lucas & Lucas.
10768. Munro.
10788. McDougall.
10807. Mills (*Greenfield & Nagel*).
10834. Bayly (*Ormsby*).
10851. Matthews, Yates, & Yates.
10875. Kunkler.
10895. Hobbs.
10909. Harris.
10929. Ruthven-Murray.
10933. Webb.
10938. Lukin & Baker.
10951. Tyler.
10956. Ainley.
10959. Pearson.
10981. Warburton.
10986. Sumerling.
11006. Tweedale.
11032. Price.
11048. Douglas.
11069. Brown.
11082. Whitehead.
11086. Robottom.
11100. Wardle.
11106. Bott, Mortimore, & Lindley.
11130. Ford.
11166. Panario & Richard.
11208. Sturrock & Macdougald.
11279. Gibbons, Hinton, & Gibbons.
11334. Huelser (*Meischner*).
11389. Pflueger.
11478. Duncan.

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11548. IMRAY (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis*).
11796. DUPONT.
11855. THE SAMSON PARAGON SUPPLY COMPANY, LD., & CLARK.
12606. CAY.
12717. YARDLEY.
12817. BARTLETT.
18894. HEATH.
15507. HAWDON & HAWDON.
16115. TAYLOR.
17021. GREGORY.
17596. HARVEY.
18961. BAYLY (*Rickie*).
19942A. THOMPSON (*Marx*). (6th December, 1890.)
20750. CHANTER & WITHAM.
11606. ROGERS & PLAYER.
11739. CLOUET.
11741. DOWN (*Him, Bolling, & Arnold*).
11850. SMITH.
11971. SMITH.
12301. CLARK.
12421. BETHMONT.
12611. BRECHTELSBAUER
12748. SAMPLE.
12986. THOMPSON.
14052. ARMOUR.
15622. WILEMAN.
16578. FARMER.
17450. HALL & CAPSTICK.
18658. STERLING.
19424. DALOT & DALOT.
20127. BOSWELL & HOUGHTON.
20831. SWANN.
20936. WYCKOFF.

1891.

125. HITCHCOCK.
539. WALDER.
868. WILLEY.
1020. BIRKBECK (*Greenfield*).
1518. CLARK.
2188. BELL.
2333. WILKINSON.
2438. SEIFRIED.
2596. THE PRATT AND WHITNEY COMPANY & SPONSEL.
2985. EDWARDS (*Sandt & Sturm*).
3617. DUNCOMBE.
4291. ROBERTSON.
4346. BARKER (*Evans*).
4555. BARTHOLF.
4875. EARLE & BOURNE.
4917. PROMIS.
5135. SOUTHARD.
5192. SCALES.
5267. MILLER, MAYER, POST, & BERRY.
5317. BURGON & BURGON.
5460. CADLE.
5512. VON EULENFELD.
5547. KELLNER.
5590. KELSEY.
5595. DEWEY.
5816. DELACOUR.
6072. CARPENTER. (27th September, 1890.)
6195. BLACK.
6259. CARROLL.
6289. BOUGHTON (*Nixon*).
6292. MILLER.
6317. SCHWAB.
6325. BOUSFIELD (*Golding*).
6369. THOMPSON (*Carrington, Morris, & Bucklin*).
6381. GOTTFRIED.
6396. HEUSER.
6406. CLARK (*Wessel & Giese*).
6409. DARBY, DARBY, & DARBY.
6434. MADELEY.
6486. NEWTON (*Gross*).
6490. RITTER.
6503. LÜTHY.
6590. WALSH. (25th September, 1890.)
491. ROBERTS.
581. LEIGH (*Fry*).
988. BOULT (*Mason, Mason, & Wiegand*).
1746. PRADA.
2307. HARDY & HARDY.
2390. BEACHAM.
2595. THE PRATT AND WHITNEY COMPANY & SPONSEL.
2888. GRANVILLE.
3857. LAKE (*Berrenberg*).
3435. NELSON. (30th August, 1890.)
4824. GARDNER.
4531. WRIGHT.
4603. KREBS & MENZ.
4894. HARPHAM.
4978. WILSON.
5186. PANZER.
5256. LAKE (*Canfield*).
5270. BOULT (*Lippold*).
5276. MUSNICKI.
5445. THOMPSON (*Lyford*).
5502. PIETSCHMANN.
5522. HOLLINGWORTH.
5563. KERFER.
5594. LAKE (*Linzee*).
5786. SKUCEK & JELEN.
6046. DONT & PARENT.
6118. WARRINGTON.
6175. LAKE (*McConnell*).
6219. YOUNG.
6260. JONES & ANSON.
6290. SAUNDERS.
6295. REQUA.
6328. TAUSSIG.
6368. BOULT (*Mason*).
6379. TOMPKINS.
6380. BREWER & KING.
6391. BLAIR & CROWELL.
6405. WHITING & LAWRENCE.
6407. VIBREGG & VIBREGG.
6420. TAYLOR.
6430. RAYNER.
6478. HATHWAY.
6487. NEWTON (*Clark*).
6498. BROWNE (*Remus*).
6580. CARTER.
6596. GEHRE.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

WIRE ROLLING.—*H. A. Williams, Taunton, Mass., U.S.A.*—It is claimed that by the method of cold-rolling practised according to this specification, wire may be produced, of any desired section and gauge, which will not require annealing after the operation of rolling, for the process described is said to have an actual annealing effect, so that rods originally quite hard, and with but little malleability, come out after the successive reductions annealed and with their tensile strength increased. The main idea in the present instance is to avoid the mode of handling the wire adapted in ordinary rolling processes, wherein the wire is considerably altered in some parts at one stage of the operation and but little affected in other parts, whereby severe internal strains are set up in the metal by this irregular deformation, which ultimately disrupt it. The inventor arranges the successive rolls so that the wire is compressed, not along separate diagonals in succession, but along several radii simultaneously; this result is obtained by using a train of rolls, the grooves of which have their surfaces substantially parallel throughout the train, the bottoms of the grooves in each pair terminating in a flattened or truncated portion, whereby the width of the space included between the pair of rolls is less, measured between the bottoms of the grooves, than the width at the tops of the grooves, the width between the bottoms of the grooves of a given pair being equal to the width at the top of the grooves in the next following pair. Claims: The arrangements substantially as described, for the purpose of displacing practically equal amounts of metal at all points acted upon by the rolls.—No. 2898. February 17th, 1891. 8*d*.

FLEXIBLE COUPLINGS.—*G. F. Redfern & Co., London.* (*F. Wolseley, Sydney, N.S.W.*)—The flexible couplings described in this specification are those employed in connection with toothed wheel gearing, which are sometimes termed "universal gearing joints," and which are arranged so as to allow of the angle between spindles of the gear wheels being varied whilst the gearing is at work. The particular improvements under this patent consist in the combination and arrangement with the sleeves of the spindles (which sleeves have flanges or heads to protect the toothed wheels) of a male and female lug on opposite ends of an extension of each of the sleeve flanges. These pairs of lugs are so arranged that when the two portions of the coupling are placed together, with the protector flanges face to face and the two spindles in line, the opposing lugs will "take" one within the other, and keeps or wards thereon will be in juxtaposition, so that when next the coupling is opened out the two halves will be locked together. The gear wheels employed are crown wheels, and are put on to their spindles and firmly secured thereto after the coupling is opened out as aforesaid. The presence of the two gear wheels prevents the two halves of the couplings from being brought into the position in which uncoupling may take place, and therefore, before such operation can take place, the wheels must be removed from their spindles. Claims: An arrangement of universal gearing joint as described, in which the unlocking of the joint is prevented by the presence of the gear wheels, and in which the joint is formed by male and female lugs interlocking with and turning upon one another.—No. 4210. March 9th, 1891. 6*d*.

CENTRIFUGAL MACHINES.—*J. Sellars, Derby.*—This invention describes improvements in what are known as continuous centrifugal machines, employed for drying sugar and other granular substances, and for separating solid from liquid substances. The periphery of the basket or drum is, according to this invention, composed of a number of vertical sections or vanes, free to rotate when desired. These vanes are perforated, and permit liquids to pass from the rotating basket into a rotating casing retaining the solids until such time as the vanes are rotated on their own centres, whereupon, through the openings thus provided, the solid residue is flung out through openings in the rotating casing into a receptacle which is separate from that into which the liquids previously issued. Figs. 1 and 2 below illustrate in plan and vertical section respectively one modification of the apparatus, which may be thus described:—To a revolving solid spindle A is secured a casing B, the upper portion C of which may be a casting of suitable material carried by the sleeve D of the spindle

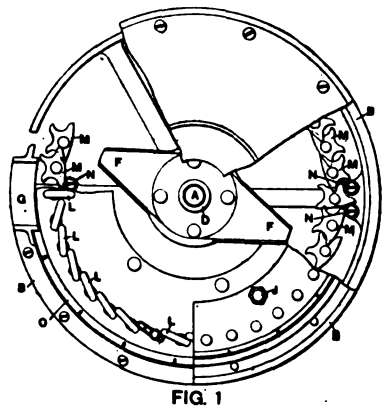


FIG. 1

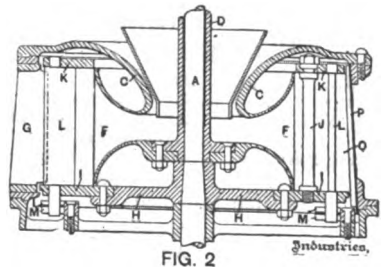


FIG. 2

A, the centre being dished or curved downwards and leading to two shoots or spouts F. The sides of the casing B are made of sheet metal with openings as at G, through which the solids are discharged into a "monitor" casing not shown in the illustrations. The basket or drum is secured to the revolving spindle A, and is composed of a bottom plate H supporting a steel ring I, into which are fixed a number of pillars J supporting at their upper ends another steel ring K, these rings I and K being the supports for a number of vanes L as above described. The casing and also the frame supporting the blades revolve in such a manner that they pass the openings G at a suitable speed, and during the time of passing these openings the blades or vanes partially revolve and allow the dried substances to pass out. As soon as the blades have passed the openings they are again closed, before coming opposite to the spouts or shoots through which the combined substances are admitted to the inside of the basket or drum. The vanes are opened and closed at the proper times by cams M which are carried upon extensions of the vanes so as to come into contact with and be operated by fixed studs or rollers N carried by the outer casing, which, although it revolves, does so at a slower speed than the basket, this diferential motion being obtained by any suitable arrangement of gearing, and being adopted for the purpose, affording the time necessary for drying the material operated upon, by causing the intervals at which the vanes are operated to be longer than would otherwise be the case. The liquid discharged through the perforations of the vanes passes into the annular space O between the vanes and the sides of the outer casing. In the latter are fixed diagonal ribs P to accelerate the discharge of the liquid into the receiving gutter. Other arrangements of discharge vanes are described, opened and closed by cams as above. Claims: The vanes, pockets, and the like forming the periphery of a drying or filtering drum, as described; the mode of operating the vanes by cams; the two casings revolved at different speeds by differential gearing; the diagonal ribs as described in the last paragraph; the apparatus as a whole and its modifications as described.—No. 10461. July 7th, 1890. 8*d*.

STEAM PUMPS.—*J. N. Floyd, Handsworth, Staffs.*—In many pumping engines where the valves are operated by the motive fluid, it has been customary to admit the latter fluid to the cylinders in which the pistons of the valve are situated, through perforations made through the said pistons, and to obtain access to the said perforations the engines have to be stopped and the covers removed. To obviate this the arrangement illustrated below has been designed, and is shown as applied to the steam

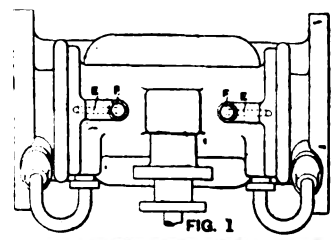


FIG. 1

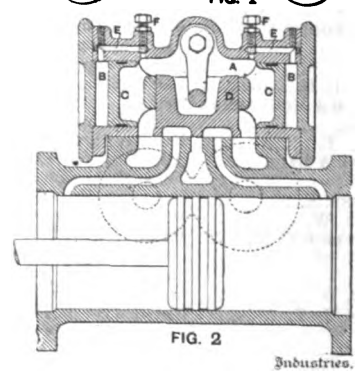


FIG. 2

cylinder of a Tangye's special pump, which, with its accessories, is shown in plan and section, from which its analogous applications will also be understood. Communication between the place A, whence the motive fluid to actuate the valve is obtained, and the cylinders B, in which the pistons C of the valve D are situated, is established by perforations E, made in the casting, and these perforations are each provided with a choking screw F or equivalent device, by which the area of the passages can be adjusted, the heads of these screws projecting outside the cylinder as shown. To prevent the screw or like device from being operated by inexperienced persons to completely close the passages and stop the engine, means are provided by which, when the screw has closed the passage to the fullest extent, there still remains a blow-through hole, by which passes sufficient steam to keep the engine working; or other arrangements than the blow-through passage in the screws may be adopted for a similar purpose. Claims: The passages arranged and regulated as described, for governing the admission of working fluid to the valve cylinders of the motive power cylinder of pumps.—No. 14619. September 16th, 1890. 6*d*.

RING SPINNING FRAMES.—*E. de Pass, London.* (*J. Imbs, Paris.*)—The improvements about to be described refer to means for building up on the slender and bare spindles conical self-acting cops of considerable height, and presenting the greatest differences of large and small diameters, from yarn of slight twist and little resistance; anti-ballooning apparatus stretches

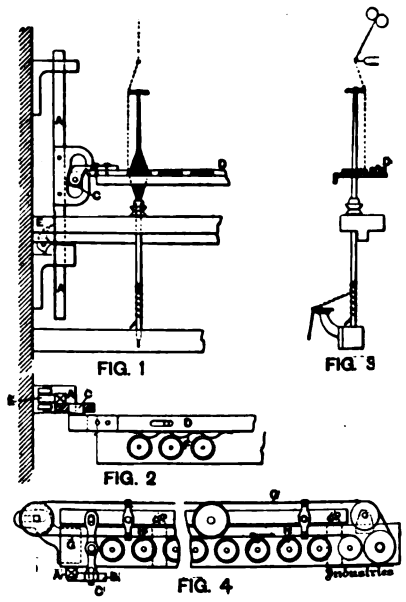


FIG. 1

FIG. 3

FIG. 2

FIG. 4

the yarn whilst it is winding upon large diameters of the cop. Figs. 1, 2, and 3 show in side elevation, plan, and cross-section, respectively, the anti-ballooning apparatus, in which the rod A carrying the cam-plate B operates by means of the roller C a bar D sliding longitudinally upon the copping-rail within limits determined by suitable stops. With the copping-rail in its lowest position, when the commencement of the winding occurs, the rod A will depend from the roller C, and rack teeth at its lower end will be below the stationary detent E, and will not engage therewith until the vertical rise of the rod A exceeds a certain limit; thenceforward the rod is permitted to rise when lifted by the roller C, but is prevented by the detent E from following the falls of the rail; thus, at each fresh rise and fall of

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the copping-rail the bar D will now receive a to-and-fro movement of an amount dependent upon the form of the slot in the cam-plate B. The side of the bar D facing the rings is provided with very flexible friction-pads F, and the movement of the rail during the formation of large diameters brings these pads against the rings G and impedes the travellers, thereby tightening and stretching the yarn, but during the formation of small diameters the pads F will be moved away from the rings. On the copping-rail, behind the rings, is an arrangement, illustrated in plan in Fig. 4, of continously driven endless band H, which is preferably arranged so as to bear against the travellers and assist them by giving them a portion of a rotation during each revolution and assisting the efforts of the yarn, which at such times is unfavourably situated for pulling. The endless band is brought against the travellers when necessary by a sliding bar similar to the bar D, and operated in like manner; or the bar D may operate both the retarding and the accelerating devices; or the endless band H may be operated as required by a pair of fast and loose pulleys regulated automatically; also, the acceleration may be applied direct to the yarn instead of to the ring or traveller, and the band H may be applied to the rings as a retarder. Claims: The accelerating and retarding devices operating upon the rings or travellers, or upon the yarn; a single or double arrangement of the bar D bringing into alternate operation the accelerating and retarding devices; the arrangement substantially as illustrated and described with reference to Figs. 1, 2, 3, and 4. —No. 2858. February 17th, 1891. 8*d*.

Gas and Petroleum Engines.—*A. G. Melhuish, London.*—The herein-described improvements in gas and petroleum engines comprise a method and means analogous to the compounding of steam engines, and it is stated that the economic effect is relatively greater. Fig. 1 is a sectional elevation, and Fig. 2 an end elevation, partly in section, of an engine constructed according to this invention, Fig. 3 being a sectional plan of the cylinder ends and passages. Two cylinders A and B are arranged either side by side or one above the other as shown in the illustration, and a port or passage C is provided from one to the other in such a manner that it is operated by a valve D which closes the said port at the same time that one of the cylinders is open to the exhaust. Two pistons E and F work in the cylinders A and B respectively, and are connected by suitable rods to two cranks G and H, each attached to separate shafts supported in bearings upon the bed-plate. The principle adopted is that both pistons

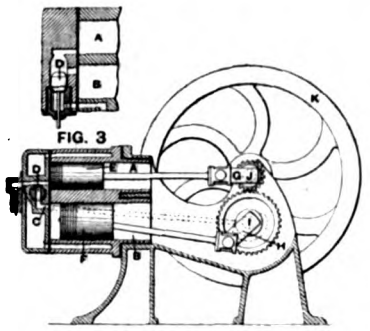


FIG. 3

FIG. 1

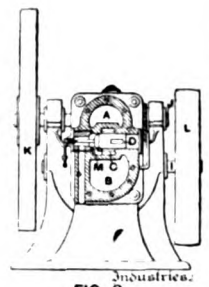


FIG. 2

may perform an equal amount of work upon the driving shaft I, which can be effected by making the piston E of half the area of F, the stroke of each being equal, but the shafts I and J being connected by gearing having the ratio 2 to 1, or the relative proportions of gearing, areas, and strokes may be otherwise arranged to attain the same result. It is preferred to attach the fly-wheel K to the shaft J, and the driving pulley L to the shaft I. The piston E makes two outward strokes and two return strokes to one double-stroke of the piston F, and the cranks G and H are placed so as to be at the position of half-stroke at the same time. The double-ported semi-rotary valve D is worked by a cam or eccentric, or otherwise, and is furnished with a screw thread of long pitch so that a longitudinal motion results from the semi-rotation of the valve and keeps it tight by the fitting of the conical end upon the seating M when the port of communication between the two cylinders is open, the valve opening the exhaust from the lower cylinder when the port of communication is closed, as shown in Fig. 2. It is an essential feature of the invention that one of the two cylinders arranged as described and shown acts as a motive power cylinder and as a pump alternately, while the other acts as a motive power cylinder only. Thus, the mixture in the example quoted is drawn into A by the piston E, and is exploded behind both E and F, the port C between the two cylinders being kept open; the igniting device, of any convenient type, is exposed to the charge by the travel of the pistons only, whereby premature explosion is obviated, and the cranks are so set that at the moment of explosion they are in the best position for receiving the impulse. The series of operations are performed as follows:—The piston E in cylinder A draws in a mixture of gas and air through a suitable automatic valve, the passage of inter-communication being closed, and the piston F being upon its instroke, expelling the products of combustion from the previous explosion through the exhaust port. The piston E on completing its instroke has pushed the mixture previously drawn in into B, the port of communication D having been opened when C reached the middle of its return stroke, during which time the crank H will have made approximately $\frac{1}{10}$th of a revolution from the dead centre. The igniting device is now uncovered by F, and the mixture explodes, giving an impulse to both pistons, and E will have commenced the second outward stroke. The return stroke of E forces the products of combustion from A into B, whence they are expelled through the exhaust port on the return stroke of F. The explosive charge is expanded, after ignition, to the same volume as before ignition in about one-third of the time necessary to procure such expansion in an ordinary gas engine. Claims: In a gas or petroleum motor, the employment of two cylinders with pistons of unequal areas in combination with two cranks of equal stroke upon separate shafts geared as aforesaid, one of the cylinders being used as a pump and both as motive power cylinders; compounding gas engines of the ordinary displacer type, so that the displacer performs the function of a four-cycle motor, and the working piston that of a two-cycle motor, both of equal power; the arrangement of valve shown used in a compound gas or petroleum motor.—No. 5192. April 3rd, 1890. 8*d*.

Water Tube Boilers.—*J. N. Paxman, Colchester.*—Enclosed within a suitable frame lined with firebricks are three or more groups of tubes, connected in series by suitable collectors, which will hereafter be more particularly described. Fig. 1 is a side elevation, and Figs. 2 and 3 are front and rear end elevations of a boiler constructed according to this invention. The lowest group of tubes—immediately over the furnace—are steaming tubes A, and all the groups are arranged to slope upwards as shown in the illustrations herewith; the next group are also steaming tubes, and are lettered B, but the upper group are steam drying tubes C. There may be any number of tubes in each group, arranged in rows, horizontally and vertically, parallel with each other. The

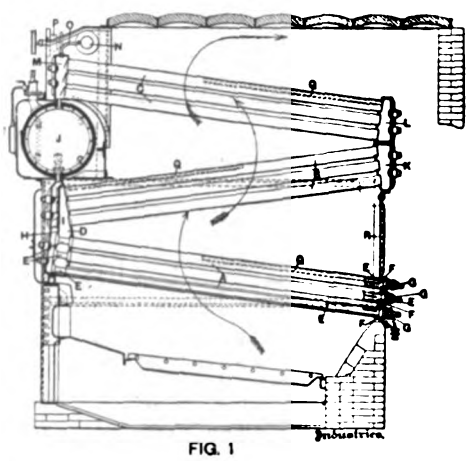


FIG. 1

tubes of the lower group of steaming tubes A are each independent and removable, and have freedom to expand; they are turned conical at both ends, and fit at the forward ends into collectors D D, and at their rear ends into junction boxes; they are kept in position by stay tubes E E, which are also circulating tubes open at both ends, and having at their rear ends longitudinal slots. The steaming tubes A are connected at the back of the boiler in pairs by longitudinal junction boxes F, forming in this example eight elements, and the adjacent tubes of each element are in communication with each other by joint boxes G, which are tightened down by a bridge piece and screw. Certain of the groups are connected by vertical boxes, as shown in Fig. 3, each filled with a suitable blow-off cock and pipe. The collectors D D are each divided into two chambers H and I, the former being in communication with the steam receiver J by nipples having conical joints tightened by nuts, similar to those which are used on the stay tubes. Suitable openings are made in the partition dividing H from I, opposite to each of the tubes B of the middle group, the openings being closed by discs which are secured in place, but which may be readily removed for the purposes of inspection and cleaning the tubes. The tubes B are expanded at both ends into the tube plates of the collectors, as also are the steam drying tubes C. The two groups of collectors K and L are alike, and are connected by suitable joints, easily removable, and the collectors M

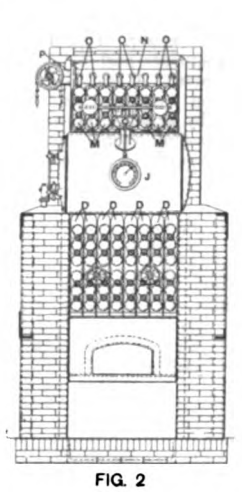


FIG. 2

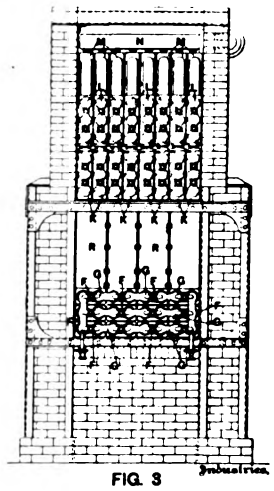


FIG. 3

communicate with the top of the steam receiver J by nipples with conical joints as already described with reference to the collectors K. In some cases these nipples can be fitted at the bottom with small valves adapted to shut automatically if, on account of a sudden and considerable consumption of steam, the water in the receiver should rise, with a tendency to prime. The steam collecting tube N placed above the highest group of tubes receives, by pipes O, the steam formed in each collector; these pipes are of small diameter, and their ends in the collector are reduced to a minimum in order to regulate the flow of steam in each element and get rid of suspended water. One end of N carries the stop valve P. Each of the groups of tubes is partly covered by angle irons Q, which form baffles and compel the products of combustion to follow a predetermined path, as indicated by the arrows in the illustration, and for similar purposes a partition R is provided to close the rear end of the boiler. The receiver J is not exposed to the action of the flames, being protected by lagging. Claims: In tubulous boilers, the arrangement of tubes disposed in three groups inclined in opposite directions as shown and connected, and working as described; the inner and outer tubes as in the lower group; the use of hollow stay tubes, slotted as described; the junction boxes, double collectors, discs opposite the ends of tubes B, and the arrangement of steam reservoir as shown, together with the general construction of tubulous boilers as set forth.—No. 8649. November 13th, 1889. 8*d*.

Spindles of Spinning, &c., Machinery.—*W. Sumner, Ghent, Belgium.*—The specification of this patent relates to improvements connected with the spindles and collars, or bearings therefor, used in machinery employed for the manufacture of cotton and other fibres. The collars, bushes, or linings are made from elastic metal, and afterwards tempered, or left untempered. They are formed as hereafter shown and described, so that a portion or portions of their outward surface act as springs, producing pressure against the inside of the frame collar or bolster, and other portions of the bush are formed to fit the spindle, so that, should the spindle or collar lining wear by use, the elastic portions of the bush will cause the bearing parts of the bush to fit the worn parts of the spindle, and prevent looseness or vibration of the latter. The bottom ends of the outsides of frame collars or bolsters, which have no linings, are reduced in thickness, and collar linings are extended below the collar sufficiently far for their lower ends to enter into oil or grease receptacles attached or fitted to the spindle (below the lifting part or traverse of the frame collars or of the stationary bolster) for the purpose of acting as an automatic lubricator to the spindle, collar lining, collar, or bolster. Figs. 1, 2, and 3 show flexible or elastic bushings for roving or preparing-frame collars; the tube is cut or slit from end to end, for example, helically, as shown at A, the parts which adapt themselves to fit the spindle being marked B; the parts C, which adapt themselves to fit the inside of the frame collar are formed with a suitable number of slits or perforations D in a helical or equivalent direction, thereby producing the spring parts C. Other forms of collar, suited to "Rabbeth" spindles, and flexible bushes for other types of spindle are described, being arranged on similar principles. Fig. 4 shows part of a roving spindle, with an oil or grease receptacle attached to the spindle at E. Fig. 5 shows an oil or grease receptacle for a mule winding or throstle frame spindle. Fig. 6 shows a preparing-frame collar reduced at its lower end F for the purpose of entering an oil receptacle fixed upon a spindle. Such method of lubrication enables a frame to work well by oiling the same, say, once per week, thus allowing

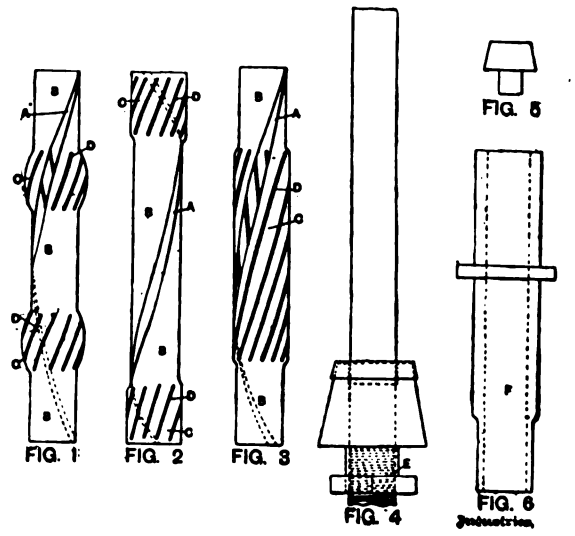


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

the frame to be more continuously in use, and preventing loss of time such as occurs by stopping the frame daily for oil. For preparing-frame collars an elastic bush may be formed from a spiral or helix of flat wire. Claims: Metallic collar linings or bushes, partially or wholly spring-like, and formed substantially as described; extending the bottom of collar linings, bushes, or hoops to below the bottom of the frame collar, whereby the hoop or lining in its descent enters an oil receptacle and lubricates the spindle bearing in its ascent; reducing in thickness the lower end of spinning frame and like collars, so that they may enter a lubricating chamber, for like purposes.—No. 8066. May 23rd, 1890. 8*d*.

Stock and Die.—*W. Horn, London.* (*J. Kreger & C. Rusbridge, Buffalo, U.S.A.*)—The object of this invention is the production of an efficient device for screw-threading pipes, rods, and similar articles, and especially one which may be used in confined positions, where the ordinary pipe-threading devices are inoperative. To attain these results the stock is formed with an annular body, and having a socket, into which is removably placed the end of a handle, the stock being also provided with a companion fixed handle. Upon the stock is located an upwardly projecting lug, having near its end a transversely arranged screw-threaded aperture to receive a correspondingly threaded spindle, having at one end a milled head and at the opposite end a button. Upon the stock, and upon both sides of the lug, are pivoted pawls, perforated to receive the screw spindle, and provided with springs to force the tail ends of the pawls away from the lug. In the annular portion of the stock there is a central aperture for the reception of the shank of the die-holder, which die-holder has an angular recess to receive a pipe-threading die and a passage for the pipe to be threaded. Below the head of the die-holder are formed a series of ratchet teeth, with which engage the ends of the pawls. Below the central portion of the die stock, and upon a conical shank, is located an annular disc, having cam-shaped recesses grooved to receive the toes of sliding cutter bars, which move in grooves located in a disc fastened to the shank of the die-holder. The cam disc is revolved by hand in accordance with suitable graduations, and its grooves cause the cutter bars to approach or recede from the central aperture. When thus adjusted, the screwed spindle before referred to is operated to bring one or other of the pawls into position to gear with the ratchet teeth on the die-holder, and cause it to rotate with the stock when the latter is used. Claims: The general arrangement and details of a pipe-threading device, substantially as described.—No. 7205. May 8th, 1890. 8*d*.

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FRICTION CLUTCHES.—*J. Wild, Oldham.*—In this clutch an annular carrier is keyed to one of the two disconnected shafts which are in line with one another, and an internally faced pulley is keyed upon the end of the companion shaft. In the annular carrier any convenient number of shoes are fitted, which may be forced outward by screws or by inclined planes actuated by levers (which in turn are operated by the well-known arrangement of grooved sliding collar) so as to be forced into contact with the internal periphery of the pulley mentioned above. To compensate for the wear that may occur in the shoes and their connections, the operating screws turn in nuts separate from the main body of the annular carrier, and are secured in place therein by set screws or in any convenient manner. By loosing the set screws the nuts may be turned independently so as to force the shoes, together with the screws, further outward from the shaft, as wear takes place. Or the shoes may themselves constitute the nuts, and adjustment be made by removing the levers and giving the screws independent rotation before replacing the levers. Claims: The friction clutch as described, and the method of compensating for wear by methods similar to those above mentioned.—No. 7062. May 7th, 1890. 6*d*.

ELECTRICITY.

ELECTRICAL DISTRIBUTION.—*Siemens Bros. & Co., London. (Siemens & Halske, Berlin.)*—The aim of the inventors has been to design an arrangement for enabling secondary batteries to be employed for storing up electrical energy produced by alternate current machines. It is well known that alternate current machines can be made to act as motors, if there be imparted to them a speed of rotation which will produce an alternating current, the phase of which shall be synchronous with that of the alternate current of the generator, and it is also known that a rotary transformer can be readily produced which shall transform alternate currents into continuous currents by coupling an alternate current machine either directly or indirectly with a continuous current machine. If the alternate current machine be then supplied with alternating currents, it can act as motor driving the continuous current machine, which will then produce secondary continuous currents. Such combined machines, which can be mechanically combined to form a single apparatus, can also be employed in an inverted manner, for converting continuous currents into alternating currents. The present invention is

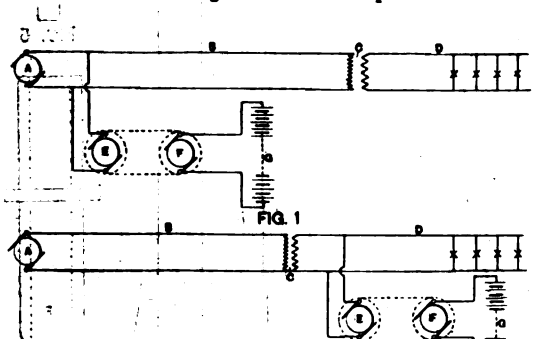


FIG. 1

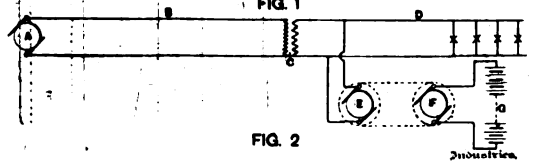


FIG. 2

based upon the above-described action. The continuous current from the secondary battery is not sent into the circuit, but is employed for working rotary transformers producing alternating currents, so that the network is supplied with alternating currents by means of the secondary batteries in the same manner as such currents are supplied from the central station. The accompanying illustration shows such an arrangement. In Fig. 1 the accumulator battery is arranged at the central station. A is the primary alternate current machine of the central station which supplies currents to the primary network D, from which the currents pass through the transformers C into the secondary network D. E is the secondary alternate current machine which is coupled with the continuous current machine F. The continuous current machine F supplies current to the accumulator batteries G if these are to be charged. If, on the other hand, the charged batteries are to supply the network, the continuous current from the batteries drives the machine F as motor. The latter then drives mechanically the alternate current machine E, from which alternating currents pass into the network, together with the currents proceeding from A, A and E being connected in parallel. Fig. 2 shows a similar arrangement, the only difference being that in this case the accumulator batteries, with their rotary transformer E F, are connected directly with the secondary circuit D instead of with the primary circuit B. The above-described mode of employing accumulator batteries on alternating current circuits has the advantage that the construction of the distributing network and its connections with the central station can be varied, because the storing stations are of precisely the same nature as the central station. It is also possible with this arrangement to supply the current partly from the accumulator batteries and simultaneously partly from the central station. With this mode of using rotary transformers it is immaterial whether the alternating current has before been transformed one or more times in ordinary alternate current transformers; the secondary batteries can therefore be arranged either in the central station itself or in proximity thereto or at a distance therefrom. Claims: The methods of distributing electrical energy substantially as described.—No. 9602. June 20th, 1890. 8*d*.

ELECTRIC METERS.—*M. Koechlin, Vevey, Switzerland.*—This is an electric meter based upon the principle of the Wheatstone bridge, shown diagramatically in Fig. 1, with lettering corresponding to that upon the sectional elevation and plan of the meter, Figs. 2 and 3 respectively, for in one loop of the circuit two solenoids A are inserted, which excite a soft iron core B, in whose field two other solenoids G are moveable. It results from this that if the equilibrium of the bridge be broken, the moveable solenoids are repelled or attracted, and by their movement displace a rheostat D, until equilibrium is again established. At the same time that this movement occurs, a roller E, moveable on a circular table F, turning under the action of clockwork, is moved correspondingly to a new position. The roller is mounted on an arbor G, to which it imparts rotation by a feather, and a groove, the arbor driving the wheels of the counter. The variable rheostat D is arranged in such a manner that for equal mechanical displacements it gives equal variations of resistance. To this end it is formed of three discs of vulcanised fibre mounted on a horizontal spindle; the middle disc, which is of a smaller diameter than the

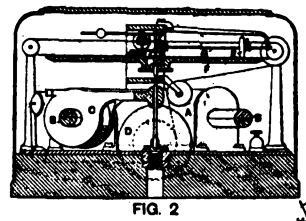


FIG. 2

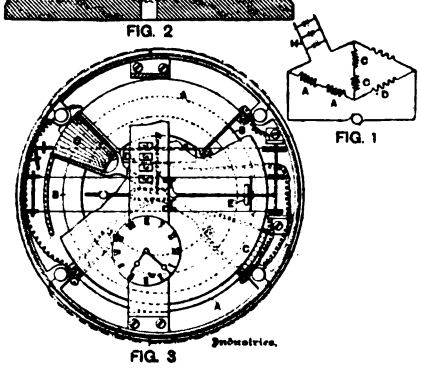


FIG. 1

FIG. 3

others, is formed with regular teeth, and also with a circular series of holes. Between the teeth and through the holes is wound helically a coil of iron wire, one end of which is insulated, whilst the other is in communication with a metallic pulley. The two outer discs of fibre are connected by a metallic ribbon, and a drop of mercury is imprisoned in the remaining annular space. It is obvious that on rotation of the discs, the drop of mercury remaining always at the lowest point, varies the interposed resistance, the rotation of the disc varying the length of wire between the mercury contact and the other terminal which moves with the disc. The movements of the sliding roller before mentioned are proportional to those of the rheostat D, and hence inversely proportional to the resistance of the lamps H. As the roller travels farther from or nearer to the centre of the table F, its speed of rotation increases or decreases in the same ratio. Claims: The automatic Wheatstone bridge arrangement, constituting an electric meter. The variable rheostat as described, and the various forms of integrating apparatus, in this connection, described in the specification.—No. 3740. March 2nd, 1891. 8*d*.

ELECTRICITY METERS.—*R. Kennedy, Glasgow.*—In this meter an ammeter or wattmeter is combined with two pendulums and a differential gear, which actuates an indicating mechanism. The lengths of the pendulums are variable, and are altered by the ammeter or wattmeter and the differential gearing operates the indicating mechanism in accordance with their difference of vibration, the pendulums being adjusted to vibrate synchronously when no electricity is passing into the meter. Fig. 1 is an elevation showing the pendulums, escapements, and meter coils, and Fig. 2 is an end elevation of the same. A and B are the two pendulums, both alike as to size and weight; C and D are the corresponding escapements, driven by separate springs and trains of wheels. E is a flexible strap passing over the pulley F mounted on the spindle G. The opposite ends of this strap are

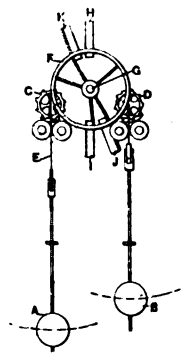


FIG. 1.

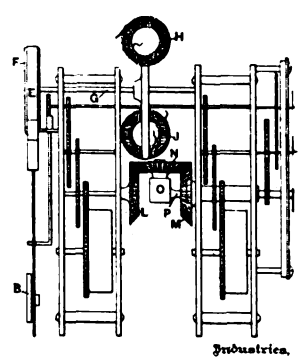


FIG. 2.

extended and carry the pendulums as shown. On the spindle G the meter movement is mounted, the meter being preferably of the class in which coils of wire carrying the current repel each other, and consisting of two fixed coils H I and two moveable coils J K mounted on the cross-arm of the pulley spindle. When current passes through the coils the moveable coils are repelled to a distance proportional to the electricity passing, and one pendulum is pulled up and shortened, the other being proportionately lengthened, the resulting difference in the speeds of the gear governed by the pendulums being recorded by the index worked by the differential gear. The differential gear is of a well-known type, the wheel L being driven by one train and M by the other, the third or floating wheel N being pivoted on O, which is mounted on a spindle P passing through the hollow spindle of M to the index train. The flexible strap E is guided by pulleys as shown. For use with alternating currents the moveable coils J K are replaced by two discs of copper. As an ammeter, a long solenoid may be used to act upon a core of iron wires which is pulled into the solenoid against the resistance of a spring, operating the pulley F accordingly. Claims: Measuring electricity by the difference between the rates of vibration of two pendulums, the difference being caused by the lengthening and shortening of the pendulums under the action of an ammeter or a wattmeter; the combination of the mechanism referred to in the foregoing parapraph, with differential and indicating gears.—No. 8867. March 4th, 1891. 6*d*.

CHEMISTRY.

MANUFACTURE OF GUNPOWDER.—*H. Kolf, Bonn, Germany.*—This invention relates to the manufacture of a nearly smokeless gunpowder which is especially free from danger by reason of the non-employment of picric acid, picrates, and chlorates, the use of which has hitherto rendered the manufacture and the manipulation of so-called smokeless gunpowder dangerous. This objection is removed by the use of carbon-hydrates, or products which possess the qualities of carbon-hydrates, in a nitrogenous condition. The materials containing carbon-hydrates are grain, malt, malt-flour, and waste from the mash, the roots, stems, and leaves of plants of the genus *althæa*, and waste of all kinds resulting from the manufacture of starch, and from breweries and distilleries. These materials are nitrated in the usual manner by treating them with nitric and sulphuric acids preferably at a temperature of between 20° to 30° C. in vessels or vats under a pressure of from 2 to 5 atmospheres. The nitrated mass, after having been drained and thoroughly washed in cold water to completely free it from acid, is dried in a temperature of about 40° to 50° C. and then crushed or ground; or the crushing or grinding can be effected while the material is in a semi-dry condition. For the purpose of ensuring regular combustion of the powder and to regulate the point of combustion, sulphur is introduced into the powdered nitrated mass. The sulphurising materials are caused to act on the nitrated powdered mass under a pressure of, say, about 5 atmospheres. In about two hours' time the nitrated and sulphurised mass is freed from the sulphurising substances by carefully washing it, and it is then treated with a suitable oxygen-yielding medium (after first drying it in a temperature of from 60° to 80° C.) by submitting it to the action of a solution containing about 5 to 20 per cent. of nitrate of potassium, sodium, or ammonium at an ordinary temperature for about 12 hours under a pressure of about 4 to 5 atmospheres, produced, preferably, by compressed air or hydraulic power. To separate any superabundant nitrate which has not been intimately absorbed by the mass, and would, therefore, act prejudicially to the consistency of the product, the latter is quickly rinsed or dipped in cold water and then dried in a temperature of about 80°. To bring the product into compact granular or prismatic form it is damped or soaked in a solution containing 2 per cent. of a binitro-combination of one of the before-named materials containing carbon-hydrates, or of cellulose, and is then formed by pressure into grains, cakes, or prisms as may be desired. It will be obvious that the solution used for the above-stated purpose may also be employed in a more or less concentrated form, and can be produced in the product obtained as before described, and which already contains nitrocarbon hydrates, by simply damping it with one of the known solvents for dissolving the nitrocarbon hydrate instead of a prepared solution. Claims: The manufacture of smokeless powder characterised by the use of nitrated carbon-hydrates or plants such as those herein-mentioned or their waste products, containing carbon-hydrates, which are sulphurised by treatment with a sulphide of hydrogen, sulpho-hydrates, or poly-sulphides under pressure; impregnated with oxygen-yielding mediums by treatment with a solution of the same under pressure; the product thus obtained is moulded by pressure with a binitro-carbon-hydrate or a binitro-combination, or with their solvents, such as acetic ether, acetone, or oil of camphor, into the desired form.—No. 8811. June 7th, 1890. 6*d*.

MISCELLANEOUS.

SPANNERS.—*Alfred Ladds, London.*—The spanner or wrench described below is self-adjusting to articles of various shapes and sizes, and is capable of being stowed into a small compass. The main jaw of the wrench is made separate from the power handle or lever, but is connected thereto by a pin (on which it is capable of turning) passed through one of a series of holes provided in the lever and provided also in the end of the jaw. Linked or hinged to the free end of the main jaw is a pressure jaw, and on the back of this latter the lever is caused to bear when the wrench is gripping an article; therefore the greater the power applied to the lever, the greater will be the pressure of the end of that lever upon the pressure jaw, and the more firmly will any article placed between the jaws be held. The faces of the jaws may be plain, but it is preferred that they should be serrated. To enable the wrench to operate in confined spaces which would not admit of the insertion of the jaws to engage the whole depth of the article, a recess or recesses is or are formed in the lower face of the jaw, tapering towards the outer edge for the reception of the nut. To render open spanners of the ordinary construction more durable, the outer ends of their jaws may be connected by a bridge piece forged in one with the jaws in the process of manufacture, or afterwards applied as may be convenient. This bridge piece is notched to allow of the passage of the screw on to which a nut may be screwed by the spanner in question. Claims: A wrench or spanner having two jaws which are hinged together and to the lever or handle of the spanner, which has its bearing or fulcrum on one of the jaws and exerts pressure upon the other; the modifications of this type of spanner shown; the improvement of ordinary spanners by the bridge piece as described.—No. 19745. December 4th, 1890. 6*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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AN IMPROVED TUBE BENDING MACHINE.

The accompanying illustrations, Figs. 1, 2, and 3, represent a general view, a plan, and a part elevation respectively of a useful machine recently patented by Mr. John Laidlaw, and which is being introduced by the firm of Messrs. Watson, Laidlaw, & Co., engineers, Glasgow, for bending tubes without the necessity of filling them with some yielding material to preserve an accurate section. As we recently referred to this machine as a novel patent under our "Abstracts of British Patent Specifications" (see *Industries*, Vol. X., page 456), a brief description is all that will be required. To begin, then, we may explain that the peripheries of the semi-circularly grooved rollers A A are kept in contact—attention being given to the fact that the bending of a tube tends to distort its cross-section to an oval, the widest portion being at right angles to the plane in which the tube is bent—by making the grooves in the rollers A, D, and E to exactly fit the cross-section of the originally straight circular tube, and thus prevent "ovalling." There is consequently a pressure set up against the tube by the rollers, and the rotation of the latter draws the tube along, all the rollers being driven at a uniform speed by suitable gearing. B is the machine frame, carrying a slide C, on which are mounted, in fixed centres, the two rollers A A. The other pair of rollers D and E rotate upon centres secured to the frame, and are driven by any convenient means, such as the gearing shown. The roller E is geared to one of the rollers A by spur wheels K L M, which are maintained constantly in gear by a linked frame shown in the plan, and a screw N operated by the hand-wheel O serves to adjust the frame carrying the rollers A relatively to the rollers D and E, for varying the curvature of the tube.

AMERICAN IRON AND STEEL PRODUCTION IN 1890.

Sir James Kitson's recent address before the Iron and Steel Institute, to which we referred in our issue of the 15th ult., directed attention to the great increase in production of iron and steel in the United States during the past few years. The Report of the American Iron and Steel Association for last year has recently been published, and a few additional facts and figures may be noted. The Report states that for the first time in the history of America the production of iron has exceeded that of Great Britain, and that it not only surpassed British production for the year 1890 by about 1,200,000 tons, but exceeded by 600,000 tons the greatest production ever realised in Great Britain in any year. During the year 1890 the most striking fact in the history of the trade was that, notwithstanding an enormous increase in consumption of iron, the market prices, both of pig iron and of the more important products of iron and steel, steadily declined during the entire year, a fact which, the Report remarks, is quite contrary to the usual experience of ironmasters, who are apt to find that when there is a largely expanding consumption, so that a marked increase in production becomes possible, there is usually an advance in prices, or prices are maintained at something above the ordinary level. But in the year 1890 expansion in several directions took place at once. There was enormous enlargement of consumption, the total amount of pig iron used being 8,959,679 tons, which is more than twice the consumption in 1885, only five years earlier. The following figures, comparing the consumption of pig iron for the years 1875, 1880, 1885, and 1890, record a progress such as no other country has witnessed in the consumption of any of the great products of industry:—

	Consumption.		Production.
1875	2,000,000 tons.	...	2,023,733 tons.
1880	3,990,415 „	...	3,835,191 „
1885	4,348,844 „	...	4,044,526 „
1890	8,959,679 „	...	9,202,703 „

The extraordinary increase in consumption, amounting to about 1,200,000 gross tons for the year, was surpassed in 1890 by the increase in production of pig iron, which was 1,599,061 tons larger than that of 1889, an increase of 21 per cent. for that year, as the production of 1889 had been greater than that of 1888. But the cheapening of production was even more remarkable than the increase, and it is found that the new establishments put into operation appear to be able to produce pig iron at a lower average cost than establishments in any other part of the country. In this connection a few figures may be quoted from another report which the Hon. Carroll D. Wright, National Commissioner of Labour, recently transmitted to Congress through the President,

AN IMPROVED TUBE BENDING MACHINE.

Constructed by Messrs. Watson, Laidlaw, & Co., Engineers, Glasgow.

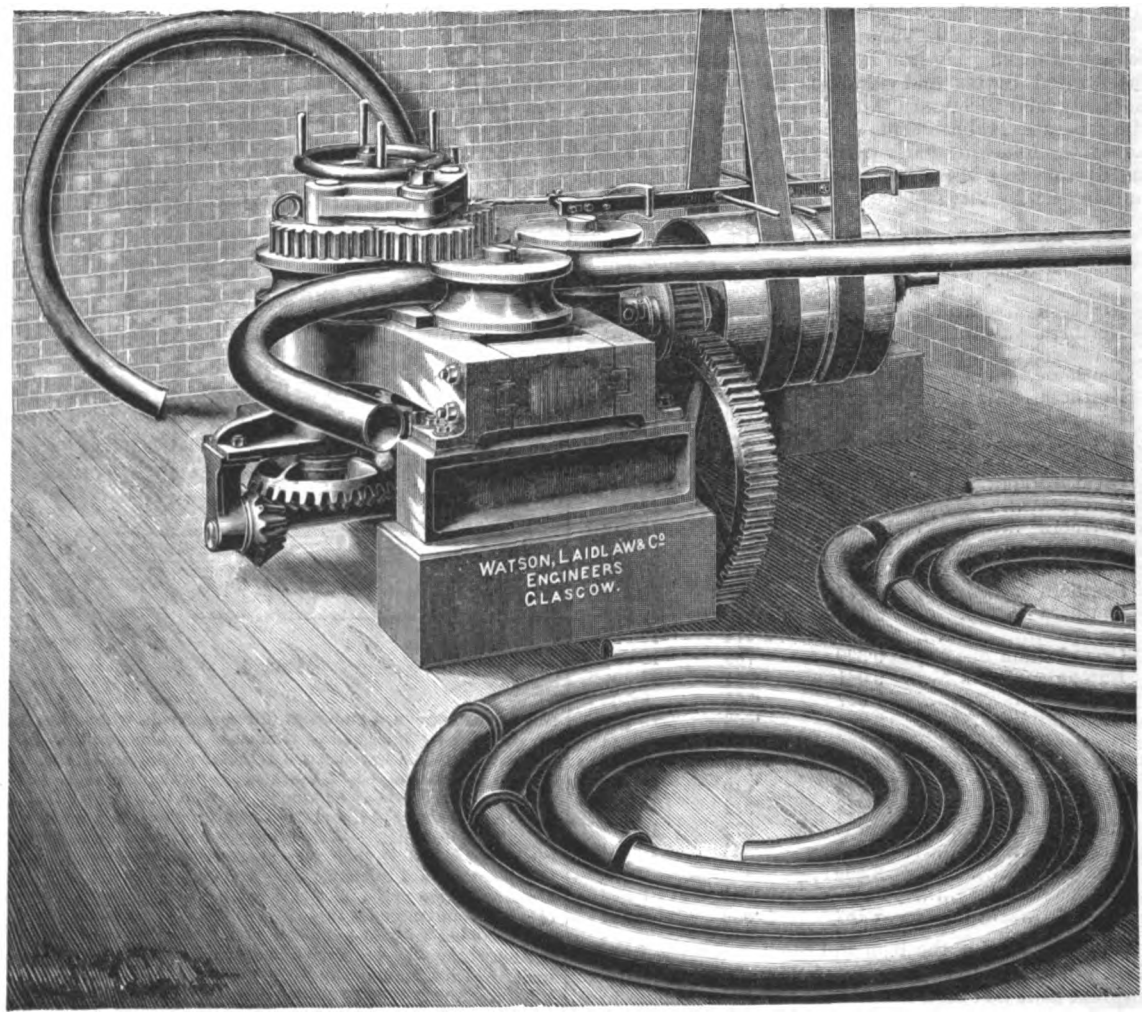


Fig. 1.

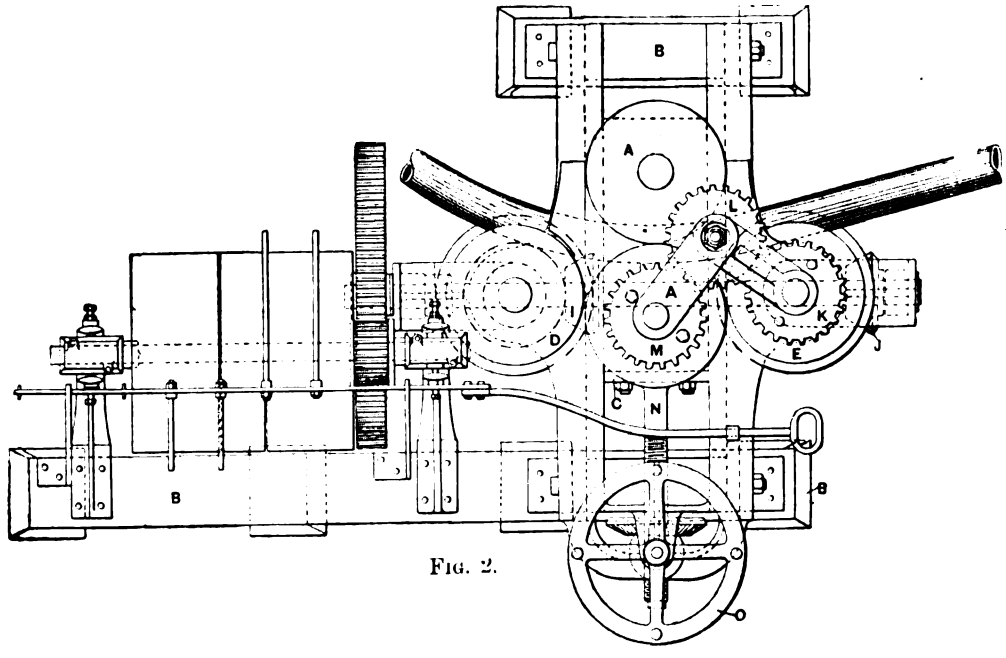


Fig. 2.

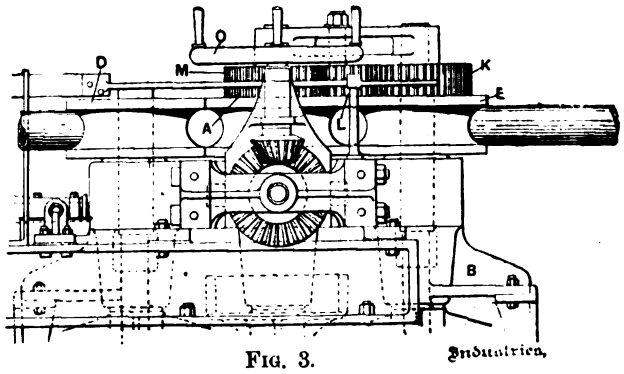


Fig. 3.

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and which is the result of several years of careful investigation in the United States and Europe, based upon an examination of the books of leading manufacturers and expert special agents of the National Department of Labour. The entire report is most exhaustive, making a volume of 1,200 pages, and one of its most striking features is the great advantage possessed by the Southern States as regards the cost of materials.

The following table shows the comparative cost, in dollars, of making pig iron in different establishments in the United States and Europe, the latter meaning Germany and Belgium. Each line represents the work of a separate establishment, and, of the 118 given in the report, the following fairly represent the highest, lowest, and average cost of materials, labour, and total cost per unit in each locality:—

THE COST OF MANUFACTURING PIG IRON.

Locality.	Cost of Material.	Labour.	Total Cost.
Northern	$17·728	$3·589	$23·165
Northern	13·223	1·194	15·202
Southern	7·757	1·461	10·279
Northern	11·991	·975	13·584
Northern	11·663	1·364	13·433
Europe	9·559	·418	10·394
Europe	12·228	·912	13·434
Great Britain.....	9·230	·601	10·290
Great Britain.....	9·308	·743	10·729
Europe	14·219	·719	15·075
Northern	12·267	2·135	15·258
Northern	11·147	1·166	12·820
Southern	7·173	1·816	9·634
Southern	8·877	1·218	10·822
Southern	8·164	·595	9·623
Europe	9·885	1·414	12·070
Great Britain.....	9·529	·769	10·893
Europe	9·061	·711	11·107
Europe	7·327	·755	8·765
Great Britain.....	8·953	·603	10·163
Great Britain.....	9·236	·710	10·244
Great Britain.....	7·168	·710	8·175
Great Britain.....	6·844	·710	7·851
Europe	12·228	·912	13·434
Europe	10·256	·972	11·228
Europe	9·559	·835	10·394
Europe	8·333	·425	9·073
Europe	7·339	·661	8·639
Europe	7·182	·950	8·132

The statistics of the Iron and Steel Association show that the increase in Southern production was not quite so great as it had been from 1888 to 1889, and being produced at a cheaper rate, it had the effect of steadily depressing the price during the year. The Report directs attention to the great increase in the consumption of Bessemer steel in other forms than in rails. Although the use of rails in the year 1890 was considerably larger than in the previous year, and the production 23 per cent. greater than in 1889, nevertheless the most striking feature in the year's history was the enormous demand for steel in structural and other forms. It was a year of almost unprecedented building, and it is probable that the demand for steel in other uses than in connection with railroads was greater than it will be again for some time to come.

THE BALANCING OF CENTRIFUGAL PUMPS.*

(*Concluded from page* 508.)

I NOW come to the main subject of "Balancing Centrifugal Pumps." Among the phenomena that arise in working these pumps is unbalanced pressure. We generally find, after making an unbalanced pump, that it "burns out" its bearings. This is sure to be the case if it is not supplied with the necessary balancing arrangement; the shaft and bearings are soon destroyed, because the pressure exceeds the limit allowed for bearing areas.

I am referring now to a disc like the one in Fig. 5. But before I speak of this pump, I will mention in connection with Fig. 4 that this encased runner or wheel, an invention of Mr. Andrews, was one of the things that James Stuart Gwynne took to England and introduced in his first pumps, and continued to manufacture for several years, but subsequently abandoned. Neither he nor his brothers John and Henry Gwynne have made encased runners for twenty years past, using only open wheels. Fig. 4 is a vertical section through a pit pump, as it is called in California, from designs of mine made four years ago. The water enters by double inlets G at the top of the pump, and then through the nozzle H to the interior of the wheel I, and is discharged by the periphery J into the casing L, against a pressure due to the head. The heads are from 50ft. to 90ft., and if, in this case, we assume 60ft., then the pressure at J, J, and also in the spaces D and E, above and below the wheel, is 60 × ·43 = 25·8lb. per inch static, or about 30lb. working pressure per inch of area. Suppose the wheel I to be 30in. diameter, then the area 706·8 times 30 (lbs. pressure) gives 21,204lb., or more than 10 tons of pressure on each side. Following this matter of internal pressure further, suppose the casing J to be 40in. diameter, then the pressure on the top and bottom plates will be about 18 tons. This seems enormous, and it is also in a sense anomalous, because if the wheel I is changed to the form shown in Fig. 6, there is no lateral thrust on it at all, and the pressure on the casing J is nothing, or negative at the centre, and the whole less than one-half that before estimated.

Now, as to balancing, we will return to the wheel I, Fig. 4. It has been explained how this wheel sustains on its sides a pressure of 21,204lb., working under a head of 60ft. and a speed of 10 $\sqrt{60}$ = 77·4ft. per second, but the whole area of the sides is not exposed. The inlet F must be deducted from the top side. The diameter of the inlet nozzle H is commonly made one-third that of the wheel, and in this case 10in., so that this area, 78·5 square inches, must be deducted from the top side, and represents an upthrust of about 1 ton on the wheel. This is enough to sustain the wheel, and a shaft 2¼in. diameter, 60ft. long, with its couplings, pulleys, &c., and now we come to that point which suggested the discourse of this evening—the control of this thrust

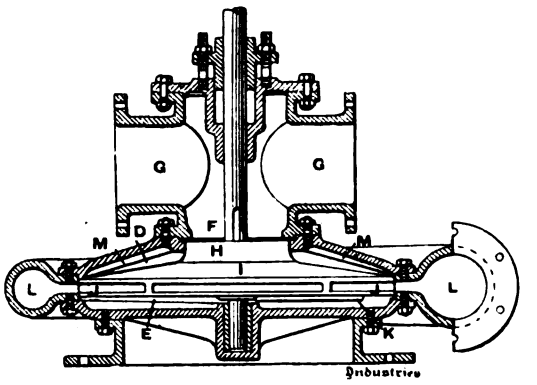


FIG. 4.

so as to balance such pumps at different heads when they have the same area of inlet at F. It must be remembered that in the quantities given I have assumed that no rotation of the water and no centrifugal effect takes place in the spaces E and D. This is the case when the runner or wheel is turned true and smooth as it should be, and fixed baffling vanes M are employed on the outer casing. It is evident that if rotation is set up in the spaces E and D, then whatever centrifugal force results is that much toward balancing the pressure in J; hence the amount of upthrust due to the inlet at F can be regulated by the amount of water rotation under the wheel at E; and this is the method I have adopted in these pumps, applying shallow vanes K on the bottom of the wheel of varied length and depth to suit the heads under which the pumps are to operate.

This is a very sensitive kind of balance. In one case, in the Santa Clara Valley, 1in. cut from the tips of the vanes K, which were only ⅛in. square, made a difference of more than 300lb. in the thrust upon the shaft. If the space E is much widened by the raising of the wheel, then the effect of the vanes K is less, and the upthrust is cumulative, increasing as the wheel rises. This feature has been discovered during six months past in practice, and was not foreseen in my original plans.

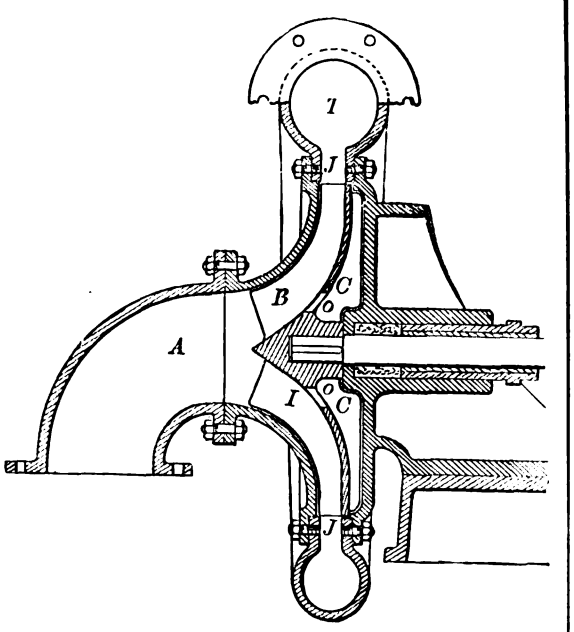


FIG. 5.

One other feature I must point out here. In all pumps with encased wheels, there must or should be maintained a water-tight joint around the nipple H. Any water forced back around this nipple will re-enter at the inlet F, and merely circulate in the pump. This is an objection to encased wheels, one hard to obviate, and should prevent them being used for pumping water containing grit or sand. Referring next to Fig. 5, the pump shown is the result of six years' fairly constant experience, as well as observation in this and other countries, and I think it will be a pardonable claim if I assume it to be one of the nearest approximations to the theoretical practice that has been made up to this time. The inlet A is at the side, so as to be accessible and easy to remove. The main casing T is volute in form, and so constructed as to be set in any position on the frame. The course of the water from A, through B to J, is by easy curves, and the area of sections is kept as nearly uniform as possible. The packing around the spindle is placed inside the main bearing, and there is, by reason of the concave form, but little overhang of the wheel.

Now as to balancing. The wheel, as may be seen, is a disc with vanes B and I on its front side. This disc, if 30in. diameter, made solid, and without vanes C on its back, would, under a head of 40ft., be subject to a lateral thrust as follows:—Area of wheel, 706·8in.; speed in feet per second, 10 $\sqrt{H}$; pressure per inch 19lb. = 13,429lb.

This is impracticable, hence the wheel is balanced in the following manner:—On its front are deep vanes I and B, and on the back are shallow vanes C. Now it is evident that centrifugal action is the same, or nearly the same, on each side of the wheel, but all the water passes on the front of the wheel. The rear or balancing vanes C are not quite as long as the main ones I. There is a difference of ⅜in. to ½in. at the tips, as seen in the illustration. This slight difference causes the centrifugal force on the front to overbalance that on the rear of the disc, causing a slow circulation of water over the periphery and through the holes O from the back to the front, just the reverse of what one would suppose. Now I maintain that a pump thus balanced is as nearly in equilibrium as one with a forked or double inlet, and is more likely to remain balanced, because there is less danger of obstruction, and, as can be seen, the waterways are more direct and easy. Thus it will be seen the working conditions of a pump are wholly changed by the kind of wheel employed. If the wheel is encased the whole interior of the pump sustains the discharge pressure. With an open wheel there is no pressure at the centre, and only one-half as much on the sides of the casing.

The friction is the same in both cases. With the enclosed wheels the friction is between the wheel and the water. With an open wheel, the friction is between the water and the main casing at the sides. Except in cases like Fig. 4, where thrust is desirable, I am inclined to think that open wheels, or wheels with vanes on each side of the central disc, are preferable. Fig. 6 shows an open wheel for a dredging pump, such as I have employed in a pump recently designed for the San Francisco Bridge Company of this city, and, also with a slight modification, for a pump to be used in the harbour at Boston, Mass. These wheels are made of steel and with five vanes, so as to admit stones or lumps of clay between them. There is no chance of obstruction, and in dredging there is no disintegration of the material beyond

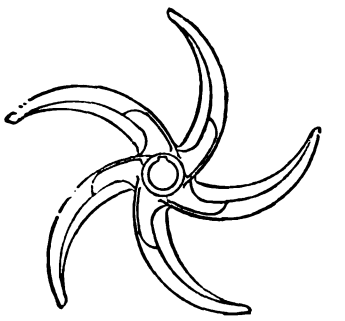


FIG. 6.

reducing it to the size of the discharge pipes. I have recently seen one of these pumps carrying more than 50 per cent. of solid matter.

Dredging pumps are commonly made with encased wheels to prevent the vanes from breaking, but this class of pumps—more than any other—requires open wheels. In 1885 I constructed in this city an open-wheel, single-suction pump that ran for months without choking or accident. Dredging pumps are also made with a double or forked suction, under the impression that this is required for balancing the wheel. This, as I have shown, is not necessary, and it need hardly be said that the tortuous passages and reduced section of the pipes is extremely objectionable, causing frequent stoppages and accidents to pumps of this kind. The wheel shown in Fig. 6 is strong enough to withstand blows from stones or pieces of iron that may enter the pump, and, moreover, is more efficient and requires less power than an encased wheel. The lateral thrust on a wheel of this kind is equal to the area of its shaft multiplied into the suction pressure, or about 80lb., just enough to keep the wheel in alignment if its bearings should wear.

In conclusion, I will say that centrifugal pumps have recently received a good deal of attention, and I think we are on the eve of having measurably fixed proportions for them. The size of the wheels for centrifugal pumps can probably never be made to correspond with the demands of theory, because the practical limit of speed for wheels is what the shafts and bearings will endure. I have read all the literature I could find on the subject of proportions for the centrifugal pump, but I find no intelligent answer to the problem of the size of wheels except that of Mr. Wagoner—namely, that they should be so proportioned that the motor will make one complete revolution only. So far is this from practice, however, that there are pumps being made that move the water through 1,500° before its discharge. The limit of speed in these pumps is, as before said, to be found in their bearings. The size of the apertures are determined by the obstructions that may have to pass through with the water; the thickness of the casing, and various other features, may be determined theoretically, based on the strains in most cases. What we will have in the end, probably, will be a compromise between the theoretical, commercial, and operating conditions, and we shall then settle down to something like uniform practice.

On the Pacific coast I think we have done more to develop centrifugal pumps than all the rest of the United States put together; in fact, it has largely been done here during eight years past. The pumps that are being made in the East are constructed in many respects on lines taken from practice on this coast.

* Abstract of a paper read by Mr. J. Richards, of San Francisco, before the Technical Society of the Pacific Coast.

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THE "DEMON" WATER MOTOR.

The accompanying illustrations, Figs. 1, 2, and 3, represent a general view, a sectional elevation, and an end view, partly in section, of the above motor, made by Mr. P. Pitman, of Aubrey Road, Withington, Manchester. This motor should be found very useful for housekeepers and shopkeepers' purposes, and various other requirements where the introduction of steam or gas would not

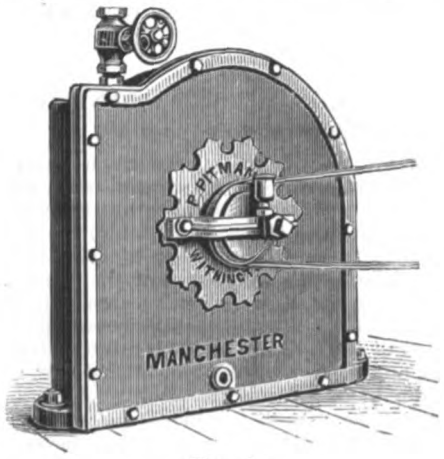


Fig. 1.

be desirable. The construction of the motor is exceedingly simple. Mounted on a horizontal shaft B which runs in adjustable bearings (shown in large size, Fig. 5) is a disc A. On the faces of this disc and near its periphery are mounted alternately small cups or buckets C, against which water under pressure and from any suitable source is discharged through twin jets or nozzles D (also shown in large size in Fig. 4), thereby causing the said disc to rotate. The water thus taken up by each

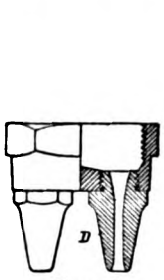


Fig. 4.

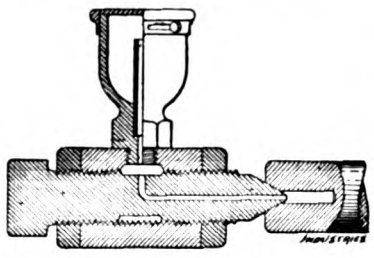


Fig. 5.

cup is carried down to the lowest position of the latter, and is then deposited and allowed to escape through the exhaust port E. The machine, it will thus be seen, can be driven at at a uniform velocity, there are no pistons or complicated parts to get out of order, and as there is no dead centre it can start in any position. The shaft and all wearing surfaces are made of the best material, and a removable cover is provided for allowing easy access to the interior. The motor is made in various sizes from ¼ up to 2 man-power.

ON TESTS FOR STEEL USED IN THE MANUFACTURE OF ARTILLERY.*

The physical and mechanical properties of steel depend upon so many conditions, that the greatest difficulty exists in devising tests which shall give the user of steel reasonable certainty as to the intrinsic qualities of his material, as well as some idea of its condition with reference to internal stresses. At first sight it would appear that chemical analysis ought to provide the most certain indication of the nature of a specimen. The purchase and manufacture of very many substances are guided by chemical tests alone, and the results are eminently satisfactory. Why should not chemistry, in its present advanced state, render equally certain indications as to the qualities of steel? The answer, I think, lies in the circumstance that the mechanical properties of steel, and of alloys generally, are affected in a remarkable manner by extremely minute quantities of substances associated with the dominant metal, by the relative proportions of these substances, by the changes in some, or in all, of them, produced by more or less rapid changes of temperature, which influence dissociation and reveal their effects by the singular phenomenon known as recalescence, which also indicates, though to a less degree, allotropic changes in some or all of the components. Chemical analysis sufficiently minute to detect even traces of every substance associated with iron, would be so tedious and costly as to be impracticable, and I fear that many years must pass away before chemical and physical science together will succeed in determining the laws which govern the mechanical properties of alloys. Some advance has already been made by Professor Roberts-Austen, who has shown that there

* Paper read before the Iron and Steel Institute on the 6th ult., by Dr. W. Anderson, M.Inst.C.E.

THE "DEMON" WATER MOTOR.

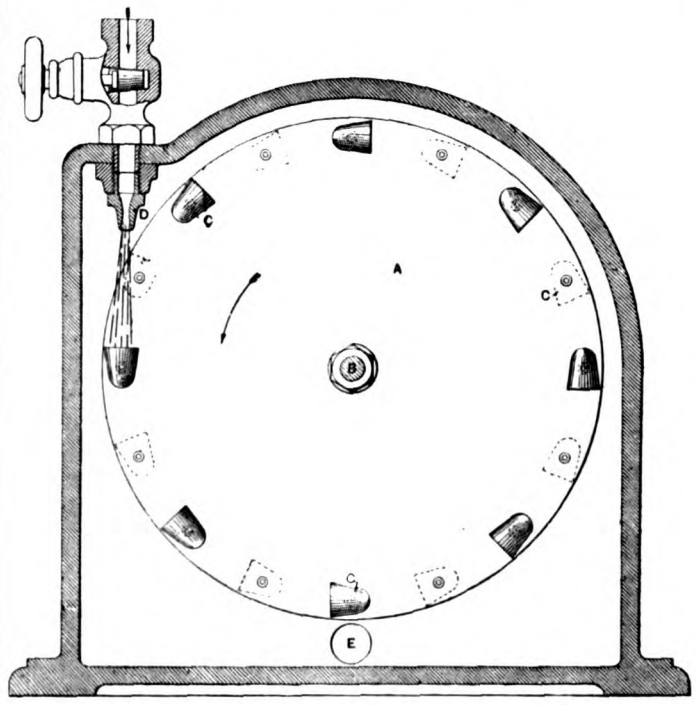


Fig. 2

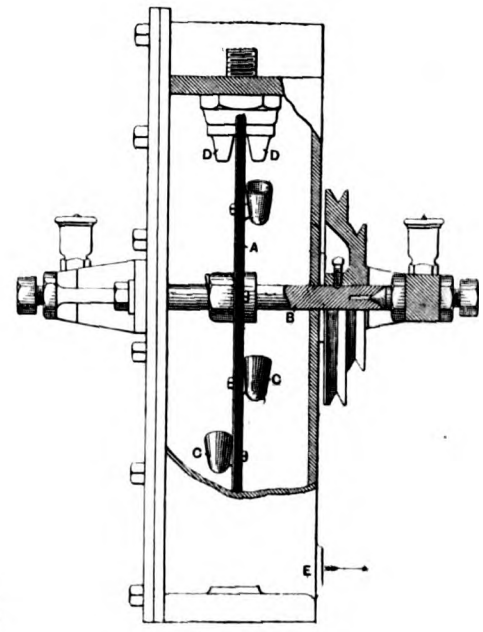


Fig. 3.

exists a relation between the mechanical properties of some alloys and of the atomic volumes of the substances of which they are composed, and I do not doubt but that farther investigations in this direction will enable metallurgists to predict with some certainty the effects of ingredients upon the mechanical properties of the substances to which they are added, but it is only those who have attempted such systematic work as Professor Roberts-Austen is now doing for the Alloys Research Committee of the Institution of Mechanical Engineers who can have any idea of the difficulties which surround the inquiry, chiefly arising from the practical impossibility of obtaining pure materials in sufficient quantity, owing to the liability to oxidation of the metals which are most used in the arts, to the disturbance caused by the occlusion of gases, and to other causes. The time which must necessarily elapse before a sufficient number of facts can be established to enable unassailable laws to be laid down, and the corresponding expense, are sufficient to deter the most enthusiastic investigator. But assuming, even, that the laws are discovered, and that the effect of each constituent of steel can be foretold, there will still remain the necessity of determining by analysis the exact constituents of the sample, which will involve expense and loss of time that cannot be conceded.

For these reasons, and acting under the advice of the President, the specifications of gun-steel used in Her Majesty's service exclude all definitions of chemical composition, in so far, at any rate, as the proportions of the ordinary ingredients of steel, such as carbon, manganese, silicon, phosphorus, and sulphur, are concerned. The introduction of new materials, such as chromium, aluminium, or nickel, is, indeed, not forbidden, but special care is taken to ascertain their effects upon the mechanical properties of the metal before their use is sanctioned. With respect to steel for lighter work, such as small arms, and especially for use in the production of swords and bayonets, some restrictions in chemical composition are imposed. In the former case, however, the percentage of carbon is defined with a view to the hardening which some portions of the components of a rifle have to undergo, and with reference to the durability of the barrels in regard to erosion by powder gases and abrasion by the bullets. In the case of swords, the difficulties of framing a satisfactory specification are so great, that the subject was specially referred to Sir Frederick Bramwell and to Sir Benjamin Baker, and by them the nature of the steel to be used was, indeed, defined by its chemical composition, but with the sole view to secure uniformity in supply, the sword maker being permitted to vary the components of the steel he proposed to use within certain limits. Once, however, the quality supplied is found suitable by the mechanical tests imposed, the chemical composition so selected is not to be departed from beyond reasonable limits of toleration, and I think that I may venture to affirm that the chemical tests for sword-steel were adopted only because it was found impossible to define the qualities required by physical tests alone, seeing that sword-blades have to be hardened and tempered, and are therefore subject to internal stresses, the nature and intensity of which certainly depend upon the chemical constituents of the steel, as well as upon the form of the blade and the mode of treatment.

It is not, I think, sufficiently realised that metals, and, indeed, most substances, are incapable of appreciable cubical compression, that is, change of volume under any stress that can in practice be brought to bear on them, under whatever conditions they may be, whether fluid, in the pasty state, at forging temperature, or cold. Like ice and water, steel and cast iron have a greater volume in the solid than in the liquid state, and therefore red-hot solid cast iron or steel floats on the surface of the molten mass, and hence, to some extent, is due the sharpness with which the metal takes the form of the mould in casting. The molecular motion in the metal, which results from the continued application of heat, culminating in producing a change from the solid to the fluid state, although it must constantly increase in energy, does not necessarily imply a greater mean distance between the molecules; in fact, the distance often becomes less, since the liquid is often more dense than the solid. Hence it is probable that the motion of the atoms in the molecule are affected, which view certain other changes due to thermal influence seem to support.

In the process of solidification the outer surface sets first and becomes rigid, but as the cooling proceeds, in spite of the slight swelling of the mass due to solidification, the loss of volume arising from cooling asserts itself, and since the outside cannot be drawn in altogether, on account of its being set and conparatively cold, the inside of the mass is broken up into porous places or into hollows, so familiar in large castings of unequal thickness; and even if solution of continuity does not occur, the casting is in a condition of internal stress, which a trifle may develop into rupture. As the cooling proceeds, the inside contracts, and the outside, which had set in a stretched state, becomes violently compressed, while the inside remains in a state of tension; and if the material yields, the sudden release of the outside surface causes the parts to spring asunder with such violence that the stress, which was originally compressive, is suddenly turned into tension high enough to cause rupture with such energy as to be generally accompanied by a report.

In the case of wrought steel cooling suddenly from forging heat, similar action takes place. When annealed from below the temperature *b* of Chernoff—that is to say, below the temperature from which, in cooling gradually, crystallisation can take place, the fall of temperature on the outside and in the inside proceeds at nearly the same rate, and the contraction is consequently uniform throughout, and no internal stresses arise; but if heated to the same point and quickly immersed in oil or water, the surface is rendered rigid in every direction, and contracts upon the heated core, and this being incompressible, the surface has no alternative but to stretch. If it does this without fracture, the mass of metal is apparently uninjured, but should the tenacity be unequal to the stress, rupture takes place at once. Should the metal survive the violence it has been subjected to, the subsequent cooling will gradually relieve the tensile stress on the surface, and substitute a compressive one in all directions, while the core will be in a state of tension also in all directions, and in some cases these stresses become so severe that a slight disturbance of temperature, or the application of mechanical force, will determine rupture with more or less noise. This has been frequently observed in hardened armour-piercing shot, in steel coining and stamping dies, and even in oil-treated gun hoops and tubes, though made of mild and tough steel; and in these the late General Kalakoutsky succeeded in accurately measuring the strains in a great number of instances, and in calculating the intensity and direction of the stresses which produced them. In consequence of the conjugate nature of the stresses, the fractures are generally of a serrated, branching, and diagonal character. As there is no such thing as an absolute elastic limit time, to some extent, obliterates the internal stresses; the metal slowly yields under them till a sort of armed neutrality is produced, so that after a few months' repose spontaneous fracture need hardly be dreaded; and for this reason dies and armour-piercing shot are kept in store for some time before being issued for service. The proper way, however, to restore neutrality, when hardness need not be retained, is to heat the steel to about the temperature *a* of Chernoff's scale (about 900° Fahr.), and suffer it to cool slowly. This is found to obliterate the internal stresses, while retaining, in a great measure, the so-called high elastic limit and ultimate strength which oil-hardening undoubtedly communicates. If, however, the process of hardening has set up fissures or cracks, however minute, in the interior of the mass, and these are just as likely to be longitudinal as transverse, no subsequent annealing can repair the mischief done, and in this lies the great danger of oil-hardening. I attribute to it most of the failures which have occurred in artillery; and although all nations are in accord in practising the oil treatment of gun-steel, it is a remarkable fact that civil engineers do not feel justified in taking advantage of the undoubted increase of elastic and ultimate resistance communicated to steel by the process, on account, I presume, of the risks attending it.

(To be continued.)

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THE NICARAGUA CANAL.

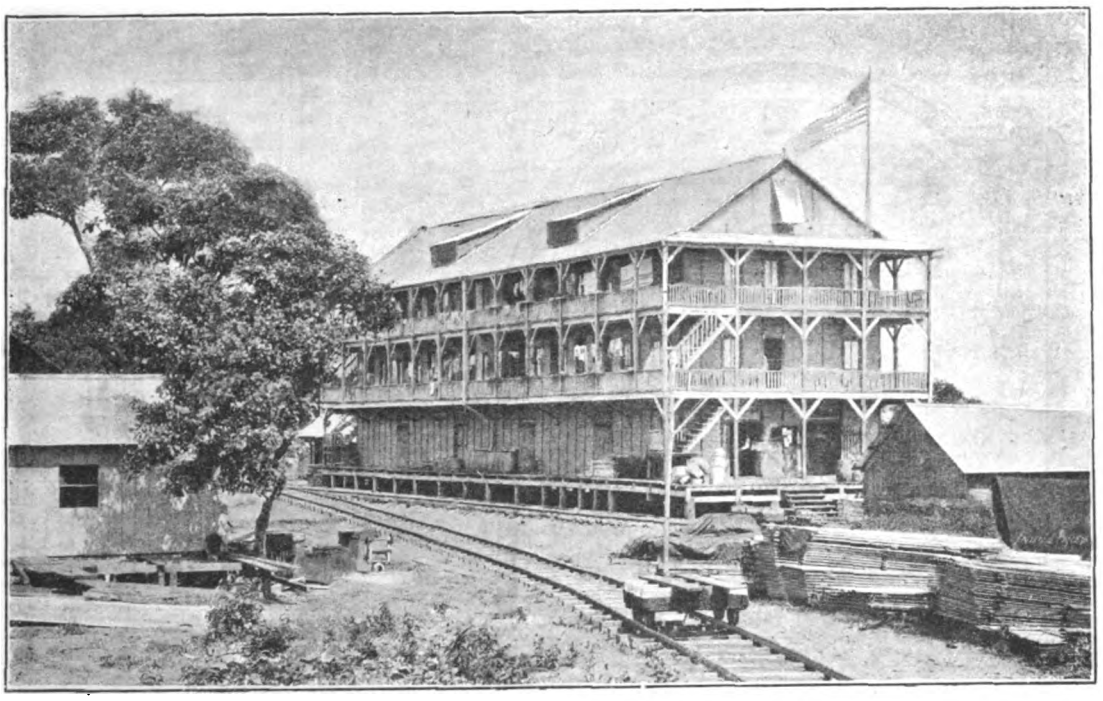


Fig. 9.—Storehouse and Staff Quarters at La Fé.

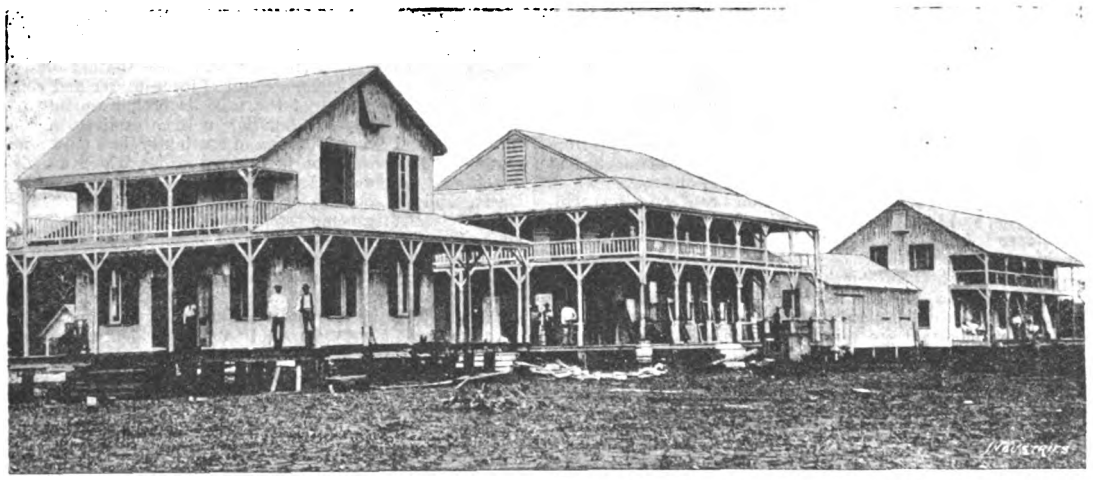


Fig. 10.—Hospital Buildings Looking West.

THE TIN DEPOSITS OF SOUTH DAKOTA.

A recent Consular report states thav the greatest interest is taken in the tin deposits in South Dakota, U.S.A., with regard to which many conflicting reports have been circulated, and a definite opinion as to the commercial value of the tin found can scarcely be formed from the work that has been done. Professor Carpenter has made a second survey of the district. Professor Vincent and many American and English experts have visited the mines and written most favourable accounts of the richness of the deposits, which are said to be inexhaustible, and Mr. Samuel Scott, mining engineer, recently furnished an able report from personal observation. The Glendale Mill, owned by the Tin Mining Company of Chicago, is the first which has placed American tin on the market: it is the only mill which has yet cast any tin ore pigs, and is said to be working steadily on a small scale, capable of working only 30 tons a day, but a larger plant is being erected, and the statements of Mr. Richards with regard to the richness of the ore are said to be confirmed. The expense of mining and treating one short ton of ore is as follows:—Mining, 4s. 2d.; concentrating, 2s. 1d.; smelting, 1s. 7d.; and incidental expenses, 1s. 1½d.; total, 8s. 11½d., which compares favourably with the cost in Cornwall, while the mines are considered a great deal richer. The work is done at present in a simple manner, by crushing and re-crushing the ore, and passing it successively through sieves till the required fineness is attained, a fine vanner being used to separate the ore and concentration effected by gravity methods. The smelting is done in a reverboratory or cupola furnace, and the molten metal is then cast into pigs.

Though tin deposits were discovered in the Black Hills some eight years ago, the excitement at once created by the discovery in a measure abated till the McKinley Act renewed the interest taken in the subject. At first no one in South Dakota knew much about tin, and some of the first capitalists who bought up claims appear, possibly for their own interests, to have discouraged the idea that mining could be successfully carried on, as it would be found impossible to dress the ore. Samples, however, of acknowledged richness were sent to New York, and mining on a small scale was commenced; but the first mills were soon stopped, and reports circulated that they could not be worked so as to be of commercial value. The Etta Mine at that time bought up a great many claims, and after about three years this enterprise was consolidated into the Harvey Peak Tin Mining, Smelting, and Manufacturing Company, of New York and London, a great part of the capital being invested by English capitalists. This is the largest enterprise in the district, and owns over 400 claims, which are being carefully prospected. There are between 300 and 400 men now employed, and about 500,000 tons of ore are in sight, with, it is stated, an assay of 14 per cent., while selected specimens, it is affirmed, have shown as much as from 30 to 40 per cent. A large concentrating plant and smelting furnaces are being erected by this company, which will probably be ready for working during this summer. There are also in the district nine other companies, variouly distributed, engaged in similar operations.

The chief deposits of tin are found in Custer and Tennington Counties, where there are about 7,000 locations. The veins vary in width from 1ft. to more than 300ft., the length from a few yards to five miles, and the outcrop ranges from a few feet to more than 150ft. above the surface. It is said that at least 4 per cent. of tin can generally be depended on. Numerous other minerals are found with the tin, but at present attention is almost exclusively drawn to the tin ore. The necessary fuel for working the mines is found in abundance in the immediate vicinity; inexhaustible resources of bituminous coal exist on the outskirts of the Black Hills, and the vast petroleum fields of Wyoming are at no great distance.

THE NICARAGUA CANAL.

V.

ESTIMATED COST AND QUANTITIES.

(*Continued from page* 482.)

Considering the wide divergence which bitter experience has generally proved to exist between the estimated and actual cost of large engineering enterprises, the company undertaking the construction of the Nicaragua Canal have very wisely refrained from tying themselves down to a definite sum as the cost of the work. According to Mr. Menocal, it is, however, calculated that the total cost will not exceed $90,000,000—say, £18,000,000—exclusive of banking commissions, interest during construction, and other expenses not included in the engineer's estimate. It is, unfortunately, just these "other expenses," as the case of the Panama Canal has shown, that run up the little bill to an extent never contemplated by the confiding shareholder. It must be admitted, however, that the surveys and preliminary studies appear to have been very detailed and thorough in their character, and in so far preclude any probability of a gross error in the purely engineering estimates. Of the material to be removed, 7,000,230 cubic yards of rock will have to be excavated from the Eastern Divide, and the cost of this work is estimated at 22 per cent. of that of the whole canal. From the Western Divide the removal of 5,696,507 cubic yards of rock will be necessary. The conditions under which this task will be carried out are favourable, as has already been pointed out with respect to the Eastern Divide, while for the cutting through the Western Divide it is stated that ample facilities exist for the deposit of the waste material not used in the construction of breakwaters, locks, dams, &c. More than twelve miles of the 26·789 miles of canal in excavation will be formed by dredging at the sea level. The healthiness of the climate in the territory to be traversed by the canal is an advantage that can hardly be overrated. In the only portion, that between Ochoa and Greytown, in which trouble from climatic causes might have been expected, the health of the employés of the company, during more than two years of hardship and exposure, has been excellent. West of Lake Nicaragua the climate is as healthy as any in Central America.

It is interesting and instructive to compare the estimated cost of the Nicaragua Canal with what has actually been spent on the Panama Canal enterprise. When the suspension of payments took place in 1888, according to the report of M. Monchicourt, the official liquidator, 783 millions of francs, or, say, £31,320,000, had been spent on the actual construction, and no less than 390 million francs, or £15,600,000, in Paris, this latter sum being required for what may be broadly termed "financing" the undertaking, and including an item of 20,432,554fr., or, say, £817,302, by way of "douceur" to the French Press. In the report of M. Lucien Bonaparte-Wyse, to which we drew attention in a recent number of our journal (see *Industries*, Vol. X., page 422), the capital necessary to complete the Panama Canal is set down at £24,000,000. If we add this to the sum already spent on construction—leaving other items out of account—we reach the grand total of £55,320,000.

In the Report of the United States Interoceanic Canal Commission, issued in 1876, the Panama route was also considered among others, and its cost estimated as being nearly 50 per cent. greater than that of the Nicaragua route. The actual words of the report were as follows:—"At the request of the Commission, for reasons previously stated, the Hon. Secretary of the Navy caused a careful instrumental survey of this route to be made in the vicinity of the line of the Panama Railroad. The proposed route is 41·7 miles long; has a summit level of 123·7ft. (surface of canal above the ocean); requires a dam and feeder 10·5 miles long; a retained dam at Obispo Station; an aqueduct across the Chagres River; a deep cut at the summit level 4·81 miles long, with a mean depth of 102ft. and greatest depth of 197ft.; the construction of the lift-locks necessary to overcome the summit level, and—what is common to all of the routes—the construction of harbours on each coast. The deep cut would probably be subject to land slides, from which the Panama Railroad has suffered seriously, and the canal would be exposed to serious injury from floods. The excavation of the deep cut, involving the handling and transport of millions of cubic yards of materials, is,

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THE NICARAGUA CANAL.

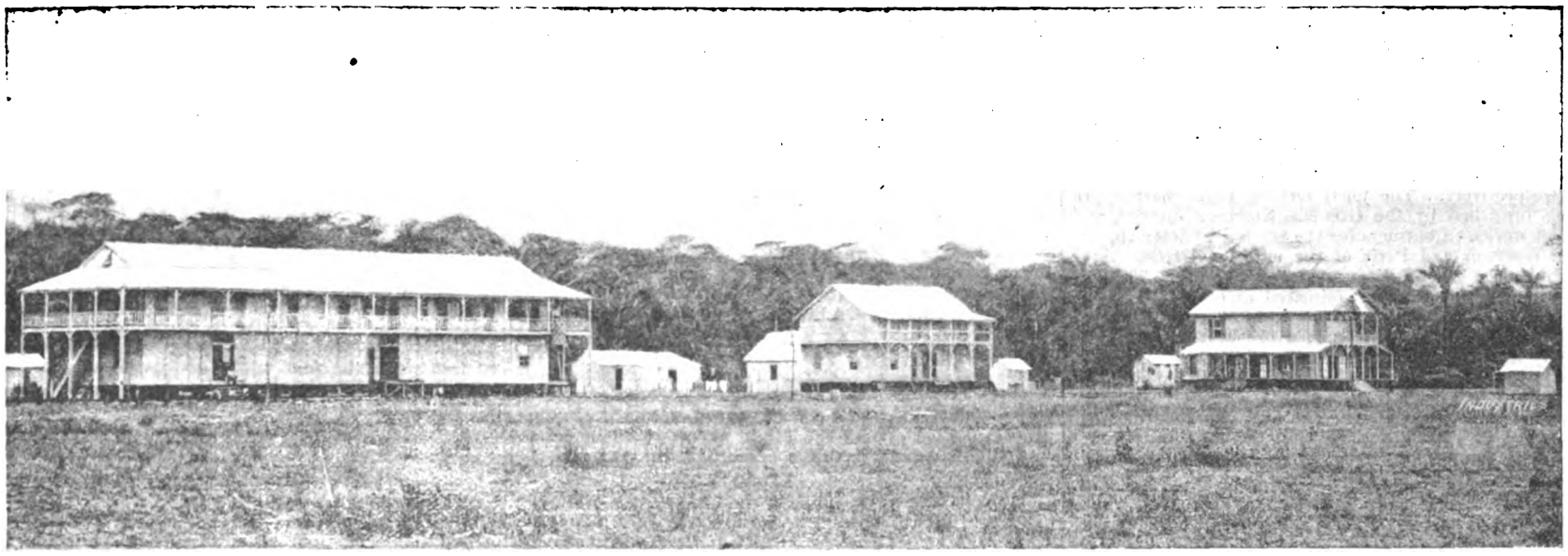


Fig. 11.—Headquarters of the Company's Staff Looking Westward.

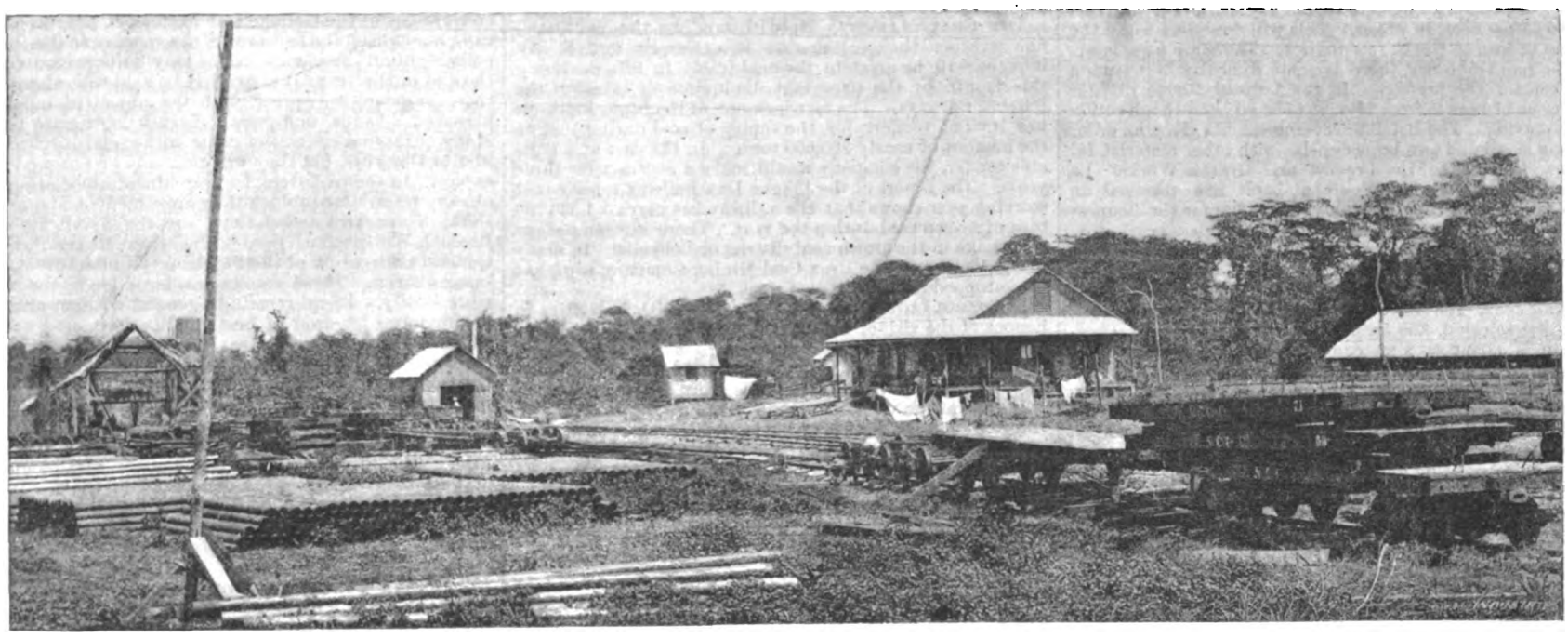


Fig. 12.—Railway Camp.

of itself, a very great undertaking, especially in such a climate as that of the isthmus. The cost of the whole work, including that necessary in the harbour of Panama and at Aspinwall, is estimated to exceed by nearly 50 per cent. that of the Nicaragua route."

It will be conceded that the authors of this report very shrewdly anticipated the nature of the difficulties which experience has shown to be connected with the construction of the Panama Canal. With respect to the route then proposed for the Nicaragua Canal, the same report says:—"No doubt exists as to the entire practicability of constructing an interoceanic ship canal *viâ* Lake Nicaragua. If the work were conducted with ability and honesty, it could be completed within a moderate period of time, and at a cost that would prove commercially profitable by the payment of tolls, moderate when compared with the loss of time, wear and tear, deterioration of cargo, insurance, &c., that belong to voyages *viâ* Cape Horn or the Straits of Magellan. The cost of construction of the canals and harbours with all their necessary adjuncts—locks 400ft. in length and 26ft. depth of water—may be set down as at least one hundred million dollars." As before stated, Mr. Menocal's latest estimate fixes the cost of construction at ninety million dollars, but this refers to a route improved in several important particulars as compared with that in contemplation at the time the report from which we have quoted was written.

The probable time occupied by steamers in passing through the canal is calculated to be about twenty-eight hours, made up as follows:—

			H.	M.
26·030 miles of canal, at	5 miles an hour...		5	12
21·619 ,, in the basins at	7 ,, ...		3	5
64·510 ,, in River San Juan, at	8 ,, ...		8	4
56·500 ,, in Lake Nicaragua, at	10 ,, ..		5	39
6 lockages, at 45 minutes each			4	30
Allowance for detentions in narrow cuts.....			1	30
Total time of transit.....			28	0

The illustrations which we give on page 532 and above, show some of the buildings which have been erected in connection with the canal works. Fig. 9 shows the storehouse and staff quarters situated at La Fé; Fig. 10 shows the hospital buildings which have been erected, looking westward; Fig. 11 shows the headquarters of the Nicaragua Canal Company at the works; and Fig. 12 shows the railway camp, which was rendered necessary on account of the railways to be constructed for the transportation of men and plant.

(To be continued.)

PETROLEUM AS FUEL IN LOCOMOTIVES.

Holden's method of using oil as fuel in locomotives has been introduced with great success on the State Railways in India. It has also been adopted by the Government of the Argentine Republic, where copious oil deposits are being developed. Recently a number of engines have been despatched to that country. There is not much apparent difference in the construction of these locomotives from those in ordinary use, as each has a tender, with the usual supply of coal, so that either coal or oil may be used as fuel as may be found most convenient, as Holden's injector does not interfere with coal burning. On the grate there is always a fire, partly of coal, but generally of a large part of limestone in small lumps or of broken firebrick. The oil passes through the nozzle of the injector at a great pressure, but very little of it falls on the limestone or firebrick fire, as the temperature is so high that it is burnt up quickly, and none of it passes to the ashpit below. The materials on the grate seldom require replenishing, as the oil is sufficient for the purpose. From some experiments which were recently made with a train of twelve carriages, on a run of 1,200 miles, it was found that the consumption of petroleum, coal, and wood was at the rate of 22lb. per mile, while a similar engine using coal alone, doing exactly the same work, needed 50 per cent. more fuel. This will be of especial importance in a country like Argentina, where petroleum can be got cheaply, and where coal costs about £4 per ton.

SHIPBUILDING IN GREECE.

During the year 1890 61 wooden sailing ships were built at Syra, in Greece, of a total tonnage of 8,673 tons, and valued at £73,640. This shows an increase of 34 vessels on the year 1889, the number constructed in that year being 27, of a total of 4,480 tons, and valued at £37,000.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 2nd June, 1891.

The Iron Market.—There was a slight decrease in the demand on the Paris market during last week, which may in part be accounted for by the bad weather having more or less interrupted building operations. The prices quoted are the same as in the previous week—namely, 140s. 6d. per ton for bars, and 148s. 6d per ton for joists. The market for the latter is strong, but both the above types of iron, if the order is of importance, can be obtained at 134s. and 142s. respectively. The joists on the Paris market are chiefly furnished by the Grenelle, Northern district, and Creusot works. Contracts for the section between the St. Cloud reservoir and Paris of the additional fresh water supply for the metropolis were awarded on the 30th ult. The value of this work is estimated at over £120,000, of which at least £40,000 is for iron work. The supplying of cast iron pipes for the maintenance of the water works in this city has been secured by the Pont-à-Mousson Works at 130s. per ton. The situation in the North remains unchanged; orders continue to be fairly plentiful, especially from the Paris market. An order for 500 tons of steel plates has been passed by the Société des Ateliers de Saint-Denis to a Maubeuge rolling mill. In the Meurthe-et-Moselle district prices continue firm, both as regards cast and wrought iron; a fifth blast furnace is being constructed at the Jœuf works; the Société de Montataire, which has two furnaces, has just blown out one, the stock of metal on hand amounting to 6,000 tons. In the Haute-Marne bars are quoted at 128s. 6d., and the general state of trade is satisfactory. The strikes in the Ardennes mentioned last week have nearly all come to an end, the masters in almost every case having agreed to an augmentation of from 20 to 35 per cent. in wages. This will doubtless cause the prices of iron to rise in this district. There are complaints in the nail trade that there is some difficulty in getting a market for the produce. In the Loire-et-Rhône district the price of bars is from 140s. to 144s. 6d., and the situation is improving. The Belgian Government has given an order for six small and two large cupolas with other material, for a new fortress, to the Creusot and Grüson Works. La Société de Commentry-Fourchamboult has received an order for iron work of the value of £22,800 for the Bourges and Cosne Railway.

Copper, Tin, Lead, and Zinc.—There has been little activity on the copper market during the past week, but quotations are slightly higher than they were—viz., best Chilian bars, £56 15s.; ordinary Chilian bars, £54 15s.; and best selected, £59 5s. per ton. The Minister of Commerce is about to sign contracts for the delivery of 90 tons of copper wire for telegraphic purposes. Tin has again fallen off in price as regards the Billiton, Banca, and Detroits marks, the first now being quoted at £98 18s., and the two latter at £100 8s. and £97 8s. respectively. There is very little doing in lead, and zinc has decreased in value, Silesian being quoted at £24 5s. per ton.

Proposed Increase of the Customs Duties.—The general discussion on the new Bill came to a close on the 22nd ult. The fees, as proposed in the first instance, have nearly all been raised, especially in the cases of machinery, tools, and manufactured goods. Raw materials, which are necessary for the existence of several branches of French industry, are naturally less heavily taxed. It now remains to be seen what further modifications may be made before the Bill becomes law, the present Government inclining to a more moderate scale of tariffs.

BERLIN, 1st June, 1891.

The Iron Market.—The following statistics have been published as to the production of pig iron by the blast furnaces in Germany, including Luxembourg, during the first quarter of 1891:—Puddled iron and spiegel iron, 419,735 tons; Bessemer iron, 94,718 tons; Thomas iron, 388,250 tons; foundry pig iron, 147,380 tons; making a total of 1,050,033 tons, as compared with 1,152,840 tons in the first quarter of 1890. In Upper Silesia there was an output of 115,700 tons, as against 128,032 tons. The total production of pig iron in Germany shows a diminution of 102,807 tons or 8·9 per cent. as compared with the corresponding period of the previous year, a diminution of 47,001 tons or 4·3 per cent. as compared with the preceding quarter, and a diminution of 7·9 per cent. as compared with the average. These results show the critical condition of the German iron market. The falling off in the sale of iron and steel which commenced in the middle of the previous year, and increased continuously up to the end of the year, became more accentuated, and it was not till last March that the blast furnaces were again in active operation. It may be concluded from these statistics that the manufacture of spathic iron is more remunerative than that of bar iron. The production of puddled iron and spiegel pig iron during this year amounted to 39·97 per cent. of the total quantity as against 44·5 per cent. in the previous year, the production of Thomas iron rose from 34·1 to 36·98, and the production of foundry pig rose from 11·8 to 14·03 per cent. At a recent general meeting of the Upper Silesian Rolling Mills Union, it was decided that two blast furnaces should be blown out in Upper Silesia. The total production of pig iron in Germany, including Luxembourg, during April, was 354,350 tons, of which puddled iron and spiegel iron amounted to 141,321 tons, Bessemer pig iron, 33,815 tons, Thomas pig iron, 134,226 tons, and foundry pig, 44,988 tons. The production in April, 1890, was 398,457 tons, and in March, 1891, was 370,018 tons.

New Sugar Refinery.—A new sugar refinery is about to be established by a syndicate at Hamburg, under the management of Messrs. Michaelles Brothers. The works, which are expected to have a yearly output of 25,000 tons, are being erected at Schulau, and will be completed in the beginning of 1892.

The Frankfort Electrical Exhibition.—During the first week this Exhibition was opened 29,773 persons visited it. Having in view the unfavourable weather, this is considered satisfactory.

VIENNA, 1st June, 1891.

The Iron and Metal Market.—There is no alteration in the state of the market since the previous week. The demand for materials for constructive purposes continues satisfactory, and the railways, which have lately shown very favourable balance sheets, are beginning to supply their wants for the present working year. The price of sheets is therefore advancing. The price of zinc sheets rose last week by 19s. 6d. per ton, so that the price now is £33 8s. 6d. at the works. With regard to the production of lead, the balance of the largest mining company of the lead mining union is very favourable. In the past year the company produced 4,113 tons of lead, an increase of 361 tons on the previous year; 6,010 tons of lead schlich and ore, a decrease of 317 tons; 1,349 tons of zinc ore, an increase of 611 tons. During the same period the works of the company made 529 tons of pig lead, 617 tons of lead shot, and 912 tons of lead oxide. Notwithstanding the generally increased production, the profit was less than in the previous year. It amounted to £15,608, which allows a dividend of 5 per cent.

The Coal Market.—Notwithstanding the continued fine weather the coal market is extremely active. An impetus will be given to the coal traffic in Silesia during this month by the important diminution of rates on the Silesian railways. The management of the State Railways has invited tenders for the supply of coal during 1892 to the amount of nearly 800,000 tons. In the case of a suitable tender, the company would make a contract for three years. The report of the Prague Dux Railway for the past working year shows that the railway has carried 1,330,280 tons of brown coal during the year. There are some signs of a strike in the brown coal district of Bohemia. In many pits belonging to the Brux Coal Mining Company work has been stopped during the past week.

Electric Lighting.—In connection with festivities in honour of the visit of the Emperor to Fiume an installation of more than 1,500 incandescent lamps and numerous arc lamps has been erected. 600 lamps of various colours are used to form a device, showing the arms of the monarchy.

International Exhibition of Photography.—An International Exhibition of Photography was opened here recently. The section devoted to British exhibits forms one of the greatest attractions in the Exhibition. From an artistic point of view the British exhibits are considered by experts here to be the best.

BRUSSELS, 2nd June, 1891.

The Iron Market.—Business shows a tendency to improve. The rise in prices at Glasgow has induced buyers to place their orders in view of a possible rise in this market. Prices, however, remain stationary, joists being quoted at £5 4s., and sheets at £6 4s. to £6 8s. The Franco-Belgian Company has received some important orders for locomotives and waggons for Egypt. The Dyle Baculan Company, the Industrial Company, and Messrs. Schlessin & Couillet have important foreign orders.

The Coal Market.—The coal market continues in an unsettled state. Screened coal is quoted at 9s. 7d. to 10s. 5d.; steam coal, 11s. 2d. to 12s.; household coal, 14s. 5d. to 16s.; coke, 14s. 5d.; small coke, 8s. 9d. to 9s. 7d. German coal, which was imported during the strike, maintains its position, and competition has been thus increased in view of the resumption of work after the strike. At Charleroi the leaders of the strike are trying to prevent the resumption of work. Wages, however, are now fairly high, and have been increased by 40 per cent. during the past two years. The number of workmen has also increased from 10 to 12 per cent.

Electric Lighting in Brussels.—The specifications for the electric lighting of Brussels have at last been published. The total power required for the system is 1,200 kilowatts. 1,000 lamps, of 16 candle-power each, are to be supplied for the Théâtre de la Monnaie by means of accumulators, 80 arc lights of 12 amperes at the Park Theatre, 120 arc lights of 9 amperes on the inner boulevards. Twice a year 700 lamps, of 16 candle-power each, will be required at the Town Hall on *fête* days. If the principal station is to be used for supplying currents of low pressure, it must be situated in the centre of the town at a distance of about 330 yards from the canal. The price of land in this part of the town is about £6 per square metre. If a secondary station should be decided upon in the upper part of the city, it will be situated near the Park Theatre, where the price of land is about £10 per square metre. The motors must be provided with all the latest improvements, so as to avoid accidents and ensure perfect working. The dynamos may be driven directly by the motors. The armature wires and commutators must not be heated by more than 50° C., and there must be no sparking at the brushes, whatever the load may be. The armature wires must also be easily accessible. With regard to accumulators, the output, the mode of construction, and the working must be specified. The connections will be preferably of brass, and the cables must be covered with lead, and supported on insulators. The transformers must be shown in place. The cables must be underground, and the total drop in the conductors must not exceed 1 per cent. The conductor must have a section of not less than 1 square mm. for every 2 amperes of current. Payment for the work will be made in three instalments—70 per cent. on the completion of the work, 15 per cent. a year afterwards, and the remainder on the final taking over of the work, on which date £800 will be paid for the cost of extending the service during the two previous years. Other particulars may be obtained on application to M. Wybauw, chief engineer for the lighting of the city.

Locomotives.—The Chemin de fer Grand Central has just ordered some large goods engines from the Société de Saint Léonard, Liège, for the goods traffic between Antwerp and Germany. The locomotives have eight coupled wheels, of 1·43 metre diameter, while the tenders have six wheels, of 1·15 metre diameter. The locomotives are to be ready by the end of this year.

DÜSSELDORF, 2nd June, 1891.

The Iron and Steel Market.—The demand has largely increased, but the average prices are not much higher than they were in the beginning of the year. An improvement in the prices of raw and finished iron is the more desirable, as the prices of coal are firm and relatively very high. With reference to the Rail Syndicate, the Convention of Westphalian Pig Iron Manufacturers, and other conventions of the German ironmasters, it has been generally announced in the German newspapers that a general collapse of all these conventions may be expected towards the end of the year. It may fairly be said that almost all of these rumours are spread with the object of influencing prices on 'Change, and greatly disturb legitimate dealing. Many of these conventions come to an end on December 31st of this year, but they will certainly be renewed before expiry. In the past week two prominent associations have already resolved to prolong their agreements to January 1st, 1893. These two associations are the Syndicate of the Rhenish-Westphalian Forge Pig Iron Makers and the General Convention of the Pig Iron Manufacturers of the same district. These resolutions have made the market more steady. Prices remain in general without alteration. White forge pig iron of best quality is quoted at about £2 13s., Thomas pig iron at £2 3s. 4d. c.i.f. Luxemburg, corresponding to about £2 10s. c.i.f. Ruhrort Harbour. The bar iron market is unsatisfactory, while the wire and iron plate trade has rather improved. The manufacturers of railway materials are well employed.

The Coal Market.—The coal market continues very firm. The State Railway management at Cologne was obliged to give the prices demanded by the Westphalian collieries for a lot of about one million tons of coals for locomotives. This is a decided victory for the coal producers. The miners' disputes appear to be settled as regards the immediate future. A large number of the men who were engaged in the recent strikes were dismissed from their work, and met with no aid from their fellow workmen or sympathy from public opinion.

The Late Mr. A. von Kaven.—Mr. A. von Kaven, who was closely connected with the foundation and management of the polytechnical school at Aix, died last week in that town.

Electric Lighting Station at Cassel.—On the 24th ult. the new central station at Cassel was put in operation for the first time. The power for the station is obtained by means of a turbine generating plant situated some 7 kilometres from the town. The whole of the installation has been carried out under the direction of Herr Oscar V. Miller. The turbines were supplied by Messrs. Briegleb & Hausen, of Gotha, the dynamos by the Maschinenfabrik Oërlikon, of Oërlikon, and the accumulators by the Hagenerfabrik.

Verein Deutscher Eisenhüttenleute.—The principal meeting of the German ironmasters' union is to be held at Siegen on the 21st and 22nd inst. On the 21st inst. there is to be a general reception, followed by a public dinner and conversazione. On the 22nd inst. visits are to be paid to mines in the district, to the Siegen machine works, and to the blast furnaces of the Cöln-Müsener Bergwerks-Verein at Creuzthal and the machine works of Messrs. Klein at Dahlbruch. Papers are to be read on the progress of the iron industry in the Siegen district; "On Mining," by Mr. Gerlach; "On Blast Furnaces and Rolling Mills," by Mr. Weinlig; and "On Foundry and Similar Work," by Mr. E. Klein.

AMSTERDAM, 1st June, 1891.

Steamship Companies.—As from June 1st the steamers of the Castle Line, starting from Flushing, will call every fortnight at Lisbon on the way out. It appears from the report of the directors of the Royal Steamboat Company that the twenty-three vessels forming the fleet in 1890 performed 262 journeys to various ports in Europe, against 244 journeys the previous year, conveying passengers and

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303,250 tons of goods (in 1889, 290,860 tons). The total gross profit during last year amounted to £79,550. Deducting various charges and the working expenses, and also writing off £17,380 for depreciation, there remains an available balance of £13,797, out of which the shareholders receive a dividend of 9 per cent. The Company recently lost a steamer near Samos, and she is being replaced by a new vessel of the same capacity, which Messrs. Laing, of Sunderland, are now building and will deliver to the Company by September 1st next. Freights were good in 1890, but have since gone down again considerably.

CENTRAL BOARD OF COMMERCE AND INDUSTRY.—The Dutch Government is preparing to found a Central Board of Commerce and Industry in Holland, which will represent trade and industries in general, and the Chambers of Commerce in particular.

DUTCH CENTRAL RAILWAY.—The annual report of the Dutch Central Railway Company shows that the total receipts in 1890 were £72,069, an increase of £3,063 over the receipts in 1889, and the working expenses £31,598, an increase of £2,617; 447,944 passengers were carried, an increase of 37,069; and 154,115 tons of goods. The net profit was £5,327, after payment of debenture interest and providing for debenture sinking fund. The shareholders receive a dividend of 1¼ per cent.

STOCKHOLM, 30TH MAY, 1891.

THE HUSQVARNA MANUFACTURING COMPANY.—Few industrial concerns in Sweden seem to be better managed than the large Husqvarna Works, where large extensions are again being made. In its large amount of water-power Husqvarna possesses a great advantage, which has been further enhanced by recent important alterations. A large dam, of granite and cement, 30ft. high, has been carried across the river above the Husqvarna fall, and the level of the water above the dam is 250ft. above the level of the water in the Vettern lake. The Husqvarna Works are now able to utilise 225ft., which is the greatest height of fall used at any industrial works in Sweden. From the dam just referred to the water is carried through a wooden tube 1,000ft. long, which is nearly horizontal, and then through a tube of Bessemer steel plate, 300ft. long and 3ft. 3in. in diameter. Sufficient water will pass through this tube to represent 600 effective horse-power, and if the speed of the water be increased, the power increases to 1,000 h.p. This power is, as yet, only partly utilised, the two new turbines being of only 300 h.p. and 80 h.p. respectively. A third turbine of 100 h.p. will be used for the electric light installation, which will consist of about 1,000 16 candle-power lamps. Close to the turbine house a new workshop has been built, 212ft. long and 52ft. broad. This building consists of basement and two stories, besides a higher portion, to which the power from the turbines is transmitted through wire ropes.

CHRISTIANIA, 30TH MAY, 1891.

CONDENSED MILK.—Few industries have increased more continuously than the manufacture of condensed milk, and further extensions are contemplated. The following figures illustrate the growth of this industry, and show the export from Norway:—1879, 7,440kgr.; 1881, 440,662kgr.; 1883, 608,987kgr.; 1885, 818,096kgr.; 1887, 1,736,073kgr.; 1889, 2,415,864kgr.; 1890, 2,500,000kgr. The Anglo-Scandinavian Condensed Milk Company owns the Hamar Milk Condensing Manufactory, which last year dealt with about 6,000,000kgr. of milk. The price paid by the works is somewhat higher, on an average, than what the farmers can realise by dealing with the milk themselves. The same company is building another milk condensing manufactory at Sannesund, which will be ready in the autumn of the present year. Several other milk condensing manufactories are, however, in a more or less advanced stage. At the Toten Milk Condensing Manufactory it is intended to condense milk, if practicable, without the addition of sugar, and should this prove satisfactory the works would be able to give a higher price for the milk.

COPENHAGEN, 30TH MAY, 1891.

ELECTRIC LIGHTING.—The works in connection with the Copenhagen Electric Central Station, which is being built for account of the Corporation, are rapidly progressing, and are expected to be ready by November next. Messrs. Siemens & Halske, of Berlin, have taken over the main contract, the firm of Messrs. Burmeister & Wain, Copenhagen, supplying the engines. The boilers are partly of English and partly of German manufacture. The dynamos are in hand, and the cables expected to arrive in Copenhagen in the course of this month. The installation will comprise the lighting of the Houses of Parliament, the Royal Theatre, the Masonic Lodge, the Exchange, the Jewish Synagogue, the Town Hall, and the Art Museum. The applications from private people are very numerous, and the original plan has had to be extended once or twice on account of the great number of applications, so that the cost of the installation will, of course, much exceed the original estimate. It seems probable that the principal squares and thoroughfares will soon be lighted by electricity.

MADRID, 1ST JUNE, 1891.

AMALGAMATION OF RAILWAYS.—The excitement caused by the railway amalgamation schemes has not subsided. Important negotiations are supposed to be going on, but at present they are kept strictly secret. The arrival of M. Léon Say, the French financier, is supposed to be connected with some of the proposed arrangements, as he is connected with the system, which is under the control of the Rothschilds. The proposal to bring forward a law which would introduce a lowering of rates on the railways has not been facilitated by the Minister of Public Works, and this delay gives rise to much comment. The influence of those who control the present railway systems is evidently the chief factor in preventing the introduction of such a Bill. A question was asked in the Cortes on this subject, and the Minister replied that he was at present considering the matter, but it is stated that no efforts have yet been made to obtain the necessary information.

DISCOVERY OF COAL AT ALBANCHEZ.—It is reported that coal has been found at Albanchez, in the province of Almeria, in such a position as to admit of easy working. The discoverer has, however, taken up only a few acres of land, which would make it probable that the discovery is not of great importance. Coal is very dear in the province of Almeria, and the production of even inferior coal would be very advantageous in developing the mining and metallurgical industries of that district.

TREATMENT OF LEAD ORES.—It is intended to establish a plant on the system of M. Castelnau in one of the lead districts in order to treat what is now considered as valueless with the present means of concentration. This process is being energetically promoted, and if the machine accomplishes what is expected there will be a large increase in the production of lead within the next few years.

THE CACERES PHOSPHATE MINES.—Though these mines were offered for sale at the very low price of £20,000, they have not yet found a purchaser. The stock of phosphate of from 35 to 40 per cent. is 31,800 tons. In addition to the mining plant there is a factory with sulphuric acid chambers for the manufacture of superphosphates.

SHIPMENTS OF BILBAO ORE.—There is an improved demand for Bilbao iron ores. The shipments of ores during the first fortnight of May were nearly equal to those of last year, so that the decrease has not continued at the same rate as at the beginning of the year.

ELECTRIC LIGHTING.—Installations of electric lighting have been made during the month of May at Jaen and at Aranjuez. These places had not been lighted by gas. At Jaen steam power is used, and at Aranjuez the water power of the Tagus is utilised. The corporation of Avila, the capital of a small and poor province, now invites tenders for a ten years' contract for public and private electric lighting. This town has not been lighted with gas, and electric lighting will therefore meet with no competition. In most cases the electric light can be supplied at a cheaper rate than gas in those places where new gas works would have to be make, and where there is no demand for coke.

ROME, 1ST JUNE, 1891.

THE MERIDIONALI RAILWAY COMPANY.—At the general meeting of this company, held in Florence on the 15th ult., a dividend of £1 9s. per share was declared, of which £1 had already been paid, and 9s. is now payable. The shareholders present represented 88,797 shares. The report of the general manager, Mr. Borgnini, states that the economical crisis which prevented the natural progress of the railway traffic in 1889, was also felt in 1890, during which year the traffic receipts of the principal line were only increased by £33,080, and those of the secondary line by £1,320. The receipts of the first three months of this year, however, show considerable improvement. The amalgamated length of the two lines is about 3,242 miles. The total income of the two lines, after deduction of the working expenses, is as follows:—

Principal line	£3,986,606
Secondary line	270,076
Total	£4,256,682

The total capital of the company up to December 31st, 1890, amounted to £31,813,480. Deducting from this the outlay on the construction of the lines and on the rolling stock, amounting to £30,754,992, it appears that the total capital undisposed of on that date was £1,058,488. The estimates for 1891 show an income of £3,338,160, with an expenditure of £2,612,000, thus leaving a balance of £726,160. The net profits for the past year amounted to £156,008.

ANOTHER SHIP CANAL.—A ship canal, to connect Venice with the Gulf of Spezia, is now under consideration. Its length, according to present estimates, would be 273 kilometres (about 170 miles), and its average breadth 75 metres (about 246ft.) There will be in all 73 locks, and the cost of construction is estimated at about £52,000,000.

NEW YORK, 23RD MAY, 1891.

AMERICAN COMPOUND LOCOMOTIVES FOR BRAZIL.—The Baldwin Locomotive Works have received an order for twenty compound locomotives for export to Brazil. The order comprises six different classes of lomotives, half being for broad gauge lines and half for narrow gauge lines. There are four 65-ton Consolidation freight locomotives, three 50-ton express passenger locomotives, and three 50-ton Mogul locomotives for the standard gauge lines, and the same number of engines and the same types for the narrow gauge lines. The Baldwin Works have built or have under order at this time forty compound locomotives, and they have assumed a regular place in their output. The firm is providing by special machinery for the rapid and economical finishing of the cylinders.

A NEW LATHE.—Messrs. W. F. & John Barnes & Co., Rockford, Ill., have completed and are using, in their own shops, a very ingenious and convenient lathe. The speed is regulated by a disc, varied from very slow to extremely rapid, and the motion can be instantly reversed regardless of speed. The feed gear has also a disc attachment, giving many variations of speed, as also reversing the direction of the feed instantly.

IRON PIPE MANUFACTURE IN THE SOUTH.—The first iron pipes made in the South—twenty-five waggon loads—was despatched from Bessemer, Alabama, to the North on the 11th inst.

PREVENTION OF COLLISIONS ON RAILWAYS.—A simple and ingenious invention by Mr. W. H. Waddell, which has been successfully tried on a section of the Baltimore and Ohio Railroad, has attracted some attention. It is intended to prevent accidents by giving to the engine driver an unmistakeable warning, conveyed as follows:—A secondary track, laid in sections of desired length, is laid inside the regular track on insulated posts, a brush connecting with a battery in the cab. When two trains are in the same section, the circuit is completed, and the alarm given. The cost of the apparatus, including 12lb. rail, would not exceed £140 per mile.

REMOVAL OF STEAM PIPES FROM BROADWAY.—The Broadway Railroad Company, of New York, City, has made a contract with the Steam Heating Company, by which the latter agrees, in consideration of the payment of £20,000, to abandon its distributing pipes on part of Broadway before September 1st. The steam pipes have been continually breaking, and require constant opening of the streets, and the Broadway Company, which is building a cable road, has declared itself willing to pay this sum, to do away with this nuisance, which would seriously interfere with its business.

PHILADELPHIA, 22ND MAY, 1891.

THE COKE TRADE.—The Stourville and Eagle plants in the Connelsville regions have resumed work with a fair number of their former workmen. The manufacturers now have 5,000 ovens burning, and more than that number of men at work. But the strikers are still hopeful, and believe they may yet succeed. The Knights of Labour Convention in Scottdale decided to continue the strike six weeks longer. The manufacturers have refused to confer with a committee appointed by the Convention to compromise the differences. A dispute has been caused between the Knights of Labour and the United Mine Workers by the refusal of the former to grant the latter an equal representation in the Convention. As a result, the United Mine Workers' officials have issued an order for the men to return to work. Large numbers of men have returned.

UNSUCCESSFUL TESTS OF THE "VESUVIUS'" GUNS.—The tests of the guns on the dynamite cruiser "Vesuvius," made in Chesapeake Bay on the 20th inst., appear to show that the long brass guns are not satisfactory. The tests have demonstrated that the guns can be fired and shells of various weight sent various distances, which, however, can be only roughly estimated. No dynamite, gun-cotton, or explosive of any kind has been fired, the test being simply for accuracy, and they have shown that the guns in this respect are not a success. Of the six shots fired, only one came near enough to the target to inflict any damage. It is expected that the board of examiners will recommend the removal of the dynamite guns and the fitting of the vessel with torpedo equipment.

RAILROADS.—A mortgage of £6,200,000 has been given by the Chicago, Rock Island, and Pacific Railroad Company to the United States Trust Company, and filed at every country seat through which the road runs. The mortgage is to run for fifty years.—The Philadelphia and Reading Railroad Company has made a thirty-year contract for the anthracite tonnage, amounting to 1,500,000 tons per year, with Messrs. Coxe Bros. & Co., beginning October 1st.—The annual report of the Burlington, Cedar Rapids, and Northern Railroad for 1890 shows gross earnings of £660,796; working expenses and taxes, £457,567; net earnings, together with other income, cash assets in 1889, make total receipts £231,478.

END OF MINERS' STRIKE.—The strike against a reduction in wages, begun thirteen months ago by 3,000 miners of the Pennsylvania and Westmoreland Gas-Coal Company at Irwin, Pa., has been declared at an end, and the men will return at owners' terms. During the past five months the mines have been worked to nearly their full capacity by non-union men.

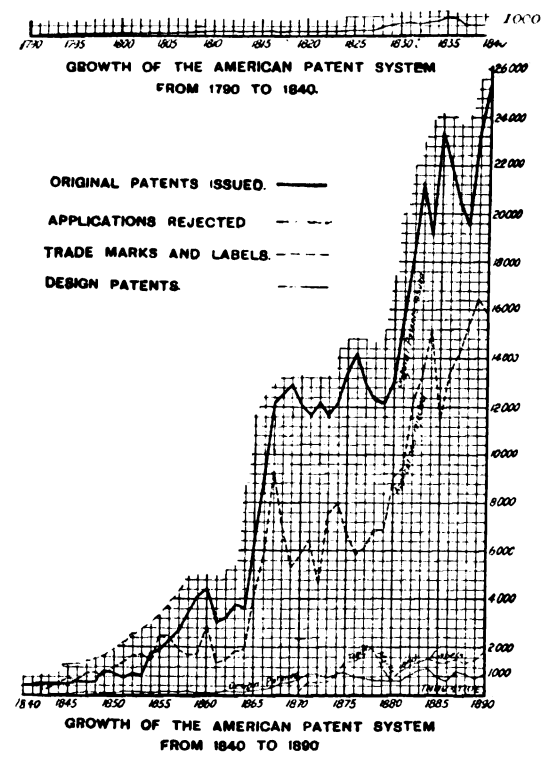
LOCK-OUT CAUSED BY SIX MEN.—Six men, known as the drag-outs, hook-ups, and carters, have struck at the Brooke Iron Company, at Birdsboro', Pa., for an increase of from 6¾c. to 8c. a ton. Owing to the action of these men, whose positions cannot be filled, 400 workmen have been thrown out of employment during the past week.

PENCOYD IRON WORKS.—The situation at the Pencoyd Iron Works is gradually improving. The departments recently shut down have resumed, and are in full operation on single or day turn.

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THE AMERICAN PATENT SYSTEM.

As the recent anniversary of the establishment of the American patent system has aroused a considerable amount of public interest, the accompanying diagram, which has been taken from our American contemporary, the *Engineering News*, showing the growth of the system from 1790 to 1890 inclusive, will no doubt be found of considerable interest to our readers. The diagram requires little description, but we may mention a few of its most important features. From the date of the first American patent, July 31st, 1790, to 1836, a period of



forty-six years, the total number of patents granted was 9,957, or an average of 216 per annum; from July 28th, 1836, to the end of 1881, a period of forty-five years, 251,685 patents were granted, giving an average of 5,593 per annum. During the seven years 1882–88 the number of patents issued has been at a uniform rate of 20,000 per annum; and at the present time the average rate of issue is about 25,000 per annum. Of the 450,000 patents issued since the establishment of the system over one half of these have been brought out during the past eleven years.

THE ROYAL NAVAL EXHIBITION.

QUADRUPLE AIR COMPRESSORS FOR H.M.S. "ROYAL ARTHUR."

Amongst the multifarious arrangements provided in the equipment of the modern war vessel, not the least interesting and important are the air-compressing machinery and adjuncts for charging torpedoes. Two manufacturers of the requisite special plant—viz., Messrs. Maudslay, Sons, & Field, Limited, Lambeth, London, and the General Engine and Boiler Company, Hatcham Iron Works, New Cross, London—exhibit specimens of their manufacture. The former company has on view one of the three air-compressors they are supplying to the first-class protected cruiser "Royal Arthur," one of the nine vessels of this type now building for Her Majesty's Navy. On page 540 we give an illustration showing a front elevation of this air-compressor, in which all the latest improvements are adopted to ensure durability, minimum wear and tear, without undue weight of material. The principal castings and forgings are of steel, the three main columns supporting the air-compressor being independent, of ample size, and of forged steel fitted into sockets cast in the bed-plate, and also in main part of the compressor proper. The steam cylinders, 9½in. diameter, 4in. stroke, are three in number, each receiving high-pressure steam, and above each is worked direct three compressing rams, respectively 7⅛in., 6½in., and 2¾in. diameter, each of which gives four compressions for one revolution of the engine. The air is drawn into the pumps on the down stroke of the engine, and on the return stroke the air is compressed into an annular space between the bush which cases the pump piston and the wall of the compressor cylinder. On the next stroke the air is further compressed into another annular space of still smaller compass, and from thence, after further compression, it passes into the reservoir. The four operations in compression, thus described progressively, when once the machine is at work are carried on simultaneously with each pump at one revolution of the engine.

In case of partial or serious breakdown of two of the sets of air pumps and two of the steam cylinders, still, whichever were the pumps or engines disabled, the remaining engine could continue to drive the undamaged pump. The air-pump cylinders are completely surrounded by a jacket, through which water is constantly kept flowing, and the compressed-air discharge pipe also passes through water on its way to the reservoir.

The three sets of pumps in the triple-compressor we illustrate are together capable of supplying 30 cubic feet of air compressed to a pressure of 1,700lb. per square inch in seventy minutes, the steam cylinders working with a maximum pressure of 90lb. per square inch. The total weight of one set of pumps and engines is about 25 cwt. After being compressed, the air is stored in reservoirs each consisting of a series of steel tubes, fifty in number, 3in. in diameter and 6ft. in length, and from thence is conveyed through thick copper pipes to the torpedoes requiring to be charged.

Messrs. Maudslay, Sons, & Field have also a number of high-class working models of marine engines, besides other objects of interest amongst their exhibits, to which we hope, later on, to refer.

FEDERATED INSTITUTION OF MINING ENGINEERS.

A general meeting of the members of the Federated Institution of Mining Engineers was held in London on the 28th and 29th ult., at the Institution of Civil Engineers. The proceedings opened with an inaugural address, delivered by the octogenarian President, Mr. T. W. Embleton, who gave an interesting account of the progress that had been made in mining and other industries since 1826. Sir George Elliot proposed a vote of thanks to the President for his address, and dwelt upon the difficulties with mechanical appliances which had to be contended with sixty years ago.

Mr. W. Foggin, of Durham, then proceeded to read the first paper, which was on "Locked Coil Wire Ropes." In this the author described the invention of Messrs. Latch and Bachelor to protect the inside coils by interlocking the outside ones. Many of these ropes were being used, some of them being over seventeen tons in weight, and comparisons were made with ropes of the ordinary construction. It is to be regretted, however, that the author gave no statements of comparative cost, and that he did not institute a comparison with some of the ropes of special construction now largely used. In the discussion that followed the reading of the paper no special information resulted.

The second paper read was on "The Coalfields of New South Wales," by Mr. G. B. Walker, of Barnsley. The mineral resources of Australia, he pointed out, were as yet but partially explored; but so far as coal was concerned the principal deposits lay within the colony of New South Wales. The geology of the coalfield was briefly described, and a large amount of statistical information brought forward. Notwithstanding the decrease in the price of coal, the improvement in the coal trade of the colony was regarded as eminently satisfactory.

This paper was followed by one on "The Coalfields of Australasia," by Mr. S. H. Cox. This paper passed over much of the same ground as Mr. Walker's. Mr. Cox, however, left the commercial aspects of the coalfields, and gave an instructive account of the geological structure of the colonies. The conclusions to be drawn from the facts summarised by the author are, that both Australia and New Zealand are fortunate in the possession of extensive coalfields, which are being developed in accordance with the requirements of the trade. Experience shows that it is not only those mines in which the coal is of the best quality that pay for working, or, indeed, that return the best interest for the money expended upon them. There can be little doubt that in the future the principal development of the coal-mining industry will be between the Newcastle and Lake Macquarrie fields to the north, and the Illawarra field to the south. The opening of mines below Sydney, an event which is only a question of time, will convert the whole district into one of the largest and probably best-paying coalfields in the world.

Mr. Binns, Inspector of Mines for New Zealand, having just arrived from the colony, was able to correct a few of Mr. Cox's statements.

The fifth paper read was by Mr. J. McLaren, of Leeds, on "The Economical Use of Steam in Colliery Engines." In this he gave the results of a series of trials carried out at his works in Leeds with a set of triple-expansion engines. The results show that, where sufficient care in construction is exercised, the same economy can be obtained with engines and valve gear of the old stereotyped pattern as had hitherto been considered obtainable only with complicated and expensive valves and valve mechanism.

The last paper read on the 28th ult. was by Professor F. Clowes, of Nottingham, and Mr. J. Ashworth, of Derby, on "The Detection of Firedamp." In this paper the authors showed that, by means of a benzene flame in Ashworth's Hepplewhite-Grey safety lamp, the detection of small quantities of firedamp is possible. With 0·25 per cent. of firedamp in the air, the cap on the flame is quite appreciable. With an ordinary safety lamp, however, quantities of gas less than 2 per cent. cannot be detected. As it is now generally admitted that coal dust is explosive when 0·5 per cent. of gas is present, the importance of this invention will at once be admitted. With the new benzene lamp the following observations have been made:—

Percentage of Gas.	Length of Cap. Millimetres.
0·5	7
1·0	10
2·0	15
3·0	20
4·0	25
5·0	30

Owing to the absence of luminosity in the benzene flame, the indications obtained with this lamp exceed in delicacy those obtained with any other lamp except the Pieler alcohol lamp. For low percentages of gas, the authors find that it is advantageous to colour the outer surfaces of the lower portion of the glass of the lamp, as the eye is thus assisted in defining the gas cap. In the tests described vermilion was the colour used.

In the discussion, Mr. Walton Brown stated that he had found that the Pieler safety lamp gave superior results, as the cap on the flame was greater for 0·25 per cent. of gas than it was for 2 per cent. with the Grey lamp.

Mr. H. W. Hughes, of Dudley, pointed out that inasmuch as the Pieler lamp was not safe in currents of ordinary velocity, it could not be regarded as a safety lamp, but should be classed with delicate firedamp detectors. He had made practical tests with every kind of safety lamp, and found that the Hepplewhite-Grey showed the presence of gas where no other lamp would.

The proceedings on the 29th ult. commenced with the reading of a paper by Mr. J. Yates, on "An Electrical Safety Apparatus for Cages." This ingenious invention was described by the aid of a model and diagrams. A copper wire in the centre of the winding rope conveys an electric current to electromagnets which hold back grips, pulling against the tension of a spring. When the current is broken by a fracture of the rope, the springs come into action, and the grips fasten against the guides. The author claims that this invention is preferable to the ordinary safety catches which are kept out of action by the tension of the winding rope, in that it is not liable to come into action by slacking of the rope.

The next paper read was a valuable report on "The Fumes produced by the Explosion of Roburite, Tonite, and Gunpowder," by Dr. P. P. Bedson, of Newcastle, with a medical report by Dr. D. Drummond and Dr. G. H. Hume. Dr. Bedson finds, after careful experiment, that the fumes produced by roburite and tonite are less deleterious than those produced by gunpowder. Indeed, if three minutes are allowed to elapse after the explosion, none of these explosives render the air of a mine so impure as that in the gallery of a theatre. The medical experts who reported on the matter find that in every case of alleged injury from the fumes of these explosives, the symptoms were entirely due to pre-existing natural causes.

In the discussion which followed the reading of this paper, special reference was made to the indebtedness of the Institution to the Coal Masters' Association of Northumberland and Durham, who caused the experiments to be made, and also allowed the Institution to publish the report.

The last paper on the programme was "Notes on Coal Dust," by Mr. H. Hall, H.M. Inspector of Mines. In this he gave an account of his experiences made for the Home Secretary, and of some experiments made to determine whether the so-called flameless explosives gave a flame. These experiments show that if insufficiently tamped all these explosives give flame. With several inches of tamping, roburite and carbonite gave no flame.

In the discussion, Mr. W. M. Atkinson, Mr. A. L. Steavenson, and Mr. W. Cochrane agreed in considering that coal dust was capable of producing explosions in the absence of inflammable gas. Mr. Walton Brown, however, agreed with Mallard and Le Chatelier in believing that firedamp was required in order to propa-

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gate the explosion. Throughout the discussion no reference was made to the experiments made by Mr. W. Galloway, the originator of the coal dust theory, who, some years ago, in his papers read before the Royal Society, brought the matter into prominence in face of great opposition.

During the meeting several works were open to the inspection of the members, and excursions were arranged to the Millbank Street Station of the London Hydraulic Power Company, to the City and South London Railway, and to the Deptford Station of the London Electric Supply Corporation. An excursion was also arranged to visit a shaft being sunk by the freezing process at Pont-à-Vendin, near Lille. In view of the shortness of the notice given, only five members were able to avail themselves of the invitation, and it was decided to postpone the visit for a month.

THE SKILLED LABOUR MARKET.

ACCORDING to reports furnished to the Board of Trade by twenty-one trade societies, with a total membership of 242,831, 6,548 were unemployed during the month of April as compared with 7,000 during the previous month. The reduction in the proportion of unemployed from 2·85 to 2·69 per cent. was caused by increased activity in the building trades. Employment in the boot and shoe and other branches of the clothing trades is reported as satisfactory, but there is some decrease of activity in the shipbuilding, engineering, and other branches of the iron trades. The number of strikes has increased from fifty-three in the month of March to seventy-seven in the month of April. Of these strikes, sixteen were connected with the building trades, in which an increased demand for labour has led to an increase in the number of strikes. There were ten strikes among iron, steel, and brass workers, and nine strikes in the cotton trade. There was an important stoppage of work in the Manchester district for the purpose of obtaining a reduction of one hour per week, in which fifteen firms were involved. On the whole, there has been an improvement in the condition of industries, though some of them show a falling off during the month of April.

SHIPBUILDING NOTES.

ON the 23rd ult. Messrs. Wm. Hamilton & Co., Port Glasgow, launched the steel screw steamer "Alice Taylor." The vessel has been built to the order of Mr. Robert Taylor, shipowner, Dundee, and is intended for coal traffic between Sunderland and Dundee. The engines have been constructed by Messrs. George Clark, Ld., Sunderland. The dead-weight carrying capacity is 700 tons. The engines are 1,400 i.h.p.

ON the 23rd ult. the s.s. "Maria," which has been built by Messrs. J. Priestman & Co., of Sunderland, for Mr. A. Embiricos, Braila, made her trial trip. The principal dimensions of the vessel are:—Length, 302ft.; breadth, 40ft.; depth, moulded, 19ft. 6in. The engines, of the triple-expansion type, with cylinder diameters 23in., 37in., and 59in., by 42in. stroke, were made by Messrs. Westgarth, English, & Co., Middlesbrough. The vessel was fully loaded, and a speed of 10¼ knots was obtained at the measured mile, and, the trial trip being in every way satisfactory, the vessel left for the Mediterranean.

MESSRS. GOURLAY BROS. & Co. have recently launched a steel screw steamer for the Pacific Steam Navigation Company, Liverpool, to be used for towing purposes at Valparaiso. The vessel is of the following dimensions:—Length, 105ft.; breadth, 22ft. 6in.; depth of hold, 12ft. The vessel has compound engines of 300 i.h.p.

ON the 2nd inst. the new war cruiser "Melampus," built and engined by the Naval Construction and Armaments Company, Ld., Barrow, sailed from that port for Portsmouth. Before leaving Barrow a preliminary trial of the engines was made, with most satisfactory results. The "Melampus" is a sister ship to the "Latona," which was also constructed at Barrow. The Barrow shipbuilders have been by far the most expeditious in their execution of the orders for seventeen of these cruisers, which were placed with private builders at the close of 1889. They secured an order for three vessels, and they have now handed over their second vessel before the Clyde, Thames, or Tyne builders have been able to deliver their first. The "Melampus" was launched on August 2nd last year. Her dimensions are:—Length, 300ft.; beam, 43ft.; and depth, moulded, 22ft. 6in., having a displacement of 3,400 tons on a mean draught of 16ft. 6in. After the preliminary trial she was handed over by Mr. A. Adamson, managing director of the Barrow yard.

THE twin-screw steamer "Scot," which has been constructed by Messrs. William Denny & Bros., Dumbarton, for the Union Steamship Company, of Southampton and London, for their South African mail service, completed her trials on the Firth of Clyde last week with most satisfactory results. On a preliminary trial over the measured mile at Skelmorlie a mean speed of 19·62 knots was realised, at a draught of water of 19ft. 9in. The draught was subsequently increased to 23ft. 2in., when the recorded mean speed of six runs over the measured distance was 19·176 knots. On the 30th ult. the "Scot" left the Clyde for Southampton, calling at Plymouth *en route*. The passage from the Clyde to Holyhead was performed at a speed of 18 knots and from the latter place to the Longships Light at the high average of 18·6 knots. The dimensions of the "Scot" are as follows:—Length, over all, 500ft.; breadth, 54ft. 6in.; and depth, 27ft. 6in.

Notices of Meetings.

THIS WEEK.

ROYAL INSTITUTION.—Friday, June 5th, at 9 p.m. Lecture on "The Implications of Science," by Mr. St. G. J. Mivart, F.R.S. Saturday, June 6th, at 3 p.m. Lecture on "The Scientific Study of Decorative Colour," by Professor A. H. Church, F.R.S.

GEOLOGISTS' ASSOCIATION.—Friday, June 5th, at 8 p.m. Papers to be read: "On Some Hill Gravels North of the Thames," and "On the Geology of Nettlebed Hill, near Henley," by Mr. H. W. Monckton and Mr. R. S. Herries; "The Geology of Devizes, with Remarks on the Grouping of Cretaceous Deposits," by Mr. A. J. Jukes-Browne.

NEXT WEEK.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—Monday, June 8th, at 8 p.m. Sessional meeting.

PRICES CURRENT, 3RD JUNE, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0		6 5 0	f.o.t. wks.
" Angles	5 10 0		6 0 0	"
" Plates	5 12 6		6 2 6	"
Staffordshire Bars	6 10 0		7 0 0	London.
" Angles	6 12 6		7 2 6	"
Crown Sheets	7 0 0		7 10 0	"
" Hoops	7 0 0		7 10 0	"
"Siemens-Martin" Steel Boiler Plates			7 5 0	"
" Ship and Girder			6 10 0	"

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£ s. d.		£ s. d.
Spelter: Ordinary	£24 10 0	to	24 15 0	
Copper: British Cakes and Ingots	59 0 0	"	59 10 0	
" Chili Bars, G.O.B.'s	55 0 0	"	55 7 6	
" Other sorts, G.M.B.'s (equal to Chili Bars)	55 0 0	"	55 7 6	
" Manufactured (strong)	66 0 0	"	67 0 0	
Lead: Common Pig	13 7 6	"	13 10 0	
" English Sheet	14 2 6	"	14 5 0	
Tin: Straits	93 5 0	"	93 15 0	
" Australian	93 10 0	"	94 5 0	
" English Ingots	97 0 0		.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: Since our report of the 27th ult. Chili bars have still further advanced in value, owing to increased speculative inquiry. Some heavy purchases of raw copper have been made recently, and stocks generally have decreased. During the last few weeks the market has therefore improved. Quotations to-day are £52 to £52 7s. 6d. cash, with steady market. Manufactured firm, at £66 to £67, "strong."

TIN has also improved, foreign having advanced about 30s. to 35s. during the week.

LEAD: Unchanged, with small inquiry.

SPELTER is dearer, and likely to advance, as supplies are small and stocks very low everywhere.

IRON ORE.

The South Wales Import Company, Ld., Cardiff, quote as follows:—

Rubio Ore—First Quality:			
C.i.f. Cardiff	13/-	to	13/3
" Newport	13/-	—	13/3
" Swansea	13/6	—	...
" Porthcawl	13/9	—	...
" Middlesbrough	14/-	—	...
" Newcastle	13/9	—	...
" Glasgow	14/3	—	...
" Maryport	14/3	—	...
Manganiferous Ore—Spanish 15/30:			
C.i.f. Cardiff	17/9	—	...
" Garston	18/9	—	...
" Middlesbrough	18/6	—	...
" Barrow	18/9	—	...
Rich Manganiferous Ore—Spanish 20/20:			
C.i.f. Cardiff	21/6	—	...
" Barrow	22/6	—	...
" Maryport	22/6	—	...
" Middlesbrough	22/3	—	...

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 5¼	to	0 0 6¼
" " Liquid	gal.	0 1 0	—	.....
" Citric	lb.	0 1 7½	—	.....
" Oxalic	"	0 0 3½	—	.....
" Sulphuric	ton	1 15 0	—	.....
" Tartaric	lb.	0 1 3	—	.....
Alum: Lump (powder 10/- ex.)	ton	5 12 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	23 0 0	—	.....
" " (White)	"	30 0 0	—	.....
" Sulphate	"	11 0 0	—	.....
" Liquor	lb.	0 0 3	—	.....
Antimony	ton	75 0 0	—	.....
Bleaching Powder	"	6 12 6	—	.....
Bisulphide of Carbon	"	13 0 0	—	.....
Borax	"	29 0 0	—	.....
Benzole (90 %)	gal.	0 3 11	—	.....
" (50/90 %)	"	0 2 11	—	.....
Copper Sulphate	ton	16 0 0	—	.....
Copperas	"	2 0 0	—	.....
Kieserit	"	.....	—	.....
Lead: Nitrate	"	21 0 0	—	.....
" White Sugar	"	26 0 0	—	.....
" Brown	"	19 10 0	—	.....
Potash: Bichromate	lb.	0 0 3¾	—	.....
" Caustic	ton	21 10 0	—	.....
" Carbonate	"	20 0 0	—	.....
" Chlorate	lb.	0 0 5½	—	.....
" Prussiate (Yellow)	"	0 0 10½	—	.....
" Sulphate (Basis 90 %)	ton	4 0 0	—	.....
Precipitate: Red	lb.	0 3 4	—	.....
" White	"	0 3 0	—	.....
Salts: Epsom (Bags	ton	3 0 0	—	.....
Salts: Epsom (Casks	"	3 15 0	—	.....
" Glauber	"	1 10 0	—	.....
Sulphur: Sublimed Flowers	"	10 10 0	—	.....
" Recovered	"	7 0 0	—	.....
Soda: Ash	deg.	0 0 1 1/16	—	0 0 1¾
" Caustic (White 70%)	ton	10 17 6	—	.....
" " " 60%)	"	9 12 6	—	.....
" " (Cream 60%)	"	9 7 6	—	.....
" Crystals	"	3 2 6	—	3 3 0
" Bicarbonate	"	6 10 0	—	.....
" Hyposulphite	"	7 5 0	—	.....
Solvent Naphtha	gal.	0 1 5	—	.....
Tartar, Cream of	cwt.	4 19 0	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: There is no change in values of the articles controlled by the Alkali Union. The inquiry for bleaching powder and caustic soda is perhaps scarcely so brisk, but prices are well maintained. Sulphate of copper is dearer, and the market is strong for prompt delivery. Benzoles are easier, and carbolic acids continue very depressed. Sulphate of ammonia has a rather better tone.

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	35 0 0
" Ceylon	"	29 10 0
Cottonseed	"	21 5 0
Cod	"	24 0 0
Lard	"	34 10 0
Linseed	"	21 15 0
Olive, Spanish	"	45 0 0
Palm, Lagos	"	26 0 0
Rapeseed: English	"	30 10 0
Seal: Pale	"	26 0 0
" Brown	"	.....
Sperm	"	50 0 0
Whale	"	22 0 0
Turpentine	per cwt.	1 9 3
Coal	per gal.	.....
Petroleum (Refined)	"	0 0 5¾
Spirit		0 0 7¾

WE have received a copy of the first number of a new monthly journal, entitled *The London Phonographer*, which is to be devoted to all matters of interest in connection with shorthand and typewriting. One of the useful features of the journal, although probably somewhat out of its strict scope, is a list of "commercial terms in four languages." The journal is well printed, and should, we think, meet with success.

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HOME INDUSTRIES.

LONDON, 4th June, 1891.

The Money Market.—The feature of the money market is still the endeavour to maintain rates at a point sufficient to attract gold here from other centres, while at the same moment money is abundant enough to seem to justify comparative ease. With the Continent still anxious for gold, the Bank of England cannot afford to let the value of money here fall below the rates current in other centres, or an outward flow would at once begin, and the advantage gained with such difficulty would be frittered away. Of course there is no desire to keep money unnecessarily dear, but simply to maintain effectively a minimum rate which may secure the preservation and augmentation of our gold reserve. The tone of the stock markets has improved distinctly during the week. Home railway stocks still excite little interest and are generally dull. Americans, on the other hand, begin to show unequivocal signs of returning strength, and the Canadians follow suit. The foreign department is still uncertain and nervous, though the Paris settlement has proceeded more easily than was anticipated. Portuguese, Spanish, and Italians are undecided, with a weak tendency. Argentines are virtually unsaleable since trouble broke out afresh in the Buenos Ayres Bolsa, and a good deal of anxiety is felt as to the future of these securities. The market has been again indulging in rumours as to the position of leading firms, but without any justification. The miscellaneous and mining markets are still without feature.

The Institution of Civil Engineers.—The annual general meeting of Corporate Members "to receive and deliberate upon the Report of the Council on the state of the Institution, with the Annual Statement of the Accounts, and to elect the Council and Officers for the ensuing year," took place on the 26th ult., Sir John Coode, K.C.M.G., the President, being in the chair. The effective increase in the roll of the Institution during the past year was 247. There had been elected 2 honorary members, 51 members, 291 associate members, and 7 associates, and 3 associate members had been restored to the Register. Only 107 names had disappeared from the list. The number of members of all classes, students excepted, on the 31st of March last, was 5,150, as against 4,903 on the same day last year, representing an increase at the rate of 5 per cent. The student class had somewhat diminished in numbers, the total being 914 on the 31st of March last, as against 969 on the 31st of March, 1890. This was not due to any diminution in the numbers admitted, but to the fact that more students had been elected Associate Members during the year, and that a greater number had become ineligible to remain in the class by reason of having passed the limit of age—namely, twenty-six years. Adding the students to the number on the Register, the gross total on the books was 6,064. From the balance-sheet appended to the Report, it appeared that the receipts during the financial year amounted to £24,274 8s. 11d., and the payments to £23,351 1s. 9d. The Council congratulated the members that, as the result of protracted litigation with the Inland Revenue Department, the House of Lords had upheld the judgment of the Court of Appeal, that the whole of the property of the Institution was exempt from Corporation Duty under the Customs and Inland Revenue Act of 1885, on the ground that it was legally appropriated and applied for the promotion of education and science. At the first meeting of the newly elected Council of the Institution of Civil Engineers, the following officers were re-appointed:—Mr. H. L. Antrobus, as treasurer; Dr. Wm. Pole, F.R.S., honorary secretary; and Mr. James Forrest, the secretary.

Institution of Mechanical Engineers.—At the summer meeting of this Institution, which is to be held in Liverpool, Mr. Joseph Tomlinson, the President, and the Council and members of the Institution will be received by the Mayor of Liverpool, Mr. J. B. Morgan, the vice-chairman, Mr. T. B. Royden, M.P., and other members of the local committee, on July 28th, in St. George's Hall. During the meeting of the Institution visits have been arranged to the Cunard R.M.S. "Aurania," the White Star R.M.S. "Majestic," to the Inman and International R.M.S. "City of Paris," to the Walker engineering laboratories, the works of the Mersey Docks and Harbour Board, the Liverpool Overhead Railway; Messrs. Laird Brothers' Shipbuilding and Engineering Works, Birkenhead; the Mersey Tunnel Railway and Works; the locomotive works of the Lancashire and Yorkshire Railway Company, Horwich; the Manchester Ship Canal; and the Liverpool Corporation New Water Works, Vyrnwy. The Institution dinner will be held on Wednesday, July 29th.

Society of Engineers.—At a meeting of this Society, held on the 1st inst., Mr. W. N. Colam, President, being in the chair, a paper was read by Mr. John Kerr on "Portable and Pioneer Railways." The author disclaimed any intention of entering into the debateable ground of Narrow *versus* Broad Gauge Railways, but dealt with railways suitable to meet the requirements of factory, mine, plantation, or for an absolutely new and undeveloped country. The author strongly recommended, for the development of the newly acquired territories in Africa, the adoption of pioneer railways, and described the class of railway recommended, and gave particulars of the cost and construction and carrying powers. Reference was made by the author to pioneer lines having paved the way for a main line railway. Pioneer lines could afterwards be removed further a-field, or be used as feeders for the main line. The author said that it would be foolish to put down a pioneer railway where the traffic would warrant the construction of a heavy line.

Shallow-draught Steamers for East Africa.—The Portuguese Government are at the present time putting together some shallow-draught gunboats for service on the Pungwe River, in East Africa, which district is now in a disturbed state. Messrs. Yarrow & Co., Isle of Dogs, Poplar, London, E., who constructed them, have only lately despatched some additional machinery to fit them for the service.

Royal Alfred Aged Merchant Seamen's Institution.—In connection with the present Naval Exhibition, the claims of this Institution, which was founded in 1867 to give to aged merchant seamen, when destitute and friendless, either a home or a pension, seem to deserve recognition. There are now 100 inmates at the Home, Belvedere, Kent, and there are 229 out-pensioners receiving £12 a year. A dinner in support of the claims of the Institution is to be held on the 10th inst. at 7 p.m., at the Hôtel Métropole, under the presidency of Captain Sir James Anderson.

MANCHESTER, 4th June, 1891.

Decoration by Machinery.—A notable exhibit is on view at the Arts and Crafts Exhibition, of a number of articles decorated by machinery. Glass, metal, or wood can be decorated by the system, which is similar to calico printing in so far as the use of copper rollers engraved with a pattern is concerned. The article to be treated can be passed through the rollers at a quick speed, and a door is shown which, after being fully constructed, was printed with a grain pattern on both sides simultaneously. The exhibit is an interesting one, and is shown by the Rossendale Glass and Wood Decorating Company, of this city.

Reduction of Working Hours.—By arrangement with the employers, the working hours of workmen in the printing trades have been reduced by 2½ hours. A few firms have not granted the reduction, but it applies to most firms in the trade, and has come into operation this week.

Fire Brigade Stables.—An improved arrangement has been invented by the Chief of the Manchester Fire Brigade, Mr. Tozer, which consists of a novel form of shutter working in a slide and having a chain attached to it, the other end of which has a weight fastened to it. The door is held in position by a pin, by withdrawing which the door is drawn up by the weight. A buffer is fixed to take the shock of the ascending door. The horses stand facing the door, so as to be readily harnessed, and the harness, which is specially constructed, can be placed in position by two movements. The time necessary for turning out is much shortened by this appliance.

Sewage Disposal.—An important step is proposed by the Conservancy Committee of the Salford Corporation. In view of the pollution of the Irwell by liquid refuse emitted from the works in the borough, they propose that settling tanks, if provided by the manufacturers, should be periodically emptied of sludge at a fixed charge per ton. This step, if approved by the council, will mark an important departure in municipal practice.

The Iron Trade.—The speculative movements in pig iron have quite unsettled business in this district, and although prices for actual deliveries have not varied to the same extent, the prevalent disbelief in any continuance of high rates prevents new business being effected. There are signs that the market is generally easier than it was, although users are still absorbing a large weight weekly. There is, however, a slackening in some quarters which is significant. Builders' ironwork is in good demand, and pig iron for this class of work is being consumed largely. Bar iron remains at about £5 17s. 6d. per ton, but neither in common or marked brands is there a satisfactory business. Steel plates for boilers are in steady demand, and prices are well maintained. In copper the advance in prices has, as yet, produced no effect upon business, the movement in Chili bar prices being looked upon as purely speculative.

The Linen and Jute Trades.—There has been a better feeling this week, both in the jute and linen branches, and sales have increased somewhat. The advances in bleached goods have alarmed some buyers, who are much more inclined to operate now that they perceive the tendency of the market. Yarns have been in better demand, both in home and Continental spins. Buyers now find that their requirements can be promptly met at Lille for large quantities, and the result of this has been that many English and Irish firms now despatch representatives regularly to the French centre. There has been a substantial advance in all classes of yarns, both tows and lines, of late, and heavy purchases have been made. Linens for the home trade meet with a steady sale. Damasks are rather quiet, but coarser makes have for some time been in brisk request. Kirkcaldy has been able to keep up sales in this district, and heavy makes of Forfar goods generally have been well inquired for. There has not been so much demand from retailers, but a better inquiry is anticipated before long, and merchants are disposed to place orders with greater freedom. For shipment there is not much business with South America, but orders for the United States are satisfactory, and the tone is one of greater confidence as to the future. The Australian section of the trade is also in a satisfactory condition, but for Central America and the West Indies there might be more business. The Continental trade is fairly well maintained, considering the keenness of the competition in the German, French, Austrian, and Belgian markets. There is a steady French trade, and it is evident that Lille has not made much progress of late.

GLASGOW, 4th June, 1891.

Electric Light in Glasgow.—The supply of electricity by meter was commenced in Glasgow about two years ago by a limited company (Messrs. Muir, Mavor, & Coulson), and generating plant for supplying current at low tension as well as at high tension was put down gradually. The plant at present is of a capacity of over 500 i.h.p. From this plant the Municipal Buildings, the General Post Office, the Exchange, and other buildings, public and private, are lighted. The firm applied to the Board of Trade for a provisional order upwards of twelve months ago, but, the Corporation opposing, this was not granted, and, instead, the application of the municipal authorities for a provisional order was granted. The time allowed for the commencement of operations under this provisional order is now drawing to a close, and the Corporation are engaged in considering the expediency of carrying out the work on account of and at the risk of the city, or of contracting with some company to relieve them of their obligations under their provisional order. The company already carrying on the work have offered to sell their plant to the Corporation and to lease it from them for seven years, undertaking to pay interest for the capital sums expended by the Corporation upon the undertaking, and to pay to the Corporation any profits earned by the company beyond a specific amount.

Minerals.—It is difficult to say decisively whether a reaction in the pig-iron market has set in. Last week the price advanced 5s. per ton, while the beginning of this week found the market in a state of collapse, and the price falling rapidly. On the 2nd inst. the fall from the price of the previous day was 6s. per ton. Although this is undoubtedly an indication of the state of the market, the quantity which has changed hands so far is insignificant. It has now transpired that the chief share in the recent manipulations, by which, for a time, the price was forced upwards, was a well-known local operator. Small lots of pig iron for forward delivery are being sold at much less than current rates. One lot, of 500 tons, has been sold for delivery in December at 45s. 6d.—The increase in coal shipments was not so considerable last week as formerly, but the aggregate increase this year amounts to 119,475 tons.

Large Bridge for India.—The Indian Government has contracted with Messrs. P. & W. McLellan to supply a bridge, 1,800ft. long, for the Kistnali River. The steel for the bridge, which amounts to 3,500 tons, has been ordered from the Steel Company of Scotland.

Scottish Railways.—The Railway Bills promoted by the North British Railway, and postponed owing to the death of Mr. John Walker, are again before the Committee.

Shipbuilding.—The proposed reduction of wages in the Clyde shipyards has been postponed until the decision of the adjourned meeting of the Employers' Society is known. It is understood that the employers are not unanimous in the matter, and that considerable difficulty has been experienced in arriving at a decision.

(From our own Correspondents.)

LIVERPOOL, 3rd June, 1891.

The Vyrnwy Water Supply.—The temporary pipe line across the bed of the Mersey near Fidler's Ferry was very successfully laid on the 31st ult., and reflects great credit upon Mr. Deacon for the skilful manner in which such a difficult operation was planned and carried out. The pipe line is 800ft. in length, and consists of 50 lengths of steel pipes 12in. in diameter, jointed with flexible joints, so that the pipe may adapt itself to the undulations of the bed of the river. They were first laid in a trench on the Lancashire side of the river, each pipe resting on a wooden block at the joint, the block resting upon longitudinal launch ways. Wire cables were fixed to the pipes, and these were coupled to the steam winches and horses on the other side of the river; at a given signal, the pipes were drawn across the river, being guided in their course by a number of boats kept under control by wire cables. The pipes were laid slightly zigzag on the shore so as to give the necessary "slack" to be taken up by the curve of the bed of the river. The Norton Tower was successfully filled a few weeks ago, and the pipes charged to the Cheshire bank of the Mersey. The permanent works under the Mersey are now progressing satisfactorily, 50 rings of the segmental plates having been fixed, and it is expected that the tunnel will now proceed at the rate of 6ft. per day.

SHEFFIELD, 3rd June, 1891.

The Iron Trade.—The recent slight advance in pig iron has given more confidence to the trade generally, and all tenders for contracts are based upon the higher value of raw material. In railway work there continues to be a fair business. Tyres and axles maintain their price of £10 to £12 per ton. Waggon builders are fairly supplied with work, mainly on account of English railways. The Tubular Waggon Company are trying to introduce their long bogie cars. The chilled wheels are very well constructed, but in

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other respects the car may require some alterations to make it suitable for English traffic. Messrs. Kitson, of Leeds, are turning out some fine locomotives for the Midland Railway Company, and, amongst other improvements, the inside cylinders are cast in one piece. The heavy forging hammers and presses are rather slack, as there is very little marine work in course of construction. Armour plate mills are well supplied with work. Messrs. Vickers are progressing well with their guns, and the smaller sizes are rapidly being completed.

COAL.—Fuel continues in brisk demand. The large quantity of coal shipped to the Continent helps to maintain the price.

REDUCTION IN WORKING HOURS.—Messrs. Hadfield's Steel Foundry Company have voluntarily reduced the hours of their employés to fifty-one per week. No change is to be made in the rate of payment.

ELECTRIC LIGHTING.—The price of gas at Barnsley being 3s. 4d. per 1,000ft., the Corporation decided to try electric lighting, and had practically accepted a tender for lighting some portions of the borough at £25,000. The Board of Trade, however, now insist upon underground wires, after twice giving their sanction for overhead wires. As this would nearly double the cost, the scheme remains in abeyance. Sheffield is to have a brick culvert under the main streets, in which all pipes and wires are to be placed. Inconvenience to traffic, and damage to road surface generally, will thus be avoided.

BIRMINGHAM, 3RD JUNE, 1891.

GENERAL TRADE.—Business in this district is not brisk, and the iron trade is inactive. The price of coal has fallen a little, and the price of pig iron has been reduced. Cinder pig is being quoted at about 37s. 6d. per ton, though such a price is regarded as unremunerative. Bar iron has scarcely changed, £6 per ton being quoted for common, and £6 5s. and £6 15s. for "Cable" and "Best Cable" qualities respectively. Cable makers are fairly supplied with orders for the present. Rivet and bolt makers are very busy. Some large inquiries for anchors for abroad have been circulated amongst the Cradley and Old Hill makers, and a Tipton firm recently secured an important contract for anchor stocks for the Admiralty. It is reported that the anchors for the same order are to be made of steel by Scotch makers. Many of the Staffordshire makers are now sending out large numbers of stockless anchors with heads of cast steel. The public chain and anchor proving houses are very well employed. The Earl of Dudley's Round Oak Works, Ld., is now in working order, and the preparations for extensions are being pushed forward. The New British Iron Company also contemplate the erection of large mills for the production of blooms, billets, and heavy sections of iron and steel at their Congreaves Works.

LEICESTER, 3RD JUNE, 1891.

WOOL SPINNING AND YARN TRADES.—The local wool market shows little change, but it is in a somewhat unsettled state. Sales are slow and for small amounts, as buyers are holding off as much as possible until the new clip is on the market. Opinions differ as to the prices which it will fetch. Prices, as a rule, remain firm, and stocks are not very heavy. Short fleeces of choice quality sell fairly well, and so do skin wools. Spinners are all fairly well employed, and are making rather larger deliveries. Buyers are very cautious in placing orders, and spinners press for an advance in prices which it is still very difficult to get. Lambswool yarns are selling steadily, but cashmeres and cottons sell very slowly.

HOSIERY TRADE.—Business shows signs of improvement, but the trade doing is very unevenly distributed, some firms being very busy whilst others are very quiet. The weather has considerably affected this industry, and repeat orders for light goods are few and small.

SWANSEA, 3RD JUNE, 1891.

NEW LINE.—Rapid progress is being made with the Rhymney Railway Company's extension in the Aber Valley. The new line, a single one, will join the main line at Aber Box and run along the left side of the valley for about 3½ miles. There will be two stations, one at Aber village and another at Park Newydd, which will be the terminus. It is anticipated that this extension will cost about £50,000. The sinking of three collieries is already contemplated as soon as the line is sufficiently advanced to allow of the transport of machinery.

THE SWANSEA HEMATITE IRON COMPANY.—These works were started again on the the 27th ult., the majority of the men having accepted the 10 per cent. reduction in wages.

NEW TINPLATE WORKS.—Notwithstanding the adverse conditions that have compelled the masters engaged in the manufacture of tinplates to decide on a whole month's stoppage, there seems to be no lack of confidence in the future of the trade. At a general meeting of the shareholders of the Briton Ferry Steelworks just held, it was unanimously carried that a new tinplate works, to consist of four mills, in connection with the steel works be erected forthwith. The location of the new works will be between the Villiers Tinplate Works and the Briton Ferry Blast Furnaces.

THE TAFF VALE RAILWAY.—The report of Messrs. Swarbrick & Tomlinson, advisers to the investigation committee, gives some interesting figures as to the cost of working various railways in Great Britain. The cost of locomotive power per train mile for the past three years has been 17·26d. on the Taff, compared with 8·22d. on the Midland, 8·15d. on the Great Northern, 7·17d. on the Caledonian, and 6·68d. on the Rhymney. Carriage and waggon repairs have cost also, for the past three years, 7·57d. per train mile on the Taff, as against 2·51d. on the Midland, 2·79d. on the Great Northern, 2·29d. on the Caledonian, and 4·21d. on the Rhymney. The committee estimate that by the appointment of a competent and experienced traffic manager from £40,000 to £50,000 per annum may be saved.

CARDIFF, 3RD JUNE, 1891.

IRON AND STEEL.—The condition of the steel trade is anything but cheerful, and as Bessemer bars will not be required in the whole district during July, owing to the stoppage of nearly all the tinplate works during July, makers are turning their attention to rails. Orders are, however, very scarce, as buyers anticipate a further reduction, which, on the other hand, it is impossible for manufacturers to concede, in view of the high prices of iron ore and fuel. Steel rails, heavy sections, are quoted at £4 10s. to £4 15s. Notwithstanding the advance in the value of Scotch and hematite warrants, consumers can still obtain their requirements in pig iron at prices which ruled during the spring. Rubio, first quality, is quoted at 13s. 3d. c.i.f. Cardiff and Newport, for 50 per cent. iron; second quality, 12s. 6d. to 12s. 9d.

COAL AND COKE.—Steam coal is quoted at:—No. 1 quality, 15s. 3d. to 15s. 9d.; No. 2 quality, 14s. 6d. to 15s.; No. 3 quality, 13s. 6d. to 14s. 3d.; No. 4 quality, 13s. to 13s. 3d.; small steam 7s. to 7s. 3d. The demand for coke is limited, and at Rhymney some of the coke ovens will be put out on account of the blowing out of another blast furnace. Prices for foundry are 21s. 6d. to 22s. 6d.; special foundry, 24s. to 25s.; and furnace, 19s. to 19s. 6d.

THE BRITISH ASSOCIATION.—The British Association will hold its sixty-first meeting in this town from August 19th to the 26th. A local committee has been formed, and every facility will be given for the various meetings, as well as for visits to mines and docks which have contributed so largely to the rapid growth of Cardiff.

BARROW-IN-FURNESS, 3RD JUNE, 1891.

HEMATITE.—Business in hematite pig iron has been done only on a small scale this week, and the transactions in hematite warrants, as well as in makers' iron, show a small trade. Warrants have been further cleared, although prices have kept up to 53s. 3d. per ton net cash, while makers have been asking 53s. 6d. net f.o.b. for parcels of mixed numbers of Bessemer iron. The Moss Bay Iron and Steel Company have put in blast two of the four furnaces which have been standing idle for so long a time, and Messrs. Cammell & Co. have commenced the erection of another furnace, which is to be engaged mainly on speigeleisen. There are now 41 furnaces in blast, compared with 46 in the corresponding week of last year. Stocks have this week been reduced 3,439 tons, and now stand at 139,543 tons, of which only 12,127 tons are stocked in Furness.

APPOINTMENT.—Mr. David Evans, general manager of the Barrow Steel Company, has been appointed to a similar post with Messrs. Bolckow, Vaughan, & Co., Middlesbrough. Mr. Evans during his few years' stay in Barrow has achieved a marked success in resuscitating the Barrow Steel Company. He cleared off an outstanding liability of £100,000, paid off back preferences, and declared last year 2½ per cent. on the ordinary stock.

MIDDLESBROUGH, 3RD JUNE, 1891.

PIG IRON.—The iron market was very weak yesterday, caused by the fall in the prices of Scotch warrants of 6s. on the best price quoted on the 1st inst., and business is practically at a standstill. Of course no one expects that there will be as rapid a drop in prices of Cleveland as in Scotch iron, for while it only advanced 5s. 6d. per ton, Scotch went up 18s. Both buyers and sellers are reluctant to operate, the former because they look for a rapid fall in prices, while sellers think that prices will go up again. Much harm is done by this continued speculation, and the conclusion of the present artificial state of affairs is anxiously awaited. Middlesbrough warrants have declined about 1s. since last week, and can now be had at 40s. 10½d. cash, buyers offering 40s. 9d. Makers' No. 3 G.M.B. has fallen 6d. per ton, and is quoted at 40s. 6d. There is no business for forward delivery. No. 4 foundry iron is 39s., and grey forge 38s. per ton. Mixed numbers of local hematite are offered at 51s. 6d. per ton. It is calculated that the stocks in the district have decreased some thousands of tons, though there is increase of 7,000 tons in the public warrant stores.

MANUFACTURED IRON AND STEEL.—The finished iron and steel industries are in a depressed condition. The manufacturers are worse off than ever, for, while they have to pay more for their pig iron, they have to accept lower prices for their productions. Common bars are £5 12s. 6d.; best bars, £6 2s. 6d.; iron ship plates, £5 10s.; steel ship plates, £6 10s.; iron ship angles, £5 5s.; steel ship angles, £5 15s., all less 2½ per cent. and f.o.t. Heavy steel rails are £4 10s. per ton net.

COKE.—Blast furnace coke of average quality can be had at 13s. per ton, delivered at works.

SHIPMENTS.—The shipments of pig iron for May are the best this year, amounting to 82,363 tons, as against 79,783 tons in April, and 80,251 tons in May last year. Of this quantity 30,931 tons have gone to Scotland, 8,540 tons to England and Wales, and 42,892 tons foreign. The comparative shipments for the five months January to May for the past three years are:—1891, 343,078 tons; 1890, 299,781 tons; 1889, 405,884 tons. The shipments of manufactured iron and steel for May amounted to 44,149 tons, of which 8,106 tons went coastwise, and 36,043 tons foreign. The chief customers were:—India, with some 16,000 tons; Cape Colony, 3,082 tons; and Egypt, 3,606 tons.

IRONMASTERS' RETURNS.—The returns of the Cleveland Ironmasters' Association for the month of May were issued to-day, and proved to be fairly satisfactory. There were 89 furnaces in blast, against 91 during the previous month. Of these, 53 were on Cleveland pig and 36 on hematite. The make of Cleveland iron for the month was 123,906 tons, an increase of 3,691 tons on April. Of hematite pig 92,775 tons were produced, a decrease of 9,077 tons. The total make was 216,681 tons, a decrease of 5,386 tons on April. Makers' stocks are 139,037 tons, a decrease of 10,770 tons. In makers' stores there are 1,820 tons, a decrease of 656 tons. In the public stores there are 126,936 tons, an increase of 8,020 tons. The total stocks are 267,793 tons, a decrease of 3,406 tons for the month as compared with April.

NEWCASTLE, 3RD JUNE, 1891.

THE IRON TRADE.—In the local iron trade business is flat, though one or two manufacturers of specialties in finished iron, among whom may be named Messrs. Raine & Co., of Winlaton, are kept busy, and are well supplied with forward orders. It is reported that the blast furnaces at Low Walker, which were blown out a few weeks ago, will again be put in operation before the autumn. Galvanising works are beginning to show a falling off of business, and a lessened trade is also being experienced in the forges. Messrs. John Spencer & Sons' forge at Ouseburn is, however, an exception, and in this instance there still appears to be a large amount of work in progress. Foundries are still generally pretty active, the establishments of Messrs. Hawthorn, Leslie, & Co., Forth Banks; Messrs. Abbot & Co., Gateshead; and Messrs. Chapman & Carverhill, Elswick, being very well supplied with work. The decline of business in some of the larger industries has adversely affected rivet works and chain works.

THE COAL TRADE.—In the steam coal trade business is still active, but for gas and manufacturing coals the demand has decreased, and in respect of household qualities there is decidedly less inquiry. The shipments of coals and coke at Tyne Dock during the week ending the 30th ult. amounted to 120,693 tons, being an increase as compared with the shipments for the corresponding week last year of 23,112 tons.

THE IRWELL RUBBER COMPANY.—This firm of Manchester manufacturers have opened a depôt for the sale of their productions at 7, Dean Street, Newcastle, under the superintendence of Mr. Thos. Beynon. The company are extensive producers of rubber goods for engineering purposes, and the opening of a branch in this district can hardly fail to effect a considerable extension of their business.

STEEL WORKS.—Messrs. Ibbotson Bros., the well-known Sheffield firm of steel manufacturers, are actively preparing for an early commencement of productive operations at the Gateshead Steel Works, which came into their possession several months ago. Much difficulty has been found in making the place ready for the special branches of manufacture which the firm intends to carry on there. The final arrangements, however, for commencing steel production are now in progress.

THE "STOCKPORT" GAS ENGINE.—The agency for the sale of the "Stockport" gas engine is shortly to be removed from Cloth Market to more commodious premises in Collingwood Street.

DUNDEE, 3RD JUNE, 1891.

THE JUTE AND FLAX TRADES.—The linen trade is quiet, but steady. Buyers of flax appear to be well supplied, and there is little business. Sellers' stocks being small, however, prices are firm. A moderate business is passing in flax and tow yarns at recent rates. For cloth the demand is fairly good, and foreign buying is rather better. In jute there has been little doing. Advices from Calcutta report a stronger market for baled jute. The prospects of the new crop are reported to be more favourable. There is a slow demand for jute yarns, and while prices are unaltered sellers cannot find buyers without granting concessions. Jute goods are in quieter demand, and the New York market is weaker, burlaps 40in. 10½oz. being quoted at 4 1/16c. per yard, and light weights at 4⅜c.

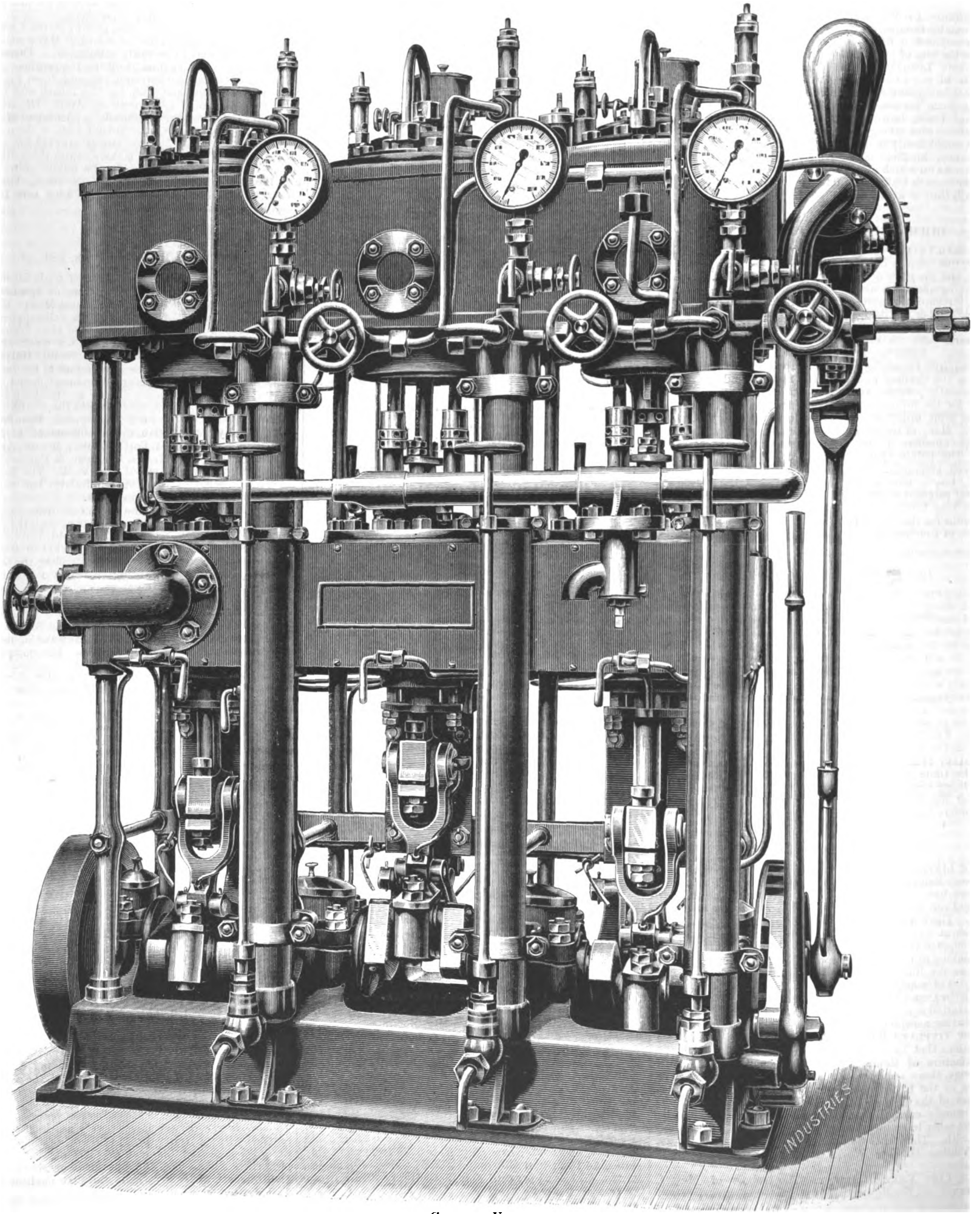
THE "DUNDEE ADVERTISER."—The proprietors of the *Dundee Advertiser* have issued a very neat little pamphlet, entitled "How a Newspaper is Printed," in which is given a description of the different departments in the *Dundee Advertiser* office. The pamphlet also contains a history of the *Dundee Advertiser*, which was first published on the 16th January, 1801.

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QUADRUPLE AIR COMPRESSORS FOR H.M.S. "ROYAL ARTHUR." CONSTRUCTED BY MESSRS. MAUDSLAY, SONS, & FIELD, LIMITED, ENGINEERS, LONDON.

(*For description see page* 536.)



GENERAL VIEW.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 5TH JUNE, 1891.

THE LONDON POLYTECHNICS.

THE study of place names is as curious as it is interesting and instructive, as from it we often obtain a great deal of information regarding the place itself. The study of descriptive names is not less curious, but often confusing and perplexing, for very often the names remain when the things themselves have completely changed their nature. The name "Polytechnic" is one which is used in many senses, but which yet has a very definite original meaning. Possibly it was first applied to an educational institution when Napoleon the First founded the École Polytechnique in Paris. That institution, curiously enough, is not, and never has been, a polytechnic in the proper sense of that term, although it was intended originally to be what its name implied. At present it is a high-class scientific school, but almost entirely concerns itself with the theoretical side of the subjects taught, and is used chiefly for preparing candidates for different departments of the military service. Belonging to the Government, but in a different department, there are the École des Ponts et Chaussées and the École des Mines, to which a few of the best students of the École Polytechnique are drafted, so that, in a sense, the latter institution is only a preparatory one for those in which the technical applications are taught. In Germany, on the other hand, the polytechnics are technical high schools, and, educationally, are on the same plane as the professional faculties of the universities, and, in fact, it has been suggested that they should become so in name, as much as they are practically so at present.

In this country, however, the name polytechnic has never stood in a very high position. It has been very often applied to shops or retail warehouses in which were sold a variety of things, chiefly of an industrial or mechanical nature. In London the well-known Regent Street Institution, in which were shown all the wonders of the day, seems destined to bequeath its name to a very numerous progeny, which, however, do not bear a very striking resemblance to the parent. For some years, through the generosity of Mr. Quinton Hogg, the old Polytechnic has been used as an institution for the benefit of young men and women, and in it there was, no doubt, a useful educational element, but there was also much that was recreative, and, to a very considerable extent, religious and moral. There cannot be the slightest doubt that institutions of this kind are of the greatest possible service in London, but what we wish to point out at the moment is the peculiarly British way of giving them names. The original institution was a show, and during what may be called the transition period this element largely prevailed, though others of a recreative and educational nature were afterwards added. A movement is now in progress for the extension and development of such institutions all over London. No doubt the educational part of the programme will be placed upon a proper basis, but the other parts will not disappear, and rightly so, for we consider them very important in their way. A German, however, coming to London and visiting such institutions, will find much to amaze and possibly amuse him, for, instead of high-class scientific study, he will find combinations of elementary and secondary schools, gymnasiums, and recreation rooms.

The scheme for the erection and extension of the so-called "Polytechnics" is due to an Act of Parliament passed about eight years ago, at the instance of Professor Bryce, to carry out the recommendation of the Commissioners on Technical Education, that "steps be taken to accelerate the application of ancient endowments, under amended schemes, to secondary and technical education." The Act provided for the diversion of a great part of the funds of the City, which had hitherto been, to a large extent, wasted or misapplied, to some purpose which would benefit the poorer inhabitants of London. The work has been done under the superintendence of the Charity Commissioners, and the scheme may now be considered to be fairly inaugurated. The central governing body has been elected, and has held a preliminary meeting, and arrangements have been made for the ultimate establishment of institutes in all parts of London—North, South, East, West, and Centre. Existing institutions are to be utilised and extended, and, of course, endowed. Among those which will benefit in this way are the Regent Street Polytechnic, the People's Palace, the City of London College, and the Birkbeck Institute. The two latter, together with a new institute to be established in Clerkenwell, are to be grouped together under the title of the City Polytechnic, while the needs of the Southern district are to be supplied by institutes at New Cross, Borough Road, and Battersea. Of these the New Cross Institute will be maintained entirely by the Goldsmiths' Company, and therefore it does not fall directly under the scheme of the Charity Commissioners, but it has been taken into account by them in making their arrangements. The Commissioners have wisely endeavoured to encourage local effort by offering an endowment equal to the amount of the local contributions, and in some cases the response has been very remarkable. In Battersea, for instance, over £50,000 has been raised locally. The promoters, therefore, feel justified in going on with the scheme, and have decided on the plans to be adopted. It was at one time proposed to acquire the Albert Palace, but the expense was too great, and moreover the existing buildings were not specially suitable to the requirements. It has been now decided, however, to erect new ones at a cost of £40,000.

The New Cross Institute will be housed in the buildings formerly occupied by the Royal Naval School, while at Borough Road, the British and Foreign Training College and the Morley Memorial College will be utilised. The Institutes for the North and the West have not been decided upon, as the necessary funds have not been raised, although they form part of the general plan. There can be no doubt that these institutes, if properly organised and managed, may exercise a most important educational and social influence in London. It is, therefore, to be hoped that they will be fortunate enough to secure governors who will have their hearts in the work, and who will have sufficient knowledge of the requirements of education to enable them to distinguish real education from mere cramming of information. For some years the institutes should be allowed to grow gradually, and be designed so that they may be extended. Their nature is so different

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from that of any institutions which have been hitherto carried out that the whole question cannot be considered to be beyond the experimental stage, and it would be a great mistake to make them all of exactly the same type. The science and art classes will no doubt be in connection with South Kensington, and we hope that the proposal which was made some time ago by the Council of the National Association for the Promotion of Technical Education will be adopted. We trust that, instead of individual grants on account of students, the Science and Art Department will be willing to pay an annual sum to the central governing body, the amount of which will depend more on the average attendance and the general nature of the work done than on the results of individual examinations. It has been remarked that the constitution of the first Board is disappointing, and that it seems constituted rather with a view to the management of the estates than to the advancement of education, and that results will be measured in too commercial a spirit. We trust, however, that it will rise to the occasion, and that it will co-ordinate its work with that of the University Extension Society. We should thus have in London an organisation which would be a popular University of London, and which would give opportunities to the most promising of its students to prepare themselves for the work of the real University of London.

SEVENTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY.

According to a programme recently issued of the proceedings at the meeting of the Congress which is to be held in London from August 10th to 17th next, the Congress has previously been held in Brussels, Paris, Turin, Geneva, The Hague, and Vienna. The Permanent International Committe, appointed in Vienna, resolved, on the invitations of the Sanitary Institute and the Society of Medical Officers of Health, that the Seventh Congress of the series should be held in London in 1891. The Seventh Congress will be inaugurated on August 10th by a general meeting in St. James's Hall. H.R.H. the Prince of Wales, the President of the Congress, will preside at the opening meeting, and will take the chair at 3.30 p.m. The Congress is organised in two divisions and ten sections. The meetings of the sections will be held on August 11th, 12th, 13th, 14th, from 10 a.m. to 2 p.m. Division I.—Hygiene. Section I. (Preventive Medicine) will meet in the rooms of the Society of Antiquaries, Burlington House. Section II. (Bacteriology) will meet in the rooms of the Royal Society, Burlington House. Section III. (The Relations of the Diseases of Animals to those of Man) will meet in the rooms of the Geological Society, Burlington House. Section IV. (Infancy, Childhood, and School Life) will meet in the theatre of the University of London, Burlington Gardens. Section V. (Chemistry and Physics in Relation to Hygiene) will meet in the rooms of the Chemical Society, Burlington House. Section VI. (Architecture in Relation to Hygiene) will meet in the West Examination Hall in the University of London, Burlington Gardens. Section VII. (Engineering in Relation to Hygiene) will meet in the East Examination Hall in the University of London, Burlington Gardens. Section VIII. (Naval and Military Hygiene) will meet in the rooms of the Linnæan Society, Burlington House. Section IX. (State Hygiene) will meet in the rooms of the Astronomical Society, Burlington House. Division II. (Demography) will meet in the theatre of the Royal School of Mines, Jermyn Street. Excursions will be made on August 15th, and the closing meeting of the Congress will be held on August 17th at 11 a.m., in the theatre of the University of London. The aim of the Congress is to stimulate public interest in the progress of Hygiene and Demography, by which latter term is understood the study of the life conditions of communities from statistical points of view, and to afford persons interested in these subjects an opportunity of meeting and of elucidating questions connected therewith by conference and debate. The Governments of all countries, municipalities, county councils, and other local administrations, public health authorities, universities, colleges, and all societies which are occupied in the study of the sciences more or less immediately connected with hygiene, are invited to co-operate and appoint delegates to represent them at the Congress. Up to the 1st ult., 508 delegates have been appointed by 149 bodies. All delegates from the bodies above mentioned, and all persons who are interested in the work of the Congress, are eligible to become members thereof. Tickets of admission to the Congress may be obtained through the post by letters addressed to 20, Hanover Square, W., and containing a remittance of £1—apart from any subscription which a member may contribute towards the Congress fund—together with the title and address of the applicant given in full. An Indian Committee has been formed with the object of making known the aims and work of the Congress in her Majesty's Eastern possessions and dependencies. Every endeavour will be made to make the visit of the Congress pleasant and instructive to the members, and to enable them to see to advantage whatever England has to show which is of interest from the point of view of sanitation, science, art, and archæology.

THE COINAGE DURING THE YEAR 1890.

According to the twenty-first annual report recently issued by the Deputy-Master of the Mint, Sir C. W. Fremantle, there was a very large production of coinage during the year 1890, which is the more remarkable as the production in the previous year had been much in excess of the average. The value of the gold coinage issued during the past year was £7,680,156, of the silver coinage £1,694,688, and of the bronze coinage £90,285. The average value of the gold coinage during the preceding ten years was under two millions and a quarter, so that the amount coined during the year 1890 is extraordinarily large. The amount of light gold withdrawn from circulation in consequence of the Coinage Act of 1889 amounted to £2,463,148, at a cost of £51,299. The cost of withdrawing the light gold coins of former reigns was about 5d. per pound sterling. The total gold coinage of the Australian mints during the past year amounted to £5,924,000. About half of the total issues of the Australian branch mints are on the average sent to England. Silver coins of the total nominal value of £1,694,688 were issued during the past year. The total value of the silver coinage of the new design is £5,256,000, of which more than one-half is supposed to be in circulation in this country. Forty-two millions of the smaller pieces, shillings, sixpences, and threepences, were added to the circulation, as compared with 14 millions of the larger. As the average price of silver in 1890 exceeded that of 1889 by $5\frac{7}{8}$d. per ounce, there was a seignorage of $35\frac{1}{2}$ per cent. as compared with 54 per cent. in the previous year. The total amount of bronze money issued was £90,285, which exceeds that of the large issue of 1889 by £24,000. The number of bronze coins issued was nearly 29 millions, the weight of which was 213 tons. The net profit of the Mint has exceeded that of every previous year except that of 1889, when the low value of silver allowed of a large profit on the silver coinage. During the past year there were melted in the melting-house 192 tons of gold, 388 tons of silver, and 74 tons of copper, besides $4\frac{1}{2}$ tons granulated for alloy. Eighty-eight million coins were struck in the coining press-room, and these were of 25 different denominations; 17,500,000 of these coins were rejected for various reasons. Thirty-six thousand and nine assays were made during the year, and investigations were carried out for the purpose of obtaining such alloys as would preserve their homogeneity during the process of cooling.

THE ROYAL COMMISSION ON THE LABOUR QUESTION.

At a meeting of the Royal Commission held on the 28th ult., under the presidency of the Marquis of Hartington, a decision was arrived at as to the method of procedure. The report of the Committee of Procedure is as follows:—

1. That for the purpose of taking evidence and collecting information, the Royal Commission be divided into three Committees.

2. That each of these Committees should institute an inquiry into the facts concerning the condition of certain groups of trades, leaving questions of principle to be treated by the Commission as a whole.

3. That for this purpose the following division of trades should be adopted, the division being provisional and non-exhaustive:—Group (a.) The mining, iron, engineering, hardware, shipbuilding, and cognate trades. Group (b.) Transport and agriculture: the term transport including shipping, canals, docks, railways, and tramways. Group (c.) Textile, clothing, chemical, building, and miscellaneous trades.

4. That it shall be in the power of members of one Committee to attend the meetings, and examine and cross-examine witnesses at meetings of other Committees; and that each Committee should report to the Commission the evidence taken, or a summary of such evidence, if they think fit.

5. That the following syllabus be submitted as a convenient summary of the subjects to be inquired into by the Committees:—

Trade Differences between Employers and Employed.

1. Their causes. 2. Their development, organisation, and conduct. 3. Their cost. 4. Their prevention or settlement.

1. Their Causes.

A. Wages:—1. How fixed. 2. How calculated: a. By piece work. b. By day work. c. By task work. 3. How paid: a. Direct, by employer, or by sub-contractor. b. Weekly, fortnightly, or at other periods. c. Increased by bonus, or reduced by stoppages. d. Truck or payment in kind. e. House, land, or other allowances. 4. Fluctuations of wages: a. How brought about. b. How adjusted. 5. Differences of wages in different establishments and localities. 6. Existence and effect of: a. Pensions. b. Deferred pay. c. Sick insurance. d. Accident insurance. 7. Notice required for the termination of wage contracts.

B. Hours of labour and continuity of employment:—1. Normal hours of work. 2. Overtime, and how remunerated. 3. Night shifts, and how remunerated. 4. Short time, season work, or other irregularity of employment. 5. Sunday and holiday labour, how arranged and paid for. 6. Duration of day's work, and week's work, and how regulated.

C. Subdivision, distribution, and classification of work, as between different trades, individuals, men, women, or children, whether half-timers or not, factories, workshops, or homes.

D. Apprenticeships.

E. Introduction of machinery.

F. Supply and quality of the machinery and materials of production or transport.

G. Safety of employment, provisioning of ships, lighting, sanitation, and inspection of workplaces.

H. Discharge for belonging to a trade union.

I. Refusal to work with non-unionists.

J. Discharge of representative delegates and use of black list.

K. Employment of foreigners.

L. Obnoxious officials.

M. Sympathetic strikes.

N. Other causes of dispute.

2. Their Development, Organisation, and Conduct.

A. Trade associations or combinations of employers or of employed, whether permanent in character or temporary, occasional, or for special dispute purposes, their trade rules, benefits, and policy. B. Strikes and lock-outs, picketing, blacklisting, and other methods of influencing persons concerned or not directly concerned in the dispute. C. Importation of new or foreign labour, whether under contract or otherwise.

3. Their Cost.

A. Economic result of strikes and lock-outs to workers, to employers, and to the community at large.

4. Their Prevention or Settlement.

A. Conciliation by joint committees or otherwise. B. Mediation. C. Arbitration, voluntary or compulsory. D. Sliding scales. E. Profit sharing. F. Industrial partnerships. G. Co-operation.

6. We have instructed the secretaries to prepare a schedule of questions founded upon the syllabus, and we suggest that it should be sent to the different unions of employers and of employed, and other representative bodies or persons.

The subjects which are to be considered by the Commission will be divided into three sets of questions, the first to be sent to the unions of employers, the second to unions of employed, and the third to other representative bodies or persons. The first division will be considered by the Commission; whilst the other two divisions will be referred to Committees. It is expected that the Committee of Procedure will complete their work during this week, and that the Commission will begin to take evidence next week.

THE LATE SIR JOHN HAWKSHAW.

We regret to record the death of Sir John Hawkshaw, F.R.S., who died on the 2nd inst. at his residence, Belgrave Mansions, London, in his 81st year. He was born at Leeds, and at an early age was placed as a pupil with Mr. Charles Fowler, who was engaged in constructing turnpike roads in Yorkshire. He afterwards became an assistant to Mr. Alexander Nimmo, who was employed to design a scheme of railways between Manchester, Leeds, and the Humber. When only 20 years of age, he became manager of the Bolivar Copper Mines in Venezuela, and occupied that post for three years. Whilst he was in South America he acquired an intimate knowledge of the country and of its people, and a few years afterwards wrote an account of the country, entitled "Reminiscences of South America, from Two and a half Years' Residence in Venezuela." On his return to England in 1835 he was appointed engineer to the Manchester and Bolton Canal and Railway. Mr. Hawkshaw was consulted on the subject of the gauges by the directors of the Great Western Railway, and gave a decided opinion that the broad gauge should be discarded, and that the gauge adopted by the Stephensons, which was then in use on the Liverpool and Manchester Railway, should be used in its place. He advocated its adoption in order to prevent the Great Western line from being isolated from the entire railway system of England. At that time the broad gauge had been laid only between Paddington and Maidenhead, and the adoption of his policy would have been very advantageous. Some of the directors, however, maintained

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that the severance of their line from the network of the kingdom was itself an advantage. In 1840 Mr. Hawkshaw was appointed chief engineer of the Manchester and Leeds Railway, in succession to George Stephenson. This line had been commenced, in 1836, under Stephenson, and the works had been partly carried out before Hawkshaw's appointment. He showed the practicability of steeper gradients than had then been adopted, and which were found to be necessary on some branches of this line. He claimed that they were desirable where a circuitous route might thus be avoided. Stephenson advocated tunnelling through hills, and the securing of a level line. Hawkshaw opposed Stephenson's views, and had the satisfaction of seeing his own received with favour. On the incorporation of the Manchester and Leeds Railway with the Lancashire and Yorkshire Company, Mr. Hawkshaw was appointed engineer of this group of railways, and designed many of the lines and branches on the system. He carried out the very costly extension of the South-Eastern Railway from London Bridge Station to Charing Cross, with a branch to Cannon Street, and constructed the two railway bridges across the Thames, together with the two terminal stations. In Russia he constructed the Riga and Dünaburg and the Dünaburg and Witepsk lines. In Mauritius the Government Railways were completed under his direction.

He also devoted much time to the construction of docks and harbours. The Penarth Harbour and Dock near Cardiff, the Albert and other docks at Hull, the South Dock of the East and West India Dock Company, and the Holyhead Breakwater, of which he was appointed engineer on the death of Mr. J. M. Rendel in 1856, are among his most important works. In 1862, at the request of the Viceroy of Egypt, he reported on M. de Lesseps' Suez Canal scheme, and it was owing to his strong recommendation that the work was not then abandoned. In 1860 he was appointed sole Royal Commissioner to inquire into the water supply of Dublin, and his scheme was carried out. He designed and superintended the construction of the fortification of Spithead forts, and was a member of the Government Commission on Fortifications. In 1862, on the failure of the great sluice at St. Germains, near Lynn, he carried out successfully the difficult work of preventing the tidal waves from flooding the low-lying lands of Norfolk. He erected an ingenious timber dam, and the drainage was effected by means of sixteen large iron syphons laid over the dam, and acting as a substitute for the fallen sluice.

He was President of the Institution of Civil Engineers in 1862–63, and some passages in his presidential address certainly deserve quotation. With regard to discovery and invention, he said that "there is no such thing in the sense which is sometimes attached to the words. Men do not suddenly discover new worlds, or invent new machines, or find new metals. There is nothing really worth having that man has obtained that has not been the result of a combined and gradual process of investigation. A gifted individual comes across some old footmark, stumbles on a chain of previous research and inquiry. He meets, for instance, with a machine, the result of much previous labour; he modifies it, pulls it to pieces, constructs and reconstructs it, and by further trial and experiment, he arrives at the long-sought-for result." In his concluding remarks he said that "no agency could be compared in its effects, or in its tendency towards the amelioration of the condition of mankind, with the establishment of railroads, the electric telegraph, or with the improvement in steam navigation. For in constructing railways, telegraphs, and steam boats, and their adjuncts, docks and harbours, and moulding and fashioning the face of the material universe to the wants of man, in overcoming its barriers, overleaping its valleys, and spanning its seas, engineers annihilate both space and time, bring into juxtaposition nations and people, and accelerate, beyond all human expectation, personal communication and that interchange of ideas which is all-important to the advancement of civilisation and knowledge. Distance and separation have led and will always lead to misapprehension and prejudice—to ignorance and mistrust—to rebellion and war; and engineers may feel, when labouring on the great public works that facilitate the intercourse of nations, that they are not merely conquering physical difficulties, but that they are also aiding in a great moral and social work."

In 1870 Mr. Hawkshaw proposed his scheme for a submarine tunnel between Calais and Dover. In conjunction with Mr. Wythes and Mr. Brassey, he had caused borings to be made to a depth of 500ft. through the chalk at St. Margaret's Bay, near Dover, and at Sangatte, on the French coast. He had also chartered a steamer at his own expense to take soundings in the Channel, and had employed a geologist to map out the outcrop of the strata on the French and English coasts. He finally came to the conclusion that a tunnel between England and France was quite practicable. In 1873 he received the honour of knighthood. He visited Brazil in 1874, and examined the principal ports and harbours of that country. He was engaged as sole Royal Commissioner in inquiring into the means of purifying the Clyde. He was President of the British Association at the Bristol meeting in 1875. His presidential address reviewed the progress of engineering from the earliest times in Egypt and Mesopotamia up to the times of the Lancashire and Yorkshire Railway, and dealt not only with civil engineering, but also with mechanical engineering and architecture. But his connection with the Severn Tunnel will perhaps be considered as his most important engineering work. During thirteen years, while the tunnel was being constructed, the large inflow of water from underground springs made the work extremely difficult, and it was feared at one time that it would be impossible to complete the work. Sir John Hawkshaw's skill and energy surmounted all obstacles, and in 1885 the first train passed under the Severn between England and Wales. In 1888 Sir John Hawkshaw retired from the profession, and his work devolved upon his son, Mr. J. C. Hawkshaw, and Mr. Harrison Hayter. The mere recital of Sir John Hawkshaw's work forms a continuous record of useful labour for the advancement of the civilisation and material progress, not of his own country only, but of the world. While England can claim such men among her sons, her present great position is likely to be maintained.

THE ATLANTIC RACE.

The race across the Atlantic continues to increase in interest, especially as German shipbuilders and engineers have now entered for it. The "Fuerst Bismarck," belonging to the Hamburg-American Line, was built at Stettin by the Vulcan Shipbuilding Company, and is essentially a duplicate of the "Normania," which was constructed by the Fairfield Shipbuilding Company on the Clyde. We understand that the "Normania" has scarcely fulfilled the expectations of her builders and her owners, inasmuch as she has not yet equalled the best run of the "Columbia," a smaller ship, with 3,500 less horse-power. The builders of the "Fuerst Bismarck" took much more time to build their ship than the Fairfield Company, and to a certain extent had the benefit of their experience in some matters connected with the construction both of the ship and the engines. The "Fuerst Bismarck" registers 8,616 tons, is 502½ft. long, 57½ft. broad, and 34½ft. deep. Her engines are of the triple-expansion type, with cylinders of 40in., 67in., and 106in. diameter. She has nine double-ended boilers, her coal bunkers have a capacity of 1,700 tons, and on her trial trip she averaged 20·55 knots.

The "Fuerst Bismarck," in her voyage from Southampton to Sandyhook, particulars of which have just been received, made the distance in 6 days 14 minutes 15 seconds, or, taking the course pursued by the "City of Paris" in her famous run of 5 days 19 hours 18 minutes, and allowing the average speed which she actually made, the "Fuerst Bismarck" would have got over the distance in 5 days 22 hours and 54 minutes. Captain Albers says she was not pushed in any way, and predicts, as she has done so well in her maiden voyage, that after a few more voyages she will beat all records. Another point in her favour is the consumption of coal. The "City of Paris" burned every day about 335 tons of coal, while the "Fuerst Bismarck" is said to have burnt only 280 tons. Such records open up prospects which deserve serious consideration from our shipbuilders and marine engineers.

Letters to the Editor.

THE "STANLEY" BOILER.

To the Editor of "Industries."

Sir,—I thank you for your notice of the test of the above boiler in your valuable paper of last week. It being in the same issue as the test of the boilers and engines of the s.s. "Iona," your readers will have a good chance of comparing a few of the results. That they may do so more closely I send you a copy of Mr. Nichol's report, which I am sorry I had not time to send you during last week, but trust you may find space for it and the following remarks in your next issue.

I see in the "Iona's" trials the grate is very small, and the ratio to heating surface is very high, 75·2, compared with 29·86 in the "Stanley" boiler, but forced draught was used instead of natural. The boilers would also be covered with composition. The temperature of the outside air was 62°, as against 50°, or rather, as the boilers were in the stokehold, about 100°. All these things make a difference of about 20 to 30 per cent. against the "Stanley" boiler in evaporation. I also burnt 25·5lb. of coal per square foot of grate, as against 22·4lb. in the "Iona." The feed-water was 51° as against 106°, and the pressure atmospheric as against 165lb. per square inch. Yet the "Stanley" boiler evaporated 7·84lb. of water per lb. of coal with natural draught, as against 9·15lb. with forced draught; 9·14lb. from and at 212°, as against 10·63lb.; 200lb. per square foot of grate, as against 205lb.; 6·715lb. per square foot of heating surface, as against 2·73lb. As the weight of the "Iona's" boilers is not given, I can only roughly compare this item. The "Stanley" boiler, however, did the very high evaporation of 244lb. of water per ton weight of boiler, smoke-box, funnel, and water included, and taking the weight of the "Iona's" boilers, &c., at 100 tons, they only did 86·16lb. per ton.

If not trespassing too much on your valuable space, I should now like to say something in reply to the queries at the end of your notice. I am certain from the experiments I have had that it will not prime in actual work, but if it should be found to do so, I can easily remedy it in this and all future boilers by keeping the top of tubes lower down. The water line in the sectional view you gave is higher than that at which I propose working it; this I omitted to correct before sending you the drawings.

The steam space is quite sufficient, and can be increased as required by a larger dome in future boilers. Your next query is answered by the remarks above regarding the water line.

In conclusion, I may say that one or two little things have shown themselves to me in the trials, whereby all future boilers of the "Stanley" type will be greatly improved. Mr. Nichol's report includes a statement of results with this boiler burning 15lb. of coal per square foot of grate instead of 25·5lb., and which shows the high evaporative efficiency of 11·07lb. of water per lb. of coal from and at 212°. With the large consumption of 25½lb. of coal per foot of grate, and the most unfavourable conditions of the temperature of air and feed-water, and the exposure of the boiler, under which it was tested, I think none can deny that the tests of this boiler are highly satisfactory. If the test had been of longer duration the results would have been much better, as the water evaporated in the first half-hour was little more than one-half of that during the other two half-hours.

Yours, &c.,
H. B. Buckland.

Hamburg Chambers, Newcastle-on-Tyne, 2nd June, 1891.

THE WENHAM COMPANY v. THE CHAMPION GAS COMPANY.

To the Editor of "Industries."

Sir,—Whilst agreeing in the main with your editorial remarks on this remarkable trial, it would have been more satisfactory if the defendants had had scientific witnesses as well as the plaintiffs; the legal and scientific weight appeared to be all on one side.

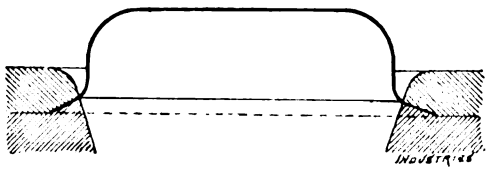
Yours, &c.,
Rock Ferry, 1st June, 1891. B.A.M.

ENGINE INDICATORS.

To the Editor of "Industries."

Sir,—I am glad to observe from your last issue that my friend Professor John Perry is turning his attention to the construction of engine indicators. The form illustrated appears very neat indeed, and for permanent immoveable attachment to a cylinder may be found very convenient. The pressure-indicating apparatus, with the exception of the multiplying gear, is the same as that of my indicator patented 24th September, 1886 (No. 12163), and described in a paper read before the S.S. and E.W. Mining Engineers, 5th April, 1888.

Professor Perry uses the angular deflection of the plate, while I used its linear deflection. He also uses a flat plate clamped firmly at the edges. I used a dished plate with rounded edges, spun in the form shown below, in order to allow of free



Section of Smith's Indicator Disc.

angular deflection at the edges, and thereby increase the flexibility for a given size and strength. As multiplying mechanism I used a fine watch chain winding on a drum ⅛in. diameter, and a thin steel tube 2in. long as lever, thus obtaining a ratio of multiplication of 20 as against 4 in the ordinary indicators, the whole weight of my transmitting and multiplying mechanism, including pencil, being $\frac{1}{10}$oz., against ¾oz. in Richards'. The equivalent piston weight in my instrument was ⅛oz., while it is 1½oz. in Richards'. My spring plate is 1¼in. diameter; Professor Perry's seems to be 1¼in., and he has, therefore, probably a still smaller equivalent piston weight.

A mirror and beam of light as multiplying mechanism was used on indicators before the date of my patent. For ordinary use with a portable indicator, I cannot see how the scale of the indicated pressures can be determined with any accuracy and readiness combined. If, however, the indicator, its mirror, lamp, lens, and diagram screen all be permanent fixtures on an engine, the pressure scale of the movement of the spot of light can be determined directly by experiment, and can be marked upon the screen. I see no reason why each end of each cylinder of every steam engine should not have its own permanently fixed indicator.

I do not know how far Professor Perry has yet tested his indicator. I should like to learn whether he does not find the two chief difficulties I found in my similar instrument. Firstly, I soon abandoned steel plates because of the steam rapidly rusting them. I tried steel plates silvered by electro-deposition, but the heating and cooling, combined with the continuous bending, made the silver soon peel off. I then used hard phosphor-bronze plates, against which I can find no similar objections. But I have found that the large surface of the spring plate and its box led to such large condensation of steam that the indications were not trustworthy. For this reason I laid aside the instrument three years ago, and have not since had any time to try to get over this defect. Professor Perry's box and plate are slightly smaller than mine, but there is so little difference that I can hardly think that this defect is absent from his instrument. I shall be most happy to hear that he has succeeded in overcoming this difficulty.

Yours, &c.,
Robert H. Smith.

Mason College, Birmingham, 30th May, 1891.

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THE ZONE SYSTEM OF RAILWAY RATES.

To the Editor of "Industries."

Sir,—As you were the first among your contemporaries to direct attention to the Zone System of Railway Rates, I hope you will continue to keep the subject before the public, and urge that inquires be made as to how far it is desirable and practicable in this country, for in this, as in many other things, the intitiative for reform is likely to come from private and not from official sources. The pamphlet mentioned in your last issue, which has been published at the office of the Glasgow *Evening Citizen*, is an example of what I mean. Your first article was founded on the original letters which appeared in that paper, and these were written by a special commissioner who was employed by the proprietors of the *Citizen* to inquire and report on the matter. He indicated some of the applications which might be made of the system in Scotland; but I have no doubt many other instances will occur to some of your readers. The system might at least be incorporated in the circular routes which are now to be found in several large towns or their neighbourhoods. In both Glasgow and Edinburgh, for instance, we have such circular lines, and I am convinced that the traffic would be immensely increased if there were an omnibus service with a uniform charge. I understand that the directors of the subway railway which is now being constructed, and which will describe a smaller circle than the one already existing, have decided to have such a service, and the same has been suggested on another line which is being projected by the Caledonian Railway to take in some of the suburban districts. In London, of course, the system might find many applications, both locally and otherwise. The objection that most English railways are already running too near their full capacity only proves that that capacity must be extended, for this argument would have blocked progress in any department. The means of communication of a country must always be fully equal to the demands made upon them. In addition to the pamphlet mentioned in your last issue, I would commend to the attention of your readers, who are interested in the subject, a paper recently presented to Parliament (Commercial, No. 11, 1891) in which further particulars will be found of the rapid development of traffic on Hungarian railways, where the system of zone tariffs is in operation.

Yours, &c,

Glasgow, 30th May, 1891. C.E.

THE PROFESSIONAL POSITION OF CHEMISTS.

To the Editor of "Industries."

Sir,—The report of the meeting of the Institute of Chemistry which appears in your issue of the 15th inst. raises some rather curious reflections to an outsider, and especially that part of it which gives an abstract of Dr. Odling's address, "On the Relations of the Chemical Society to Professional Chemistry." He stated that the function of the Chemical Society being the advancement of pure science it followed that it had no concern with the furtherance of professional interests. His whole argument rested on the assumption that from a financial point of view it was expedient that the number of Fellows of the Chemical Society should be maintained. That is to say, that the Society is to a large extent a financial or commercial concern, and in order to keep it going a certain number of subscriptions are absolutely necessary, and in return for these the subscribers are to be allowed to write the letters F.C.S. after their names. Now it is wonderful how ignorant the public still is of the meanings of the letters which people like to add to their names, and also how much a few such appendages raise the wearers in their estimation. Those, indeed, who most like to use them stand most in need of raising. I wonder if Dr. Odling has never discovered that the best scientific work of any society is generally done when it is young and struggling, and when it has got within it a band of enthusiastic workers. When it becomes large it too often degenerates into a struggle to making ends meet in the payment of officials, of the rent of large and pretentious premises, and generally in maintaining its respectability.

The report raises the questions, Why is it necessary to maintain a separate existence for the Chemical Society and the Institute of Chemistry? and why should the profession of chemistry be placed on a different basis from any other?—for I may assume that the members of both bodies claim to be chemists. I understand that the Institute was founded as a protest against the abuse of the Society which was made by some unworthy members. The Associateship, I believe, is conferred on those who satisfy the examiners that they have gone through a course of study such as will give them a fair knowledge of the subject. I would suggest another grade, that of member, for those who are qualified to perform the ordinary duties of a professional chemist, either analytical, manufacturing, or consulting, or to act as a teacher of the subject, while the position of Fellow should be reserved for those who had really distinguished themselves in their profession either by their researches or practical work. If that arrangement were carried out, there are no reasons why the Chemical Society and the Institute of Chemistry should not amalgamate and form a strong body, similar to the Institution of Civil Engineers, which includes all grades of the profession. In my opinion it is altogether a mistake to separate theory and practice in any arrangements whatever, and such an amalgamation would lead to the advancement of pure chemistry, and to the raising of the position of professional chemists.

Yours, &c.,

M.A.

Glasgow, 28th May, 1891.

STEAM ENGINE JACKETS.

To the Editor of "Industries."

Sir,—There is one point connected with the design of the engines of the "Iona" and of the experiments of the Committee of the Institution of Mechanical Engineers to which I would like to direct attention, and on which I would like to have the opinion of some of your readers. Quoting from your description of the engines, you say that "One of the principal features of these engines was the arrangement of the cylinders. The high-pressure cylinder was placed in the middle, and had three metals or walls around it. Counting from the inside, the first metal is the working barrel. Between the first and the second metal a space forms a steam jacket, at full boiler pressure. This is the only jacket about the engines, and is the one referred to throughout the Report. The space between the second and the outer wall is partly the receiver between the first and second cylinders, but mainly it is the receiver between the second and third cylinders. The jacket, therefore, gives off heat inwards to the first cylinder and outwards to the receivers."

This is a very ingenious arrangement, but it is contrary to ordinary practice, in which we seldom find the high-pressure cylinder jacketed. I suppose that that practice is the result of experience, or probably arises from the fear of dry or slightly superheated steam making it difficult for the pistons to work smoothly, a certain amount of condensation being considered necessary for lubrication. But the design of the engines of the "Iona" seems to be justified by theory, which requires that all steam engines should receive their steam at the highest temperature possible. For multiple-expansion engines, we ought therefore to have a superheater for the steam before it enters the high-pressure cylinder, and "hot pots" between the other cylinders, as was done by Mr. Cowper. But these arrangements are very clumsy, and altogether unsuited for marine engines. The design of the engines of the "Iona," however, carries out these theoretical arrangements to a very considerable extent, as the high-pressure cylinder is jacketed, and the jacket, at the same time, acts as a "hot pot" for the other two cylinders. The experiments show a very considerable amount of condensation in the jacket, but they do not show the effect of the jacket itself on the efficiency of the steam. I do not know whether the construction of the cylinders of the "Iona" will allow of the conditions of the use of the jacket being varied, if it does some most interesting experiments might be made. In the meantime, perhaps some of your readers will state their experience in such matters.

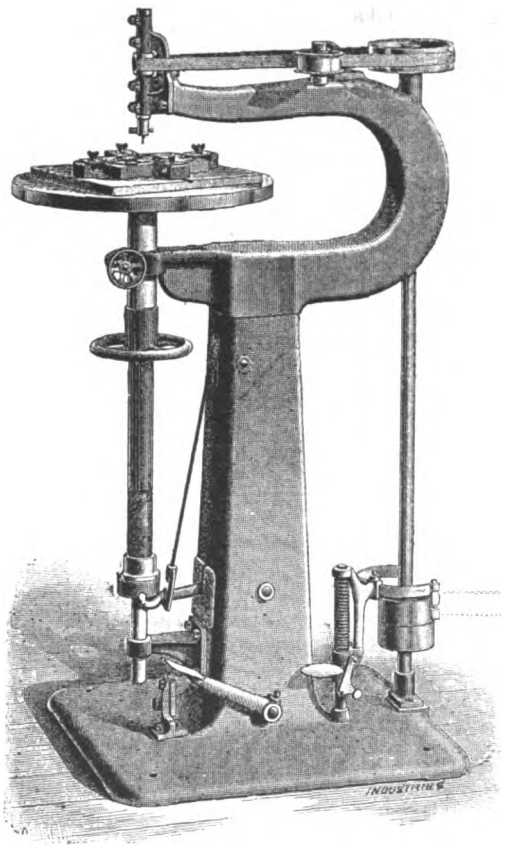
Yours, &c.,

Marine Engineer.

Liverpool, 29th May, 1891.

AN IMPROVED ROUTING MACHINE.

The accompanying illustration, for which we are indebted to our contemporary the *American Machinist*, represents a routing machine of simple construction, specially designed for meeting the requirements of publishing houses, electrotypers, and others, where machines are required to cut down large surfaces on engravings, &c. A rigid overhanging arm, above a vertically moveable table, supports a cutting spindle of steel, which can be run at 6,000 to 8,000 revolutions per minute. It is driven by an endless belt, arranged with a "stenting" pulley for governing the tension. The vertical shaft, extending to the base of the machine, affords a convenient mode of driving, which effectually eliminates any tremor that otherwise might be imparted from the driving belt.



The work to be routed is secured to a movable holder or loose iron plate, and passed beneath the cutter over the surface of the table by hand. This plate possesses sufficient inertia to resist the rotative force of the cutter, and enables the operator to move the work readily in the desired direction. Suitable clips, arranged in slots, are provided for fastening either mounted or unmounted plates to the work holder. The table may be moved vertically for entering the cutter, and for withdrawing the same from the work, by means of a conveniently arranged pedal for the right foot. A hand-wheel beneath the table provides an adjustment for controlling a uniform depth of cut. The table is also counterbalanced by a weight suspended within the column of the machine, making the movement of the table very sensitive. The adjustment for depth, combined with the vertical movement of the table, permits the machine to be successfully used for boring nail holes in zinc and electrotype plates, or for boring out mortises if desired.

The work holder is 12in. square, and it will take in plates 9in. in width. The driving pulley is 5in. diameter by 2¾in. wide, and the floor space required is 24in. by 31in.

The makers of this machine are Messrs. John Royle & Sons, Paterson, New Jersey, U.S.A.

Books Received.

A Dictionary of Applied Chemistry. Vol. II. By T. E. Thorpe, B.Sc., Ph.D., F.R.S. London: Longmans, Green, & Co.

Report of the Proceedings at the Annual Meeting of the Manchester Steam Users' Association

Proceedings of the South Staffordshire Institute of Iron and Steel Works' Managers. Session 1889–90.

Transactions of the Institute of Brewing. Vol. IV. Nos. 3, 4, and 5.

Grundlager für das Veranschlagen der Löhne bei der Bearbeitung der Maschinentheile. Von Richard Schulze. Berlin: Julius Springer.

Les Théories Modernes de l'Electricité. Essai d'une Théorie Nouvelle. Par O. Lodge. Traduit de l'Anglais et annoté par E. Meylan. Paris: Gauthier-Villars et Fils.

The Comprehensive International Wire Table. Compiled by W. S. Boult. Liverpool: W. S. Boult.

The Metallurgy of Gold. By M. Eissler. Third edition. Revised and greatly enlarged. London: Crosby Lockwood & Sons.

Transactions of the American Institute of Electrical Engineers, April, 1891.

Screws and Screw Making. Edited for and published by the Britannia Company, Colchester.

City and Guilds of London Institute. Report to the Governors, April, 1891.

Annual Report of the Board of Regents of the Smithsonian Institute to July, 1888. Two volumes. Washington: Government Printing Office.

The Law of Building and Engineering Contracts. By Alfred A. Hudson, Barrister-at-Law. London: Waterlow & Sons, Limited.

Transactions of the Institution of Engineers and Shipbuilders in Scotland Meeting, March 24th, 1891.

The Education of an Engineer. Reprint of a Paper read before the Liverpool Engineering Society by Professor H. S. Hele-Shaw.

The Action of Heat Engines, as Explained by the Molecular Theory. Reprint of the Presidential Address to the Liverpool Polytechnic Society by Professor H. S. Hele-Shaw.

The Missing Link in Industrial Education. Reprint of an Address to the Delegates of the Trades Congress, Liverpool, 1890, by Professor H. S. Hele-Shaw.

The Eight Hours Day. By Sidney Webb and Harold Cox. London: Walter Scott.

Safe Railway Working. By Clement E. Stretton, C.E. Second Edition Enlarged. London: Crosby Lockwood & Son.

Proceedings of the Société des Ingénieurs Civils, March, 1891.

With the Iron and Steel Institute to America. By Henry Webb. Letters reprinted from the *Bury Times.*

Proceedings of the Physical Society of London. Vol. XI. Part I.

Proceedings of the Society of Architects. Vol. III. No. II.

The Journal of the Franklin Institute, May, 1891.

Transactions of the American Society of Civil Engineers, March, 1891.

Reviews.

Elementary Lessons in Heat, Light, and Sound. By D. E. Jones, B.Sc. Macmillan & Co. 1891.

This little work, though it comes into being at the end of a long line of pre-existing text-books, will nevertheless, we believe, be welcomed by a large class of teachers and students of elementary physics, as supplying a want in educational literature which has been widely felt. The author deals with his subject as essentially an experimental one—each law and theory being, as far as possible, introduced and developed through the avenues of either practical experience or suitably contrived experiment. Very complete instructions for conducting such experiments form a noteworthy feature of the book, which contains many useful hints for the benefit of those who desire to put to practical test the various principles with which they seek to familiarise themselves. Sometimes the expositions and, more fre-

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quently, the definitions given are, as it appears to us, hardly sufficiently explicit to guarantee perfect clearness in the beginner's ideas; and we do not consider that the author is wise in recommending his readers, on first attacking the subject, to omit all that he has printed in small type, many important points (as, for example, the nature of a coefficient of expansion, p. 16) being hardly rendered intelligible without reference to the less prominent paragraphs. On the whole, however, the style of the book is concise and clear, and its value is considerably enhanced by a large number of excellent illustrations.

MIXED METALS OR METALLIC ALLOYS. By A. H. Hiorns. London: MACMILLAN & Co. 1891.

In this little volume the author gives a useful abstract of the researches of various authorities on alloys. The arrangement adopted is similar to that employed by Guettier in his "Guide Pratique des Alliages," the alloys being arranged in the following order:—Copper alloys, including brass and bronze; nickel alloys, including German silver; tin alloys, including solder, fusible metal, and Britannia metal; lead alloys, including pewter and shot metal; mercury alloys or amalgams; alloys of the precious metals; and iron alloys. The author has largely drawn on the lectures of his teacher, Professor Roberts-Austen, and reproduces several of the illustrations given in the Professor's Cantor lectures before the Society of Arts.

SEWAGE TREATMENT. By H. L. Hinnell. Bolton: TILLOTSON & SON. 1891.

A short descriptive sketch enumerating the different methods of dealing with water-carried sewage has long been wanted, and the author has endeavoured to supply this desideratum in the pamphlet under review. Most of the small handbooks, which have been brought to our notice during the last few years, have been written by men who had "fads" to put forward or patents to exploit, but Mr. Hinnell, although he has evidently had considerable experience in the actual working of many of the processes described, refrains from advocating any special treatment for general adoption on the ground that no one system could be mentioned which would be advisable to adopt in all cases. The author gives short descriptions of about twenty different processes, and although he has only given the barest outlines of some of these, the book will be of value to engineers and members of local boards and sanitary authorities, who are contemplating constructing works for the purification of their sewage, as it forms a valuable guide, which will aid them in selecting that process or processes which are most adapted for their special needs. It is unfortunate that many of the methods which have been brought before the public in recent years, whilst possessing in many cases undoubted merits, have had their virtues extolled in quack phraseology, and described by engineers and others interested in their promotion in language which is wanting in accurate chemical description, and we are afraid that the author himself, who appears to be well trained in the engineering parts of the sewage problem, has not made use of his chemical knowledge to eliminate the absurd chemical statements which have been brought forward by advocates of some of the processes described. Some men are so fond of making rash and sweeping generalisations, such as "it is difficult to find a more efficient, harmless, and economical manner of treating sewage" than that of bringing about "the defecation and deodorisation of the sewage by means of lime, tar, salts of magnesium, or *other chemicals*," which, when italicised (as we have done), are shown to mean nothing, but which, unfortunately, are flaunted about for the edification of the unscientific public as important, accurate, and reliable statements. We strongly object to such expressions as "the *grosser* part of the suspended matter," "the cheapest known form of alumina and iron," "the alumina ferric process," "ferozone," "polarite," ferozene (ferozone ?), "polarised oxygen,"&c., which we find in the accounts of several of the processes which the author attempts to describe. We admit that in most of these cases the author is not so much to blame as the inventors themselves, who describe their patents in such meaningless verbiage, but we think that it would have been far better if Mr. Hinnell had taken some little trouble in putting before his readers these processes in, we will not say scientific language, but in intelligible English, instead of leaving them in the dark as to the meaning of these ambiguous phrases.

The subject of sewage treatment undoubtedly presents many difficulties from a chemical point of view which have, no doubt, wisely deterred chemists from attempting explanations when such explanations would only be incomplete and unsatisfactory in the present state of our knowledge; but the average sanitary engineer rushes in where the chemist hesitates to tread, and gives out to the public what purports to be a full and complete account of the mysteries which have been left unsolved by wiser and more cautious men. Notwithstanding these faults, we commend the book to the consideration of those of our readers who are interested in the sewage problem, as the author's careful classification of districts and remarks on the various circumstances which have to be taken into consideration when determining what system of treatment and disposal is most advantageous for any particular town are worth their very careful perusal.

THE VALUATION OF GAS WORKS FOR ASSESSMENT. By T. Newbigging, M.I.C.E. London: WALTER KING. 1891.

Mr. Newbigging has such a complete mastery of the subject on which he writes, and is so well known as an expert on all matters related to the construction and valuation of gas works, that it is almost unnecessary for us to commend his new essay to those of our readers interested in this problem, either from the assessment committee or appellants' point of view. The author has done good service in pointing out those particulars which usually give rise to the greatest contentions between the parties concerned. We note that Mr. Newbigging contends that a quarter's rent may fairly be deducted from the assessment value of the undertaking, and as this amounts to one-fourth part of the gross estimated rental, a gain on this point is much to be desired by the gas companies. On the whole, we are convinced that Mr. Newbigging has been urged to state the case as impartially as possible, and no doubt the publication of his views on the matter will tend to smooth any difficulties which may arise in future disputes on this important question. Although the subject is primarily applicable only to gas works, many of the points raised can be urged with equal force for water works which are not under the control of the local authorities.

CHARLES' BRUSH HOLDER.

WE illustrate herewith in Figs. 1, 2, and 3 a very simple and effective form of dynamo brush holder designed by Mr. P. J. Charles, electrician to Messrs. Harland & Wolff, Belfast. By rotating the handle the holder is free to move on the pin of the rocking bar. The brush can thus be readily moved along the commutator to any desired position. A quarter turn of the handle fixes the split sleeve to the pin. The adjustment of the pressure of the brushes

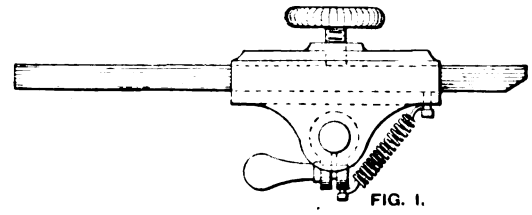


FIG. 1.

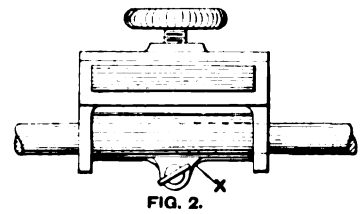


FIG. 2.

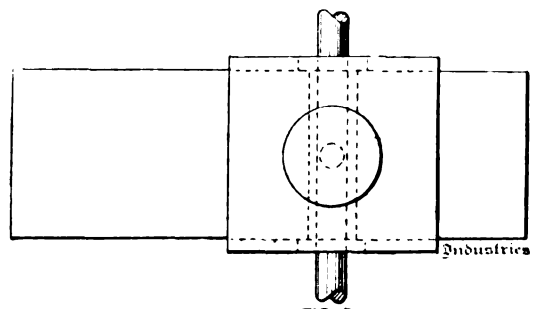


FIG. 3.

is effected by the same handle, and the arrangement has the advantage that the pressure is felt by the hand, so that the attendant knows exactly what pressure he is putting on—an important detail, too often overlooked. To take the brushes off, the handle is turned to slacken the sleeve; the sleeve is turned on the pin and made to grip in a new position. The whole arrangement is beautifully simple and very effective. We have tried this holder and found it admirable, and it is rapidly coming into use.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT a meeting of this Institution on the 21st ult., the discussion was continued on a paper entitled "Some Effects of Alternating Current Flow in Circuits having Capacity and Self-induction," by Dr. J. A. Fleming.

Major Cardew remarked that the condenser, on which the experiments mentioned in paragraph 12 of Dr. Fleming's paper were made, had been constructed from imperfect plates, and since then a good condenser, kindly lent by Dr. Muirhead, had been carefully tested for capacity by the alternate current method. The capacity so found was in this case also greater than the capacity given by the makers. The discrepancy, he thought, might be due to the fact that Dr. Muirhead determines his capacities by rapid charges and discharges, which, in consequence of absorption, would give a result too low, whereas in the alternate current method the absorption would have the effect of increasing the apparent capacity. Experiments had also been made by the voltmeter method, described by Professor Ayrton and Dr. Sumpner, and Mr. Swinburne, on the power spent in a one-microfarad condenser when subjected to alternating pressures of 650 volts. The power found was 5 watts, and after a long-continued run the condenser was not much heated.

Dr. Sumpner pointed out that many of the formulæ given by Dr. Fleming could not be used practically without considerable reservation as to the values to be substituted for R and L in the expressions. Since secondary circuits exist in all electrical apparatus in the shape of iron, copper, &c., not infinitely laminated, the changes in the so-called "constants" of the primary coil may be very important. The ordinary formula for the angle of lag between the e.m.f. and current in a coil is $\cos\theta = \frac{\text{Resistance}}{\text{Impedance}} = R\frac{A}{V}$, where A is the current and V the volts. The experiments given in Table I. (section 17) did not show whether any of the rise occurred in the dynamo as well as in the transformer. The same theory accounted for rises in both parts, but, as Mr. Swinburne had pointed out, the primary circuit of a transformer could not act like a coil with self-induction, unless there was some magnetic leakage. In the experiments made at the Central Institution it was found that, under certain conditions, about half the rise was due to the self-induction of the transformer, and the other half to the dynamo. The proportions differed, however, with the ratio of transformation.

Mr. Blakesley mentioned that he published an account of such a rise long before the Deptford station was commenced, and he was not at all surprised when he heard that such a rise occurred there.

Mr. A. Siemens, referring to the change of ratio of transformation, said that more recent experiments, using a different form of transformer, showed that the ratio of transformation was independent of the capacity.

Professor Ayrton inquired what was the difference in the two kinds of transformer used, and Mr. Siemens replied that one was an open-circuit and the other a closed-circuit transformer.

Mr. Swinburne directed attention to the practical points to be attended to in coupling alternators in parallel on mains having capacity. An important point he had recently observed was that, by employing a motor in conjunction with an alternator, the effect of fall of pressure could be neutralised, for weakening the fields of the motor caused it to act like a self-induction. By strengthening the fields of a motor it could be made to act like a capacity. Hence, even in transmitting power over long distances by alternate currents, an attendant at the receiving end could maintain the pressure at that end constant independent of the load by simply varying the strength of the fields of a motor working on the circuit.

Dr. Fleming, in his reply, thanked Dr. Sumpner for calling attention to the parts he had omitted from the paper, and said that some practical method of getting the inductance of a transformer at any load was greatly needed. He, Dr. Fleming, had hitherto failed to get a clear idea as to what Mr. Swinburne's views really were, but he thought that both the orthodox theory and the armature reaction view would be found wanting in some respects. A significant fact, however, was that with large machines of small inductance no rise was observed, whereas when small machines of comparatively large inductance were used the rise was great. Referring to Major Cardew's experiments on condensers, he thought that the observed effects might be due to leakage, for a leak would cause the capacity to appear greater when tested by alternating currents, and less when direct currents were employed. He could not agree with Mr. Evershed about the quantity Lp being of the nature of electromotive force, for, although it was not of the nature of resistance in the sense of being dissipative, yet its dimensions were those of resistance, and only those of

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e.m.f. when multiplied by current. On the subject of throwing machines in parallel, he pointed out that the procedure depended entirely on the nature of the machines and of the circuit, for the operations necessary to put the large Deptford machines in parallel on the mains were the reverse of those required when the small machines were used. Dr. Sumpner, he said, had greatly over-estimated the magnetising current of the Deptford transformers, for, instead of being 5 amperes, it was, he thought, only 4 amperes.

After this the discussion on "Some Points Connected with Mains for Electric Lighting," by Mr. W. H. Preece, F.R.S., and on "The Most Economical Mode of Feeding a Low-pressure Network," by Mr. R. E. Crompton, was continued.

Mr. Addenbrooke said that the object of Mr. Preece's paper was to point out the economy of the high-pressure principle, whilst that of Mr. Crompton's was to impugn that principle. On examining the question as to the cost of high-pressure mains, he found that to give a 10 per cent. loss in 2,400 yards of feeder supplying 100 kilowatts at 2,000 volts would require a $\frac{7}{14}$ cable, and this, of best Silvertown make, would cost about £165 per mile. This would give the cost of cable about £400 instead of £1,300, as stated in Table I. The cost of the culvert or pipe was taken the same for both the high and low pressure feeder. This, he thought, was unfair to the high-pressure system, and the cost of the transformers and apparatus was also too high. Altogether, the cost of the high-pressure feeder ought to be put at about half that of the low-pressure one under the conditions there stated. These conditions were, however, not practical ones, for no engineer dealing with the alternating transformer system would allow a drop of 10 per cent. in so short a feeder; 2½ per cent. would be much more reasonable. Taking this drop the cost of the cables would come to about £1,300, but the 7½ per cent. saving would mean an increased revenue of about £160 per annum.

Mr. R. C. Jackson described the method of laying underground concentric mains as carried out by the Newcastle-upon-Tyne Electric Supply Company, and exhibited samples of the work. The system, he said, was a draw-in and draw-out one, using cast-iron pipes and concentric cables for 2,000 volts pressure. The joints were made in junction boxes by bolting copper rings cast to thimbles, in which the ends of the cables were "sweated," to the top of porcelain insulators. The same points served also as connections for service lipes. The advantages claimed were:—Simplicity and small cost, a six-mile circuit to feed 12,000 lamps, with a variation of pressure never exceeding 6 per cent., having been laid at about £1,100 per mile.

Mr. Kapp said the case which Mr. Addenbrooke had made out for the A.T. system was not strong enough, for Mr. Crompton's calculations were vitiated by not taking the extra cost of plant into account. With a low-pressure feeder of 90 per cent. average efficiency, about 30 per cent. more boiler, engine, and dynamo power would be required, as well as 30 per cent. more wages, &c., than for a high-pressure system. Mr. Crompton would thus have to lay down 30 per cent. more plant and pay 30 per cent. more wages and interest for the privilege of using a low-pressure feeder.

Major-General Webber said Mr. Crompton wished them to believe that the A.T. people had now found that it would be necessary to use a low-pressure network such as used in direct-current distribution. This, he said, was by no means new, for Mr. Ferranti, as long ago as 1885, described a system like the one now mentioned by Mr. Crompton.

Sir W. Thomson inquired what ratio the energy sold had to that generated in the various systems of distribution. In his opinion, the comparison would be favourable to the low-pressure system wherever it was practicable. In dealing with large conductors, both Mr. Preece and Mr. Crompton seemed to have ignored the fact that the conductivity was less for alternating currents than for direct ones. Conductors of 2cm. diameter offered 8 per cent. more resistance when the frequency was 80, whilst for 3cm. diameter the increase was 31 per cent. On the whole, he thought it injudicious to rush to alternate currents for distribution purposes, and he himself rather inclined to continuous current distribution by feeders, as described by Edison.

Mr. A. Siemens thought the principal object to be aimed at in designing stations was *simplicity*, and the design for a particular district must be guided largely by local circumstances. In his opinion, the discussions on both Mr. Crompton's papers had converged too much on high and low pressure. Speaking of cables, he said that, in addition to the theoretical conditions referred to by Sir W. Thomson, practical and financial points had also to be kept in view. In making concentric cables for the London Electric Supply Corporation, they had found that putting in a jute core increased the diameter of the cable and added considerably to the cost. It was cheaper for them put in extra copper to make up the conductivity.

Mr. Swinburne said the "skin effect" could be minimised, even in large conductors, by making them, say, in six smaller cables stranded round an inactive centre.

Sir W. Thomson agreed that if each wire of such a cable had as much external surface as another wire the full conductance would be obtained, but this condition was not fulfilled in cables as ordinarily constructed, and in conductors 2cm. or 3cm. in diameter the conductivity for alternating currents is seriously diminished.

Mr. A. E. Mavor said that by soaking the separate wires in an insulating medium before stranding, considerable resistance could be got between the strands; a light serving of cotton did not seriously increase the diameter of the cable. In this way he thought Mr. Preece's square inch section could be obtained without much diminution in conductivity for alternating currents. He characterised Mr. Crompton's estimate of £1,300 for 2,400 yards of concentric cable as absurd, and he assured Mr. Preece that great attention was being given to the construction of mains. He was also of opinion that rubber would be superseded by cheaper dielectrics. On the subject of feeding a network he had no doubt but that high-pressure cables would be much cheaper than low-pressure ones.

Mr. Preece, in reply to Sir W. Thomson, said that in one alternate current system with which he was acquainted the coal burnt per unit sold was 17lb., whilst per unit generated it was 8lb. In Rome, however, these numbers were 10lb. and 8½lb. respectively. This satisfactory result he attributed to the system of "banking" the transformers. Sir W. Thomson, he remarked, had said a great deal in favour of low-pressure systems with numerous stations, but in so doing he had apparently overlooked the fact that working expenses were greatly increased by this duplication of stations.

Mr. Crompton, not being present, did not reply.

EXPERIMENTS WITH ALTERNATING CURRENTS OF HIGH FREQUENCY.*

The recent meeting of the American Institute of Electrical Engineers will long be remembered by those present, not only on account of the brilliant experiments shown in connection with a lecture given by Mr. Nikola Tesla, but also for the many possibilities which it suggested in the development of the artificial illumination of the future. For the purpose of his experiments, Mr. Tesla employed an alternating machine with 400 poles, which, when run at full speed, permitted him to obtain 20,000 alternations per second. The currents of this machine in all of Mr. Tesla's experiments were first run through a condenser in order to avoid the possibility of injury to the machine. The machine itself was set up in the electrical workshop of the college, and was driven by an electric motor, the speed of which could be varied by a switch on the lecture platform.

Mr. Tesla introduced his subject by the remark that modern science has been able to make rapid strides by the recognition of ether as the medium of transmission of vibrations of various forms which manifest themselves to our senses. We are therefore able now to see things in a different light than was formerly the case, and being tolerably well able to explain them, the truth cannot be hidden much longer. The answer to the question, "What is Electricity?" we were not yet prepared to give. We were justified in assuming, however, that electric phenomena are ether phenomena, and we may consider the phenomena of static electricity as phenomena of ether under strain, and those of dynamic electricity and electromagnetism as phenomena of ether in motion. The lecturer, while expressing the highest consideration for the work of Dr. Lodge, was not in entire accord with the views advanced by him, which he considered to be more of the nature of ingenious explanations than of a probable theory, the lecturer contending that there can be no two electricities. Alluding further to the electromagnetic theory of light, and to the Hertz experiments and those of Dr. Lodge, and their application to the production of an efficient source of light, the lecturer considered the electromagnetic waves as unavailable for the production of luminous effects, for the reason that long before we could reach the necessary frequency the conductor would become opaque to the passage of the waves. The lecturer thought that electromagnetic waves, unless they have the frequency of true light waves, cannot produce luminous effects. Not so, however, with the electrostatic waves or thrusts. These, no matter what their frequency, can excite luminous radiation. He reasoned that the static effects in the Hertz and Lodge experiments were excessively small, due to the fact that they were produced in a practically closed coil, the spark acting as a bridge, making the coil practically continuous and depressing the potential. To obtain the desired difference of potential we must work with an open circuit generator of high potential of high frequency to enhance the electrostatic effects, and it was the recognition of this fact which led the lecturer to the results he showed.

In carrying out this idea of obtaining enormous differences of potential, the lecturer at once encountered the difficulty of obtaining the requisite insulation for the induction coil employed by him. His experience demonstrated that what we consider the best insulators, such as glass and rubber, are inferior to others, not formerly so considered, such as oil and wax. The lecturer then started a spark coil in action, the primary of which was in connection with his alternator which was speeded to give from 10,000 to 11,000 alternations per second. The coil emitted a clear note, which rose as the number of alternations was increased. As the discharges took place between the terminals of the coil, an exhausted Geissler tube held in proximity to the discharge did not light, but upon blowing out the arc the tube lighted up, which was due to the rise of potential caused by the rupture of the arc. This effect the lecturer considered as purely electrostatic.

Mr. Tesla then showed the influence of insulated bodies having considerable size upon the spark length demonstrating the effect of capacity upon the nature of the discharge. Thus, when we attach an insulated body to the terminal of the coil, the potential may be raised or lowered. He showed this by wrapping an insulated wire of about one foot in length about one terminal of the coil, and touching the other terminal with a brass sphere held in the hand; under these conditions streams of light emanated from all sides of the wire. When the sphere was removed, however, the streams disappeared almost entirely. He then cut off the wire in successive lengths, and the stream discharges became more marked and brilliant. He then attached a fine platinum wire to the terminal, which also showed the streams to a remarkable degree, and kept up a continuous vibration to and fro. He also showed a pin-wheel effect, the wheel being rapidly rotated with streams issuing from the two points. Another experiment consisted in attaching two spheres of about 4in. diameter to the terminals. The spark passes first between the two points nearest to each other on the spheres, then works up toward their tops, is extinguished and is re-established at the first point, this being continuously repeated. The neighbouring exhausted tubes and lamps were illuminated and extinguished in unison with the action of the spark between the spheres. These, the lecturer pointed out, were not electromagnetic vibrations like the Hertz waves. He showed how by the use of the dielectric the spark is induced to jump between the separated spheres due to the increase in the specific inductive capacity of the medium, and he also demonstrated that the streaming discharge passed easily through thick glass plates, rubber plates, and a book. The lecturer then showed these static effects in a non-striking vacuum. A tube of this nature when connected to the machine glowed brightly, and the terminals became incandescent. The lecturer remarked that if, instead of using a filament in a lamp—which necessarily limited us in the degree of incandescence which we could practically employ—we could employ solid blocks of carbon, much higher efficiency could be obtained. Based upon this reasoning, he has constructed a lamp which he showed, containing two blocks of carbon in non-striking vacuum. When connecting these two carbons to the two terminals of the coil or one to one terminal and the other to a body of some size, the blocks can be raised to high incandescence.

(To be continued.)

* Abstract of a recent paper read by Mr. Nikola Tesla before the American Institute of Electrical Engineers. For the above abstract we are indebted to our American contemporary the *Electrical Engineer*.

THE PHYSICAL SOCIETY.

At a meeting of this Society on the 22nd ult., Professor W. E. Ayrton, F.R.S., being in the chair, Mr. C. J. Woodward exhibited Dr. Schobben's form of lantern stereoscope. This instrument consists of a double lantern by which the two pictures of a stereoscopic slide are projected on a screen. The two pictures are coloured complementary tints by placing pieces of red and green glass in front of the lenses, and each observer views the overlapping images through spectacles, the eyeglasses of which are also coloured red and green. The stereoscopic effect is very striking. Mr. Boys stated that he had tried to obtain a similar result with the aid of polarised light, by viewing two polarised images through Nicol's prisms. No effect was obtained, owing to elliptic polarisation produced by the screen, but he thought that if a dead gold screen had been used, instead of an ordinary one, the effect might have been obtained.

Professor Perry, F.R.S., then showed a new form of steam engine indicator, which we described and illustrated in our issue of last week. In reply to Mr. Carus Wilson, Professor Perry stated that the deflection of the disc was proportional to the pressure in the cylinder within the limits any particular disc was intended for.

Mr. Addenbrooke thought the instrument an important improvement on its predecessors, and considered it would prove of great service to electrical engineers. Mr. Swinburne said a peculiar merit of the indicator was that it could be permanently attached to an engine like an ordinary pressure gauge. He suggested the use of a small telescope instead of the ray method. The President thought that the instrument could be modified so as to be useful for analysing the shape of the curves representing alternating currents.

After this a paper was read on "Blakesley's Method of Measuring Power in Transformers," by Professor Perry. This paper referred to the supposed error in Mr. Blakesley's formula due to the fact that transformers show magnetic leakage. The proofs of the formula hitherto given have been obtained by treating the equations in the manner first adopted by Dr. Hopkinson. On this system the reactions of the primary and secondary currents are represented by the equations—

$$V = R_1 C_1 + P \frac{dN}{dt} \qquad O = R_2 C_2 + S \frac{dN}{dt},$$

where P and N are respectively the turns on the primary and secondary coils, and N is the magnetic flux between the coils. Here it is assumed that there is no magnetic leakage, and the author thinks that on this account the method is inferior to the original method of Maxwell, in which the induced electromotive forces are

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expressed in terms of coefficients of self and mutual induction. On the assumption that there are no eddy currents Maxwell's equations are—

$$V = R_1 C_1 + L_1 \dot{C}_1 + M \dot{C}_2; \; O = R_2 C_2 + M \dot{C}_1 + L_2 \dot{C}_2,$$

in which, although L_1, M, and L_2 may not be constant, it may be assumed that they are respectively proportional to P^2, PS, and S^2 if there is no magnetic leakage, and if the amount of magnetic leakage bears a constant proportion to the whole flux the three quantities may still be assumed proportional to each other, although M^2 is less than $L_1 L_2$. From these equations we obtain

$$VC = R_1 C_1^2 - R_2 \frac{M}{L_2} C_1 C_2 + \frac{L_1 L_2 - M^2}{L_2} C_1 \dot{C}_1.$$

Hopkinson puts down the last term as zero, but owing to the very rapid rate at which C_1 changes, the last term is very important, even though M may be but a small percentage less than $\sqrt{L_1 L_2}$. On integrating this equation, the first two terms on the right-hand side yield Blakesley's formula, and the last term vanishes in the integral, because, however great the magnetic leakage may be,

$$\int C_1 \dot{C}_1 \, dt = 0$$

when taking over a period, because the functions are periodic. Mr. Blakesley's formula thus appears to hold whatever the magnetic leakage. The paper contains several tables of calculations showing the effect of magnetic leakage on the value of the terms in the equation.

Mr. Blakesley said he doubted the correctness of the assumption that the value of M was the same in the two equations, and thought that the result arrived at must be incorrect.

Dr. Sumpner did not doubt that, if the coefficients could be considered constant, the formula was true, whatever the leakage, but he did not consider that the action of transformers justified such an assumption. If the formula were true, it would also hold if there were eddy currents, as these would merely produce the effect of additional secondary coils. He had analysed Blakesley's method by using a modification of the Hopkinson equations, and had shown that the power, as estimated by Blakesley's formula, had to be lessened by the fraction represented by the expression,

$$X = \frac{\int x \dot{A}_p \int A_s dt \, dt}{e + \int A_p A_s dt}.$$

Where A_p and A_s are the instantaneous values of the primary and secondary currents, and x is such that $N_p = N_s(1 + x)$, where N_p and N_s are the fluxes of magnetism through the primary and secondary coils at the same instant, e is a negligibly small quantity compared with the rest of the denominator. In obtaining this factor no assumptions whatever had been made, and it was easy to see that if A_p and A_s could be assumed sine functions and x a constant, the value of the factor X became x simply. In only one case did X reduce to zero, and that was when x was a sine function of the same period as A_p and A_s. He believed that in actual transformers x was approximately constant.

Mr. Swinburne pointed out that the split dynamometer was merely a wattmeter, and stated that he had transformers which, owing to magnetic leakage, would indicate an efficiency of over 100 per cent. if tested by Blakesley's method. If this method gives an efficiency of 96 per cent., and leakage causes a drop of 2 per cent. in e.m.f., the real efficiency is only about 94 per cent. He thought that the assumption that the currents followed a sine law was equivalent to supposing that there was no loss in hysteresis.

The President said that no one would be more glad than himself to find that Mr. Blakesley's method was accurate, but he could not agree with Professor Perry that Dr. Hopkinson was wrong in abandoning the academical method of Maxwell.

Professor Perry replied to the various points raised in the discussion.

A paper on "Current and Potential Difference Analogies in the Methods of Measuring Power," by Professor W. E. Ayrton and Dr. Sumpner, was postponed.

NOTES ON OILS.

III.

The close of the financial year for the Scotch mineral oil companies has not shown that satisfactory increase in profits which might have been expected from the yearly turnover. Only four companies—the Pumpherston, Oakbank, Broxburn, and Young's—have declared any dividend. This general failure to make the past year profitable may be in part due to increased competition from outside, but the rapid rise in wages and cost of fuel, with the disorganisation of trade caused by the several great strikes, are probably chiefly answerable for this result.

During April extensive trials were made at the works of the Metal Reduction Syndicate, Patricroft, Manchester, with an apparatus for the use of petroleum as fuel, under the direction of Mr. W. E. Smith. The plant employed has been extensively used in Russia, but is new in this country. It consists of a tank for the storage of the fuel, placed above the boiler to be heated. The oil descends by gravitation to the burners, to which is connected a steam pipe from the boiler. Each burner consists of a spray injector with perforated shield, and the oil is injected by steam in such a way that it is "sandwiched" between the steam and a current of air passing through the central channel. The flame is thrown out very prominently, in order to save the burners as much as possible. The evaporation from Russian petroleum refuse equals 16lb. of water per 1lb. of fuel consumed, so that the comparison between coal and liquid fuel required is as 2·5 to 1, whilst in well-set boilers the ratio may reach 3 to 1. The new fuel has the advantage of being absolutely smokeless.

In Mr. Redwood's recent paper, on "The Conversion of the Nitrogen of the Acid Sludge of Oil Works into Ammonia," it was pointed out that the Scotch oil works make about 37,000 tons of sludge per annum, and that it would be possible to obtain therefrom 6,100 tons of ammonium sulphate, worth £68,000, as against the relatively small sum at present obtainable for this refuse as fuel. The author's process, which has not yet been fully worked out, consists in heating the neutralised sludge in an iron retort connected with two "contact" chambers filled with broken brick, where the tar which distils over is acted on by superheated steam. The oily bases are decomposed with the liberation of nitrogen in the form of ammonia. The gases evolved are swept into a gasometer to be used subsequently as fuel for the retorts, whilst the ammoniacal liquor is separated from the neutral tar and run off. Mr. Redwood states that average acid sludge contains 3·498 per cent. nitrogen, whilst 62 per cent. nitrogen is obtained as ammonium sulphate, or only 17·8 per cent. of the total nitrogen. Of the remainder, 63·5 per cent. appears in the gases, the difference being found partly in the neutral tar, and partly in the residues from the retorts. The gas obtained will supply half the required fuel.

A recent report of the British Consul at Batoum, on the Russian petroleum industry, shows the existence of a similar state of things to that prevailing in the Scotch trade. Although there has been an increase of 26 per cent. in output, and of 37 per cent. in value, since 1888, yet business is less satisfactory on the score of profits. One of the best established and organised firms has liquidated, whilst a syndicate has been formed to consolidate several other firms against the increased competition. The inadequate means of transport, currency fluctuations, and the extraordinary unhealthiness of the past year at Batoum, are mentioned in the report as causes for the unsatisfactory result of the year's trading. The output has, however, been considerably increased, and there is no falling off in the consumption.

The patent of the Alboline Oil and Varnish Company for the chemical treatment of linseed and other drying oils, so as to increase their drying properties, is favourably mentioned by a foreign contemporary. The oils are floated on a deep layer of oxygenated water at temperatures varying from 32° C. to 99° C. for several days. A saturated solution of chlorate of potash, manganese oxide, or chromic acid, very gently warmed, may be substituted for the above, but the treatment must be prolonged. The oil treated thus is said to dry well without cracking, and to make excellent varnish. It is decolourised by the process, and its tenuity, tenacity, and elasticity are not diminished.

An interesting paper upon "Turkey Red Oil" has been recently read before the Académie des Sciences by M. Scheurer-Kestner.* After mentioning its usual mode of preparation—namely, by the action of monohydrated sulphuric acid upon castor oil—the author touches on the conflicting views as to the nature of some of its constituents. Some chemists believe it to contain glycerine, whilst others deny that this is an integral constituent. All, however, agree in regarding it as composed principally of a sulphonated fatty acid. Although other oils are often substituted for castor oil in the manufacture, his own researches have been made exclusively upon a Turkey red oil obtained from castor oil by the action of $H_2SO_4.H_2O$. The product thus obtained is of a complicated nature, but consists, for the most part, of sulphoricinoleic acid in which, as Benédikt and Ulzer have shown, the sulphonic group has a different position to that which it is represented to have according to Müller Jacob's hypothesis. Besides this, Turkey red oil still contains undecomposed (unsulphonated) fatty acids, as is proved by their undergoing decomposition or transformation into the sulphonated compounds, as some sulphuric acid is left in the prepared oil, its amount varying with the extent and nature of the washing. The presence of these fatty acids has been surmised by chemists engaged in investigating this product, but who have not arrived at its exact nature or mode of formation. M. Guillard has recently recognised that the acids contain bodies polymerised by the sulphuric acid. According to him, Turkey red oil is composed of sulphoricinoleic acid together with various polymers of ricinoleic acid up to penta ricinoleic acid. These conclusions were published after M. Scheurer-Kestner had occupied himself with the problem for a year. Certain of the latter's results agree with M. Guillard's, but he does not find such highly polymerised ricinoleic acids as that chemist. He attributes this to M. Guillard employing common salt to separate the sulphonate from the washing water. This, with the sulphuric acid present, is liable to form free hydrochloric acid, whose polymerising power M. Guillard has recognised. M. Kestner substitutes sodium sulphate with advantage, and employs no heat in the washings, which decomposes the products more or less. He regards Turkey red oil as containing sulphoricinoleic acid with mono- and di-ricinoleic acids. Raoult's method was used for the determination of the molecular weights, with acetic acid as a solvent. The sulphonate is hydrated, and in this state it is stable at the ordinary temperature, but at 120° C. it loses its water, completely forming insoluble fatty acids and mono-hydrated sulphuric acid. He has observed an important fact in connection with the use of the oil in alizarin dyeing—namely, that the sulphonate gives various tints of yellow, whilst the polymers give carmine tints.

A contemporary draws attention to the possibility of the Chinese "wood oil" being imported to the European markets, as, owing to its unique properties, there are many industries in which its use would be found advantageous. This oil is obtained from the seeds of the Tung tree, or *Allurites cordata*, and with modern oil expressing machinery can be cheaply prepared in large quantities. Although its chemical nature has been investigated by Cloez, its constitution is at present unknown. In China and Japan it is used for caulking and painting the native junks, preserving woodwork, and for varnishing, and as it resists the action of water and exposure to a hot sun, as well as being impervious to the attacks of insects, there can be no doubt that it would be of considerable industrial utility.

* *Comptes-Rendus*, "Revue de Chimie Industrielle," II., 14, page 45.

SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

At a meeting of this Section on the 1st inst., the first paper read was entitled "Gum Arabic and its Modern Substitutes," by Dr. S. Rideal, of St. George's Hospital, and Mr. W. E. Youle, and in it the authors, after describing the natural gums which had been introduced into the London market of recent years owing to the closing of the Soudan to commerce, gave an account of their more important physical properties, and the methods by which their relative value to gum arabic may be ascertained. The authors then discussed at some length the various gum substitutes, consisting of dextrin, fish glue, and various patented mixtures which had been introduced as substitutes for the natural gums. One of the most important methods for arriving at an opinion as to the commercial value of a gum or gum substitute is based upon a determination of the viscosity of its solution, and the authors have carried out a series of experiments with a view of ascertaining the most suitable way of making this test, and how far the different commercial bodies differ in their viscosity values. They described a form of apparatus, which is not open to the objections which may be urged against the common method of ascertaining the viscosity, by noting the time of flow out of a burette, and gave a table of results which they had obtained in this way expressed in absolute units. They showed that these results were similar to those obtained by Poiseuille and others for water and other liquids by careful experiments in a physical laboratory. It was important in commercial work to use, if possible, methods which gave results which could be reproduced at any time, and which did not depend upon the instruments employed. The authors also show that the ghatti gums, which have hitherto, owing to their partial insolubility in water, found little favour for many classes of work, have properties which render them available if due attention be paid to the conditions required for their successful use. The authors have studied the proneness of the different gums to undergo fermentation, their relative hygroscopic characters, and their more important chemical differences. The gum substitutes, which for the most part consist of dextrin, starch, sugar, and foreign

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substances, are often of very low viscosity, and have an unpleasant taste and smell, which render them of much less value for mucilages and adhesive purposes, but considerable improvements have recently been made in their manufacture, so that now the better class of gum substitutes compete favourably with the natural gums.

A short discussion ensued, in which Mr. Blount criticised the authors' method for ascertaining the viscosities, and Mr. Christie drew attention to a German soluble gum made by a secret process from the natural insoluble gums.

Afterwards Mr. Joseph W. Lovibond gave an abstract of a long paper "On the Quantitative Analysis of Light and Colour founded on the Tintometer Colour Scales," in which he described his recent work with the tintometer. We have already (see *Industries*, Vol. VIII., page 44) given a short description of this instrument, and the valuable work, both commercial and scientific, that can be done by its use. The author in the present paper states that many of the difficulties which were first met with in preparing the standard glasses have now been overcome, and he is confident that his method is one which places the determination of the colour of bodies on a true scientific basis. In the paper, which was fully illustrated by diagrams and models, the author showed how the instrument may be used for ascertaining the colour of the blood, chlorophyll, and allied bodies, and states that he has always been able to express a given colour by numerical value which was capable of being reproduced at any future time. The latter part of the paper was devoted to a discussion on the theory of colour, and the light which the work of the tintometer had thrown upon this complex subject.

In the discussion which followed, Mr. Newlands testified to the value of the instrument over other forms of colorimeters for gauging the colour of caramels and sugars, whilst other speakers argued that a basis of colour classification upon spectroscopic work was more likely to be of permanent value than that based upon the arbitrary glass colour standards adopted by the author. Several of the speakers bore testimony to the great utility of the instrument for estimating minute differences of tint, shade, and fading, which made it indispensable for many different classes of manufacturers.

Notes.

TWO NEW FORMS OF SULPHUR.

Two novel modifications of this most Protean element have been recently discovered by Engel. The first, like that proved to exist in Wackenröder's solution, is soluble in water and very unstable. The other is crystalline, soluble in carbon disulphide and chloroform, and polymerises slowly in the cold, and quickly at a temperature of 100° C., but unlike prismatic sulphur, which changes on keeping into the octahedral variety, it becomes converted into the white insoluble form which commonly constitutes so large a percentage of the material known as "flowers of sulphur."

THE JAPANESE NAVY.

The Japanese coast defence vessel "Hashidate" was launched at the Imperial Dockyard at the end of March. The first attempt to construct a large vessel of steel with high speed was in a despatch vessel modelled after the French ship "Milan." On her trial trip last year this vessel, on a three hours' run under forced draught, made a mean speed of 20·75 knots, and attained as a maximum 21·5 knots. In the construction of steel vessels the material used is purchased in Europe, largely in France, with machinery principally from this country. The "Hashidate" and sister ships are of the following dimensions:—Length, 295ft. 2in.; beam, 50ft. 6in.; draught, 21ft. 2in.; aft displacement, 4,300 tons. There are numerous water-tight compartments, &c., and, though called coast defence vessels, there is no protection save the protective deck and coal bunkers.

MISDIRECTED ENERGY IN ELECTRICAL ENGINEERING.

One of the most pertinent remarks in Mr. Preece's recent paper on Mains, was that "It is a pity that some of that redundant mental energy which is endeavouring to raise the efficiency of dynamos and transformers from 94 per cent. to 95 per cent. could not be transferred to the question of mains." There is a curious fascination which leads people to try and make a very good thing still better, and leave a very bad thing alone. This is very noticeable in connection with central station work. If a dynamo gave 1 per cent. lower efficiency than some other, it would be rejected at once, even though mechanically stronger and more likely to be durable; but comparatively little care is devoted to the selection of the boilers and engines. It seems as if very few people could grasp the real significance of a percentage. The differences between the evaporative efficiency of boilers are enormous in comparison with the differences of dynamos. The difference of one pound of water per pound of coal in a station swamps all the differences of full-load efficiencies in the electrical apparatus, yet only one or two engineers go into these matters carefully. It all points to the conclusion that the successful stations will be those designed by engineers, in a broad sense, rather than by electricians, in a narrow sense.

ENGLISH AND AMERICAN MARINE ENGINES.

"Charles W. Wetmore," "E. D. Bartlett," and "A. D. Thompson" are the names, states the *Marine Review*, of Cleveland, that will be given to the three steam barges now on the stocks at the yard of the American Steel Barge Company at Duluth, Minn. Triple-expansion engines, built by the North-Eastern Marine Engineering Company, of Sunderland, and now at the yard at Duluth, will be placed in the "Bartlett," and their efficiency will be compared with that of engines built by Messrs. Hodge, of Detroit, Mich. The cylinders of the Hodge engines are 18in., 30in., and 48in., by 36in. stroke, while the English engines are 17½in., 28in., and 47in., by 33in. stroke. The experiment will, no doubt, attract some attention, but the Detroit builders express no fear regarding the results of the comparison. The cost of the English-built machinery is not definitely known, but it is understood to be slightly under the prices that have ruled on the American lakes.

NEW ALKALI PROCESS.

A process for the manufacture of soda and chlorine presenting some novel features has recently been patented in France by M. Reynaud. Common salt and sulphide of iron are heated together in a stream of air. Sodium sulphate, ferric oxide, and chlorine are produced, the last named being led away and utilised. The solid residue is heated with coal or other form of carbon in a reducing flame, the following reaction occurring:—

$$3Na_2SO_4 + 2Fe_2O_3 + 16C = Fe_4Na_6S_3 + 2CO_2 + 14CO.$$

The product is treated with a mixture of moist air and carbonic acid, giving

$$Fe_4Na_6S_3 + 2CO_2 + O_2 = Fe_4Na_2S_3 + 2Na_2CO_3.$$

The mass is lixiviated, the sodium carbonate removed and recovered by evaporation, while the double sulphide serves to begin the cycle of operations once more, thus

$$Fe_4Na_2S_3 + 4NaCl + 18O = 3Na_2SO_4 + 2Fe_2O_3 + 2Cl_2.$$

FRENCH COMMERCE.

The following figures, taken from the statistics just published by the Customs Administration, give a comparative view of the value of the imports and exports during the first four months of last year and this:—

	1891.	1890.
Imports—		
Alimentary produce	£19,319,880	£18,195,440
Materials used in manufactures	36,987,440	31,241,480
Manufactured articles	8,305,200	7,742,880
Other goods	1,663,360	1,551,920
Totals	£66,275,880	£58,731,720
Exports—		
Alimentary produce	£9,348,120	£10,425,720
Materials used in manufactures	9,329,520	9,317,120
Manufactured articles	24,745,400	25,351,480
Other goods	2,871,400	2,721,200
Totals	£46,294,440	£47,815,520

SIMPLICITY IN ELECTRICAL DISTRIBUTION.

Sir W. Thomson's strong adherence to low-pressure direct supply, even for large towns, is a matter of no small importance. His whole argument is that direct supply is simple and cheap, while high-pressure feeder systems are complicated and expensive. Curiously enough, before Sir William put forward his views at the Institution of Electrical Engineers, Mr. Kapp urged the superiority of the high-pressure feeder system on practically the same grounds. The direct-supply system sounds simple, but is not simple in fact. Putting buried transformers at the points of junction of the feeder and networks does not really increase the complication of a central station, but the direct-current feeder arrangement is only simple outside the station; it involves what physicians call "serious internal complications." In calculating the size by Sir W. Thomson's law, the current densities come out very high, and the full-load drop is also very great, and varies very much with the distance. The result is that parallel running at the stations, and the battery arrangements become enormously troublesome. Moreover, a large town needs several stations, which is a further serious drawback.

WATER GAUGE GLASSES FOR BOILERS.

The fracture of a gauge glass is always an awkward accident, and many devices have been made for automatically cutting off communication with the interior of the boiler when it occurs. But prevention is proverbially better than cure, and a new cause for the failure that happens from time to time has been noted, and means for avoiding it indicated. It has been observed that the upper end of a gauge glass, where it enters the steam-space in the boiler, is sometimes attacked above the packing—being either worn into ridges and grooves, or reduced uniformly in thickness until it is a mere shadow of its former self. No particular harm results from this corrosion when the diameter of the gauge glass is small, but if about ⅜in., fracture is very common when the attack has extended to about half the thickness of the walls of the tube. The lower end of the gauge glass, where it is immersed in water, is not attacked, a circumstance that would lead to the supposition that the steam had some specific action, were it not that at the upper end the glass is attacked only on the outer surface. It is difficult to see why this selective action should take place. The practical solution arrived at, however, consists in allowing the upper end of the gauge glass to project from the packing as little as possible.

GREAT INCREASE IN THE WHEAT TRADE OF BOMBAY.

The Bombay papers record an extraordinary export of wheat from that port during the past few weeks. The *Times of India* says that every warehouse near the docks and every available piece of open ground were occupied by towering tiers of bags filled with grain, awaiting the arrival of ships to take it away to other ports, where abnormal prices have been paid for it. In 1874 the total shipments of wheat from Bombay were 33,071 tons, while in 1886 the figures went up to 617,834 tons, this being the largest total shipped up to the present year. But never since 1874, the year when the wheat trade practically began, have the receipts of wheat in Bombay been so large, or nearly so large, as in the first four months of the current year. They reached during that period the enormous total of 198,097 tons, as compared with 97,420 in the corresponding four months of the previous year, and 178,686 in the same period of 1886. Steamers representing a total carrying capacity of between 350,000 and 400,000 tons were expected to load in Bombay during May; and, in spite of this large carrying accommodation, it will be no easy matter to get the bags, or, at least, those that are not under cover, shipped before the rains. The receipts continue to be so great that as fast as the ground is cleared of one consignment it is occupied by another. The real cause of this unprecedented traffic is the damage sustained by the French wheat crop, which is likely to be about 25 per cent. under the average. The traffic over the different railway systems terminating in Bombay has been gigantic during the past few months. As recently as 1876 wheat was rotting in the Central Provinces, which is now regarded as the granary of India, on account of want of transport; but owing to the railway extensions carried out since that time—the through route to Calcutta being one of the most important—the number of growers has increased materially, and it is now worth their while to produce grain extensively. The lines have been overcrowded with grain, the receipts in Bombay being so vast that the greatest difficulty is experienced in finding warehouse accommodation for the hundreds of tons which are daily brought in from up country. Indeed, the competition for accommodation is so great that the rentals have gone up to more than 100 per cent. beyond the ordinary charges. The price of labour and cost of carting have also increased.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

19th May, 1891.

8500. Roper & Roper ..... Dies for making bricks.
8501. Jones, G. P. ..... Locking attachment for surface boxes.
8506. Stibbe, G. ..... Knitting machines (*Dubied*).
8509. Dutton, E. K. ..... Differential gearing (*Wattles*).
8514. Harding, H. J. ..... The construction of boats and vessels.
8517. Heys, W. E. ..... Automatic time stamps (*Giroud*).
8519. Oakley, W. ..... Middlings purifiers.
8528. Rylands, D. ..... Furnaces for glass melting.
8537. Stern, Horsfall, & Bickham ..... Wire-heald machinery.
8539. Smith, C. H. ..... Rotary sewing machines.
8543. Newton, H. E. ..... Printing machinery (*R. Hoe & Co.*).
8547. Beck, W. H. ..... Production of compressed air and its application (*Morean*).
8569. Meister, E. J. ..... The propulsion of steamships.
8571. Hunt, M. R. ..... Bosh jackets for blast furnaces.
8577. Elliott, G. R. ..... Rifled ordnance and projectiles.
8578. Lake, H. H. ..... Steam boilers (*Tonns, Hall, & Allen*).
8585. Lake, H. H. ..... Vacuum pumps (*Berrenberg & Nickerson*).
8586. Lake, H. H. ..... Self-threading shuttles (*Mason*).

20th May, 1891.

8590. Lindner, E. ..... Turning lathes and chucks.
8591. Thompson, W. P. ..... Delinting cotton seed and grading the lint (*The Knerr O'Brien Cotton Seed Cleaning and Linting Company, Ld.*).
8593. Haynes & Wilcock ..... Bobbins or pirns for yarn.
8597. Haigh, N. N. ..... Wood-sawing machines.
8600. Bradshaw, A. ..... Back pressure valves.
8606. Justice, P. M. ..... Liquid meters (*The Thompson Meter Company*).
8607. Cuttriss, T. ..... Gas engines.
8614. Loosemore, R. F. ..... Motors for driving sewing and like machines.
8617. Chadwick, J. J. ..... Taking-up motion for looms.
8621. Soulby, W. H. ..... Rotary steam engine.
8624. Coppard, J. ..... Machines for mincing meat.
8629. Spencer, W. H. ..... Apparatus for vaporising oils.
8638. Petersen, E. ..... Apparatus for producing draught in steam boilers.
8645. De Michele, V. D. ..... Cranks and discs to obviate dead centres.
8646. Brydone & Chattaway Railway station indicator.
8648. Bazin, E. ..... Producing electric light and cold.
8651. McGlasson, R. ..... Steam boilers and engines.
8652. Nichols & March ..... Gas locomotives.
8654. Horn, W. W. ..... Trueing locomotive wheels (*Elder*).
8657. The Patent Stamped Steel Railway Axle Box Company, Ld., & Donnelly ..... Machinery for the manufacture of axle boxes.

21st May, 1891.

8669. Sheppard & Rispin ..... Couplers for railway carriages.
8670. Sykes, W. R., Sen. ..... Railway signalling apparatus.
8685. Newton, A. V. ..... The construction of ships (*Grimm*).
8687. Vautin, C. T. J. ..... Amalgamator.
8688. Vautin, C. T. J. ..... Extracting gold from ores.
8693. Rinne, H. ..... Flue boilers.
8695. Breyer, J. ..... Safety apparatus for hoists.
8699. Dähne, J. F. G. C. ..... "Trollies" or "bogeys."
8705. Donnelly, J. ..... Gas welding appliances.
8706. Donnelly, J. ..... Buffer guides for railway vehicles.
8707. Capell, G. M. ..... Exhaust and blast fans.

22nd May, 1891.

8711. Doran & Stack ..... Ship elevator.
8728. South & Bursch ..... Car coupling
8731. Mewburn, J. C. ..... Apparatus for moistening air (*See*).
8734. Davies & Fuge ..... Fluid pressure engines.
8737. Williams, R. H. ..... Ploughs.

23rd May, 1891.

8766. Briscoe, J. ..... Single-cylinder compound steam engine.
8769. Clark & Clark ..... Process for the production of armour plates.
8782. Littlewood, M. ..... Bearings for the axles of trollies, trucks, and railway and tramway vehicles.
8785. Meikle, W. ..... Exhaust blast contrivance for steam boilers.
8788. Coombs, E. T. ..... Harrows.
8794. Herbert & Smith ..... Bending or curving metal strips.
8801. Tangyes, Ld., & Williams ..... Locking the screw nuts of screw bolts.
8809. Mirrlees, W. J. ..... Evaporating and distilling apparatus (*Yaryan*).

ELECTRICITY.

19th May, 1891.

8499. Crompton, R. E. B. ..... Apparatus for controlling currents.
8540. Moore & Warren ..... Conductors for railways.
8555. Thompson, W. P. ..... Insulated conductors (*Williams*).
8575. Tesla, N. ..... Methods of and apparatus for generating and utilising electric energy for lighting purposes.

20th May, 1891.

8609. Smith, T. ..... Leads for conductors.

21st May, 1891.

8659. Rowan, A. H. ..... Electric tramroads.
8664. Sigmund, C. ..... Storage cable.
8680. Cox, Robinson, & Gritton ..... Electric lighting of ships' signal lamps.

22nd May, 1891.

8735. Berdoe & Shum ..... Storage batteries.

23rd May, 1891

8784. Evershed & Richards ... Telegraphic signals.
8798. Hanusse & Borrel ..... Signalling apparatus.
8806. Gravier, A. I. ..... Dynamo machines.
8808. Green, W. J. ..... Batteries.
8811. Mengarini, G. ..... Meters.
8812. Hoster, A. ..... Casing for electric wires.

CHEMISTRY.

19th May, 1891.

8510. Pennington, H. ..... Process of manufacturing lead sulphate from metallic lead.
8530. Hedley, G. H. ..... The manufacture of sulphate of soda, hydrochloric acid, and red oxide of iron.
8573. Johnson, J. Y. ..... Hydrocarbon products for insulating purposes (*Weir*).
8574. Vogt, A. ..... Manufacture of carbonate of soda and carbonate of potash.
8584. Riedel, L. F. ..... Manufacture of an iodine derivative of phenacetin.

20th May, 1891.

8641. Chambaud, G. ..... Agglomeration of lignite.

21st May, 1891.

8692. Lyte, F. M. ..... The production of caustic alkalies and other products.
8697. Lobet, L. ..... Carburetting apparatus.
8702. Willcox, B. ..... The production of colouring matters from anthraquinone and alizarine blue (*Farbenfabriken vormals Fried. Bayer & Co.*).

MISCELLANEOUS.

19th May, 1891.

8513. Turnovsky, C. ..... Grate bars.
8529. Bateman, D. C. ..... Hardening and tempering steel wire.
8563. Wagener, V. ..... Safety lamps.
8564. Simpson & The Ixion Company, Ld. ..... Ball bearings.
8565. Andrews, T. L. ..... Locking nuts on bolts.
8583. Hall, R. F. ..... Driving chain.

20th May, 1891.

8608. Fox, C. J. ..... Launching ships' boats.
8611. Hosack, H. H. ..... Ships' boats disengaging gear.

21st May, 1891.

8681. Thompson, W. P. ..... Placing detonating signals on railways (*Elcoate*).
8690. Woakes, E. R. ..... Jointing thin metal pipes.
8698. Lane, H. ..... Indicators for railway carriages.

22nd May, 1891.

8708. Cooper & Wigzell ..... A collision averter or self-projecting sea drag.
8721. Hyde, C. ..... Driving bands for spinning machine spindles.
8736. Defries & Fenny ..... Lamps.
8739. Everson, C. R. ..... Metal roof.
8746. Gougy, F. E. ..... Non-conducting means for steam boilers.

23rd May, 1891.

8771. Read, J. C. C. ..... Air spreaders for argand burners.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

2707. Whipple.
7702. Schon.
7838. Drakin.
8056. Simpson.
8108. Sang.
8675. Oldershaw & Lakin.
8734. Turner.
9404. Mills.
9472. Hardingham (*Felten & Guilleaume*).
9597. Bower.
9651. Lok & Gumhart.
9708. Davies.
9802. Baker.
10187. Thompson (*Stanley & Shallenberger*).
10232. Harding.
10295. Curson.
10297. Abbey.
10363. Hitching.
10432. Lutter, Scholvien, & Riedel.
10448. Brooke, Simpson, & Spiller, Ld., & Green.
10449. Hutton.
10668. Jenner.
10707. Simpson.
10802. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
10830. Yates (*Boll*).
10872. Thompson (*Yates & Learned*).
10953. Cuffe.
10991. Buckley.
11033. Bennett.
11063. Lake (*The Typewriting Machine Company*).
11136. Martin.
11137. Barrett.
11144. Merrill.
11153. Royle.
11161. Gosnell.
11189. Lake (*Kalle & Co.*).
11190. Herbst.
11197. Whitton.
11199. Coombe.
11212. Hollis.
11223. Miles.
11228. Reason.
11226. Craddock.
11245. McDougall.
11261. Hudson.
11265. J. H. Hopkins & Sons, Ld., & Willis.
11284. Chorlton & Scott.
11293. Thornton.
11296. Haddock & Leith.
11299. Rice.
11347. Whittaker, Whittaker, & Whittaker.
11348. Howat.
11351. Rylands.
11368. Guest & Barrow.
11379. Sheard & Harrison.
11394. Bell, Stravenson, & Clough.
11398. Tully & Corbett.
11399. Cator.
11408. Murgatroyd.
11415. Firth, Knowles, Halstead, & Robertshaw.
11421. Stokes.
11422. Turnbull.
11461. Edwards (*Schulze*).
11469. Fleuss.
11471. Brown.
11476. Mattioli.
11493. Meire.
11512. McGlashan.
11522. Bayly (*Adams*).
11524. Bayly (*Hague & Bolles*).
11529. Chapman & Vickess.
11534. Webster, Gould, & Gould.
11541. Müller.
11559. Robert.
11607. Aytoun.
11619. Allen.
11631. Guhrauer.
11651. Rylands & Husselbee.
11755. Richardson & Norris.
11757. Laing.
11780. Maynard.
11900. Lempriere.
12085. Lee.
12088. Lamplugh.
12184. Turnbull.
12201. West.
12352. Bagnold.
12372. Uhler & Depresle.
12378. Roos.
12380. Hartmann.
12569. Ayton.
12815. Barker.
12989. Dunn.
13037. Grunewig.
13144. Harrison.
13371. Harris & Power.
13634. Feuerlein & Lahusen.
13881. Hill.
14046. Sprange.
15408. Leigh (*Baker*).
15903. Morris.
16190. Köpcke.
16191. Köpcke.
17537. Weatherhead & Hancock.
17958. Angove & Watkins.
18608. Daw.
18990. Greenwood.
19395. Ross.
19682. Woodhead & Angois.
19975. Clifford.
20187. Sanders.
20522. Haight.
21127. Lake (*Platt*).

1891.

68. Vowles.
335. Jeantet & Jeantet.
860. Bagnold.
923. Smith.
1459. Hayes & Gregson.
1951. Allen, Newton, & Morton.
2134. Greenwood.
2571. Cartier.
2334. Eyre & Graham.
3836. Newton (*Worthington*).
3361. Newton (*The Electric Typographic Company*).
3847. Gilbert.
3902. Gronwald & Oehlmann.
4263. Wright & Wilson.
4710. Owles.
4796. Gollings.
4838. Bailey & Warner.
4889. Nedderman.
5090. Milnes.
5106. Hughes & Woodruff.
5111. Jarhne.
5463. Kulage.
5644. Buchman.
5675. Meyer.
5735. Farquhar & North.
5971. Thompson (*Dodge*).
6185. Schapiro.
6249. Kingzett.
6307. Houtain.
5374. Guenet.
6375. Megill.
6496. Parsons.
6583. Miller (*Miller*).
6584. Rothwell.
6602. Pridreaux & Chave.
6656. Glazier.
6662. Holder.
6663. George. (31st October, 1890.)
6671. Gildermeister.
6676. Rabe.
6680. Hett.
6689. Barker.
6700. Vernon.
6715. Norton (18th September, 1890.)
6727. Van Rennes.
6733. Vorbrodt.
6761. Hood.
6775. Gordon (*Okrassa*).
6797. Weigelin.
6804. Garnier.
6822. Gardner.
6823. Newman.
6842. Boult (*Noxon*).
6852. Drew.
6855. Haddan (*Dies & Hart*)
6856. Cline & Trimble.
6859. Altmann & Gray.

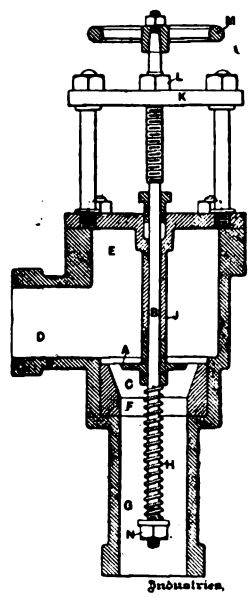
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6877. Anderson.
6879. Lake (*Gormley*).
6889. Newton (*Griffiths*).
6907. Mackett.
6909. Schbid.
6963. Spagnoletti.
6986. Smith & Whitehead.
7016. Downing (*Smyrk, Barnett, & Barnett*).
6878. Porter & Bardwell.
6881. Walcott.
6894. Lake (*The Nye Boiler Cleaner Company*).
6916. Maxwell.
6977. Scheibe.
7018. Halverschbid.
7027. York.
7089. English & Burnett.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Governor.—*A. B. Collis, Halstead, Essex.*—This is a governor for steam engines, which is not operated by centrifugal action, but which consists, in effect, of a valve so arranged as to be sensitive to variations in the flow of working fluid past it to the engine, and operating to close the supply passage on an increase of flow, or conversely, increasing the opening of the passage in the event of a diminution of flow, as may be understood by reference to the illustration below, which represents one modification of the appliance, in vertical cross section. The disc valve A is mounted to slide freely upon a stem or spindle B, and is arranged within, but does not seat upon, a conical chamber C, through which the steam or other fluid passes to the engine. Steam, for instance, admitted by way of the pipe D to the space E, enters at the large end of the conical chamber, passes round the edge of the disc valve, and escapes at the smaller end of the chamber, through the cylindrical part F, into the pipe G. The pressure of the incoming steam tends to force the valve towards the part F, and thus to diminish the area of the annular passage between the valve and the conical aperture. The movement of the valve is, however, resisted by a spiral spring H, which may be mounted upon the spindle I as shown, and so arranged as to permit of its being adjusted from the exterior of the apparatus. It is preferred



to adjust the spring by causing the spindle I to move longitudinally. In the illustration, the spindle is shown as working through packing in a stuffing-box and gland on the cover of the casing, which is extended downward to form a stop J for limiting the upward movement of the valve A. Part of the spindle is screw-threaded, as shown, and engages with a screw-thread cut in the crossbar K. L is a lock nut for locking the spindle in position. After loosening this lock nut the spindle can be turned by a hand-wheel M to bring the nut N nearer to or further from the valve A, and so increase or diminish the compression in the spring. When the valve A enters the cylindrical aperture F, below the conical opening C, the supply of steam to the engine, except for leakage past the valve A, is entirely cut off. The downward movement of the valve may be limited by the insertion of a grid or of projections in the part C, so that steam may never be entirely shut off by the valve A, sufficient steam to run the engine at a certain predetermined limit of power being always allowed to pass. Instead of a single disc valve, a partially balanced equilibrium valve regulating two steam passages may be employed and controlled by a spring as in the foregoing arrangement, than which, however, it would be much more sensitive. Claims: The valve or valves operated by the rush of steam acting against a spring whose resistance may be conveniently varied, for use as a governor; also the details of the arrangement substantially as described.—No. 7899. May 22nd, 1890. 8*d.*

Automatic Adjustable Bearings.—*D. Abercrombie, Manchester.*—This invention is applicable to the adjustment of the wearing parts of bearings, particularly where the bearings are difficult of access. In applying the invention to the large end of an engine connecting-rod in which the brasses are held together by bolts parallel to the rod, a spur pinion is screwed upon the end of each bolt, each pinion gearing into a toothed ring placed between them. Each pinion bears against the cap of the bearing, and forms the nut for the bolt upon which it is screwed. To the inner side of the toothed ring is secured one end of a coiled spring, the other end of which is connected to a central stud capable of being rotated, so that by turning the stud or boss the spring can be wound up, the tension in the spring being retained by means of a ratchet arrangement. After the first adjustment, whenever wear takes place, there will be sufficient power in the spring to move the toothed ring and thereby slightly turn the pinions, automatically tightening the brasses. This compensation will take place as required by the wear. Equivalent arrangements are shown, applied to individual nuts, and arranged for tightening up cotters. Claims: The use and application of the spring and ratchet as described.—No. 8887. June 9th, 1890. 8*d.*

Rotary Engine.—*J. Griffiths, E. C. James, & J. Hunt, all of Cardiff.*—This is a rotary engine in which variation of the amount of expansion is stated to be provided for, and in which it is sought to diminish friction as far as is possible. The manner in which these results are obtained will now be explained with reference to Fig. 1, which is a sectional elevation of the engine, and to Fig. 2, which is a sectional elevation taken at right angles to Fig. 1. In these views A is the working cylinder, B is a drum carried upon the main shaft C, which latter rotates about a

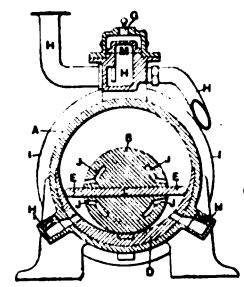


FIG. 1.

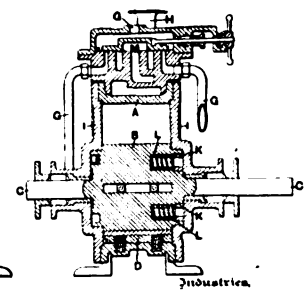
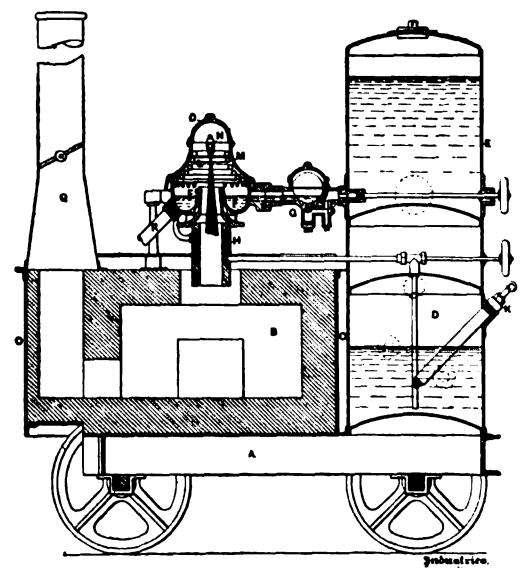


FIG. 2.

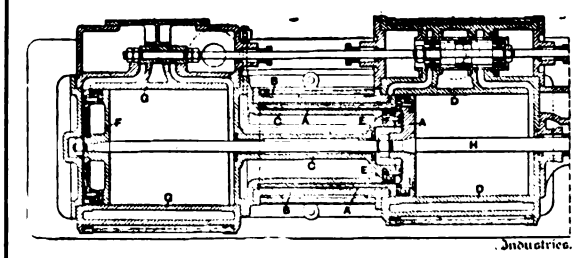
permanent axis eccentric to that of the cylinder, as shown. It may be observed that the position of the drum, relatively to the cylinder, is such that the periphery of the former is always in contact with the latter along a line at the end of the shortest diameter of the cylinder. A packing piece D, of an inverted saddle or crescent shape, is fitted in the cylinder A, and causes the cross section of the cylinder to be approximately elliptical. E E are the pistons, and they, as well as the packing piece D, are provided with suitable packing strips F. Springs are inserted between the pistons to keep their outer ends in touch with the face of the cylinder. In consequence of the form of the cross-section of the cylinder, no cams are required to keep the pistons in contact therewith, and the inventors esteem this an important feature of their improvements. The supply of steam to the engine enters by the pipe G and exhausts by the pipes H. The steam enters through ports in the cylinder covers I and flows into the respective ports J in the drum. A ring K lies in an annular groove in the face of the drum, and is provided with springs L adapted to press it against the adjacent cylinder cover to make a steam-tight joint therewith. Radial tough pieces are provided to prevent the ring from revolving in its recess, and also serving to prevent the steam from passing across the ends of the drum and distributing itself into the wrong portion of the cylinder. The engine is governed by a reversing valve M, which causes the steam to pass through one or other pair of the steam and exhaust passages, which are duplicated; and the amount of expansion the inventors state is "governed by the length of the ports J; the longer they are, the further is the steam carried into the cylinder; while, on the other hand, shortening them leads to the cut-off being effected at a correspondingly earlier point in a revolution." Claims: The combination of cylinder, inverted saddle piece, drum, and radial pistons; the combination of cylinder elliptical in cross-section, revolving drum, and "arrangement of ports adapted to render the amount of expansion variable, according to the lengths of the respective ports, as set forth;" the whole arrangement as a combination.—No. 2569. February 12th, 1891. 6*d.*

Oil Flame Furnace.—*The Lucigen Light Co. & T. M. Jarmain, London.*—This invention relates to a furnace in which heat is produced by an oil flame directed by a steam jet. The furnace may be either stationary or portable. The portable furnace is constructed as shown in the accompanying illustration,



which is a longitudinal section. On a wheeled truck A is a furnace chamber B, of fire-brick or other suitable refractory material, preferably strengthened by a metal casing C, and at the side of this structure, separate from it, is placed a tank D containing water and compressed air, and above it a tank E containing oil. Over the furnace chamber is fixed the burner, which is of the following description:—A basin F, having a tubular boss F¹ projecting up from its centre, is supplied from the oil tank E with oil up to a certain level determined by a suitable float valve. Below the basin is a closed annular vessel H constituting a boiler supplied with water from the water tank D, subject to the pressure of air in that tank produced by a hand force pump K or otherwise. From the annular boiler H a pipe extends upwards, and after being carried in the form of a hollow coil L above the basin it terminates in a nozzle N directed downwards towards the centre of the basin. The coil L is enclosed by a metal casing M covered by a cap O. Within the boss F¹ of the basin, and within the boiler H, there are refractory linings to protect those parts from excessive heat. For putting the burner into action the cap O is removed, the oil in the basin F is kindled, and the flame burning upwards, heats the coil K until steam is generated. The steam issuing from the nozzle N then directs the flame down through the tubular boss F¹, and the water supplied to the annular boiler H is converted into steam, which, becoming superheated by passing through the coil L, issues from the nozzle N in a powerful jet directed downwards. The cap O being replaced, air drawn in by the injector action of the jet through the holes of the cap and through slots round the edge of the basin, mixes with the oil vapour evolved from the oil in the basin, and forms a flame directed downwards into the furnace chamber B, so as to heat crucibles, rivets, or other articles placed therein. The products of combustion pass upwards by the chimney Q. By means of a pipe R provided with a valve or stopcock the basin can be emptied, the flame being thus extinguished. For a stationary furnace the burner is like that above described and acts in the same manner, but the water and oil tanks may be arranged where convenient, the oil tank being at a level sufficiently high to supply the basin of the burner. Claims: An oil flame furnace constructed and operated substantially as described with reference to the accompanying illustrations.—No. 9181. June 13th, 1890. 6*d.*

Engines and Pumps.—*H. G. Holborow, Stonehouse, Gloucester.*—The improvements hereinafter described are particularly applicable to motor engines of the compound and triple-expansion types, the objects aimed at being simplicity, compactness, and accessibility, together with moderate prime cost. The improvements are applicable also to pumps. The nature of the invention may be readily gathered from the horizontal section below of a portion of a stationary engine of the triple-expansion type constructed according to this invention. A is a trunk piston, which works within a cylinder B, and upon the exterior of a fixed trunk C, the cylinder B, as also the trunk C, being arranged concentrically with the cylinder D. The outer extremity of the trunk C is packed at E, as shown, and the piston A, against



which the trunk packing works, is similarly packed in the cylinder D. The piston rod H is connected to the solid face of the hollow piston A. The construction thus far is applicable for use as a compound engine, the live steam being primarily admitted to the annular face of the hollow piston A, and subsequently conveyed to the opposite or disc-like face of the same piston. The cylinder D is steam-jacketed, and live steam is admitted for heating purposes to the interior of the hollow trunk C. Any steam or water which may leak past the packing E passes through a passage in the trunk C to the interior of the hollow piston, whence it may be withdrawn. For triple expansion a final or low-pressure cylinder is added, either tandem or parallel with the first. The tandem arrangement is shown herewith. As before explained, the annular face of the piston A is exposed to the high-pressure steam and is single-acting. The opposite face of the same piston serves as a single-acting intermediate piston. The low-pressure piston F is enclosed in a second cylinder G, and is double-acting, and also, by preference, steam-jacketed. Any convenient valve gear may be employed. The application of this invention to a "bucket and plunger" pump is described, in which, rigidly connected with the bucket, is a hollow plunger, which works on the exterior of a fixed trunk, and is enclosed within a barrel, the latter being formed as a continuation of the pump barrel, and enclosing the fixed trunk aforesaid. Claims: In a motor engine working on the compound or triple-expansion systems, the employment of a trunk piston the trunk of which works upon a fixed trunk, which it fits, and working freely within the high-pressure cylinder, whilst the body of the piston works in and fits the low-pressure cylinder; the arrangement of parts (including particularly the arrangement of packing) as described and shown; the employment of the piston and hollow trunk, the latter fitting a fixed trunk, for pumps, as shown, whereby the packing of the working parts is facilitated.—No. 6919. May 5th, 1890. 11*d.*

Keys for Railway Rails.—*H. H. Lake, London.* (*Paul Espinasse, Montclar de Quercy, France.*)—A metallic wedge or key for securing the rails of railways in their chairs is formed of a single piece of steel of definite length, this plate being bent several times upon itself in a special manner in order to form an elastic body, and being provided with stops to prevent it from being displaced when once it is driven into its place. The bending is effected in such a manner that between the two parallel sides of the wedge, when it is in place, one of the extremities of the plate presents the form of an S, and will bear upon the interior side placed against the rail, whilst the straight part of the exterior side is placed against the chair, its length corresponding to the width of the latter. The extremity of this exterior side is provided with a bend, so as to form a stop bearing against one side of the chair, and on the other side of the chair a second larger bend is formed, which terminates in the interior side bearing against the rail. For enabling the insertion of the wedge to take place, the side bearing against the rail is inclined, when the key is free or expanded, so that the key can

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be placed by hand in readiness for forcing into place, which is effected by a strong jack. A modification is shown, which is capable of being introduced vertically into place, the curved strip forming an elongated eye with one fold overlapping and being left straight; two snugs project from the two sides of the straight arm, and embrace the edges of the jaw of the chair, when the key is forced into place by a suitably formed lever. Claims: The elastic keys, with stops or snugs as described.—No. 7884. May 20th, 1890. 8*d*.

MANUFACTURE OF GLASSWARE.—*D. Rylands, Stairfoot, Barnsley.*—Improved machinery for the manufacture of bottles and other glassware is described, together with improvements in the processes of working the same. One of the objects of the invention is the better regulation of the pressure of the plunger

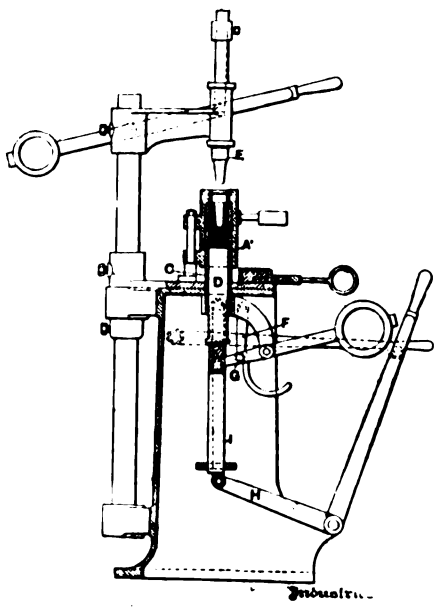


FIG. 1.

used in first pressing the molten glass into the required shape in readiness for the blowing out of the glassware to its full size, another object being that the pressing or parison mould shall be kept at the heat most favourable for securing the best output. The improvements are applicable to fixed, rotary, or radial machines, and the parison mould may be worked top downwards as well as upwards. Fig. 1 is an elevation partly in section, and Figs. 2, 3, and 4 are sectional elevations, of the mould and mould table. The apparatus and mode of operation are as follows:—The blowing mould A being closed and locked by a catch lever B, the parison mould C and the moveable parison mould bottom D being in the position shown in Fig. 2, molten glass is charged into the cavity contained in the upper portion of the parison and blowing moulds, and, the pressing plunger E descending, causes the molten metal to ascend and occupy the space formed in the upper portion of the blowing mould, thus completing the neck and mouth of the bottle or other article. The plunger E in its descent having closed the opening in the upper portion of the mould A, will cause the descent of the moveable mould bottom D, which will then occupy the position shown in Fig. 3, when the

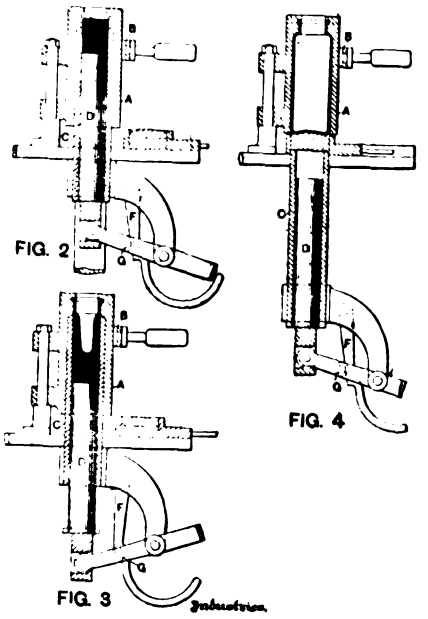


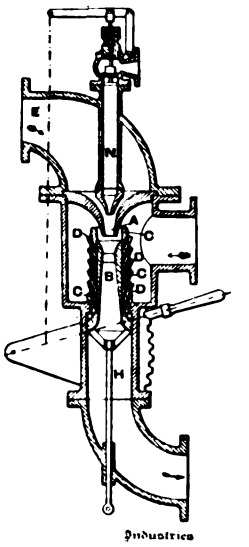
FIG. 2

FIG. 4

FIG. 3

detent lever F will have latched itself on to stud G, thus preventing the ascent of the moveable mould bottom upon the re-ascent of the pressing plunger. The sliding pressing mould being now, by lever H and link I, withdrawn from the blowing mould (sliding down upon the blowing mould bottom), the parison mould C is again raised, lifting with it the blowing mould bottom, into the position shown by Fig. 4. A blowing attachment, not shown in the illustrations, but carried by the pressing ram, descends and closes the mouth of the blowing mould. Air under pressure being then admitted, will cause the parison, as shown in Fig. 3, to expand and assume the completed form as in Fig. 4. It will be seen that the pressing mould bottom D, being counterpoised, will prevent any undue pressure being applied by the plunger to the molten metal, and, as a consequence, the bottles or other articles will be free from marks or other defects. Also, the molten glass being charged into the upper portion of the combined mould, the glass will not have far to ascend before the neck of the bottle is formed, and, the after formation being from the top downwards, prevents any violent plunger action on the molten material. To ensure the blowing mould being at a suitable temperature, any convenient number of separate parison moulds may be employed, disposed radially round the main pillar of the machine, the blowing mould bottom being capable of being moved radially round the centre pillar to come over any one of the parison moulds, the one last used being cooled whilst the next mould is in use. Another modification is shown in the specification, differing slightly in arrangement, but operating upon the same principle. Claims: In the manufacture of machine-made bottles, regulating, by counterbalancing the parison moulds, the pressure exerted on the molten glass during manufacture; the arrangements whereby one blowing mould can be worked in conjunction with two or more parison moulds; claims also the particular arrangement and combination of parts described.—No. 7145. May 8th, 1890. 8*d*.

EJECTOR CONDENSERS.—*O. Lindemann, London.*—This invention has for its object the variation of the length of the water jet in an ejector condenser by means of a moveable receiving or combining nozzle which will simultaneously increase or decrease the distance between the mouth of the water nozzle and the throat of the receiving nozzle. The inlets for steam to the interior of the condensing tube are arranged over the whole length of that tube in such a way that when the receiving nozzle is moved within the condensing tube a greater or lesser number of the steam inlets are covered and put out of action. Thus the capacity of the condenser is variable, and the variation is said not to influence the vacuum to any great extent. The receiving nozzle may be moved by hand, or should the engine to which the condenser is applied be worked under a variable load, the receiving nozzle may be moved automatically in accordance with the variations of working. Where a supplementary or starting jet is employed, the actuating arm thereof is so connected with the gear for moving the receiving nozzle that as the receiving nozzle is raised the aperture of the starting jet is opened, and *vice versâ*. The accompanying illustration represents in section an ejector condenser



with moveable receiving nozzle, and a nozzle for the admission of a starting jet, or jet of high-pressure liquid or fluid, arranged in the centre of the water nozzle. In this view A is the water nozzle, B the receiving nozzle, and C the condensing tube with the steam apertures D distributed over its surface. The receiving nozzle is fitted with a cross piece, which is connected to the rod H, which passes to the exterior of the apparatus, and by means of which the receiving nozzle B can be moved, either by hand or automatically. E is the water supply pipe, and N the nozzle for high-pressure fluid, within the water nozzle A, with a valve which by suitable connection is operated simultaneously with the movement of the receiving nozzle as before described. Claims: In water jet or ejector condensers a receiving nozzle moveable from the outside, and fitting into a cylindrical condensing tube as described so as to operate as a regulating valve; the connection of the arrangement for moving the adjustable receiving nozzle with the valve for shutting off the pressure fluid, the one opening or increasing while the other operates reversely, as described.—No. 4165. March 9th, 1891. 6*d*.

SCREW BOLTS AND NUTS.—*H. H. Lake, London.* (*C. Higbee, Philadelphia, Penna., U.S.A.*).—It is desired to include all threaded coupling devices, as well as the two named above. In threaded couplings of all kinds the thread is usually turned in or on a cylindrical or annular part prepared to receive it, and at the end of this part the thread merges gradually into the face of the article, which is usually in a plane at right angles to the centre of the thread. Thus the end of the thread is for some distance very thin, and is by no means symmetrical to the axis of the thread, the consequence being that the two parts of the screw union are frequently put together wrongly, cramping and binding the parts and injuring the threads. To overcome these defects the inventor terminates the thread below the face level of the cylinder or annulus on which it is formed, and he forms the extreme end of the thread so that it is stopped off sharply, and has a broad blunt face lying symmetrically on each side of the centre line of thread. A plain cylindrical portion extends from the finish of the thread to the face of the article. It is recommended that both the male and female threads be formed in this manner, but an improvement is observed if one of the threads be of the usual construction and the other of the improved construction. The inventor believes the broad principle of the device to be original with him, and therefore claims: The improved arrangement of thread with cylindrical finishing portion, where such is used upon one or upon both members of a thread coupling.—No. 4261. March 10th, 1891. 6*d*.

CYLINDRICAL SLIDE VALVES.—*H. Turner, Hoylake, Chester, & W. & T. D. Bayliff, Birkenhead.*—The object of the arrangement described in detail below is to secure and combine the advantages of the ordinary slide and piston valve, whilst eliminating their individual disadvantages. According to this invention as applied to steam engines, the steam distribution valves are constructed of a plurality of portions having a number of faces, the cylinder port face being arranged to correspond. Between the portions of the valves, at their backs, are wedge devices, so arranged that steam is kept off the valve portions, while the wedges themselves are kept up to their work by steam pressure. The waste of steam resulting from worn rings is obviated, and the automatic compensation for wear as in the case of flat slides is secured, the valve being substantially an interrupted piston valve. Fig. 2 below illustrates in sectional elevation a valve casing and cylinder ports, and Fig. 1 is a section through the valve upon the centre line. It will be seen that the valve is composed of four distinct parts, all of which are identical, and which are lettered A B C D. In Fig. 2 half of the portions B and C are shown in section with the wedges. E is the cylinder valve face, having port passages F for the admission of steam, and passages G for exhaust. H H are the steam admission ports, I being the exhaust port. The wedges J are arranged back to back, and bear upon and work in correspondingly shaped recesses in the different portions of the valve, these recesses being carried from end to end of the valve, and being therefore in free communication with the interior of the valve casing, and thus the steam has free access to the spaces K between the bases of the wedges J. In the inclined faces of the wedges, recesses L are provided, which are in communication with the exhaust passage M of the valve sections by way of passages N. By thus having the surfaces covered by the spaces L in communication with the exhaust, the pressure acting upon the bases of the wedges is always equivalent to the difference of pressure between that in the valve casing and that in the exhaust. Springs O keep the valves normally against their bearing surfaces. The wedges are kept in place by the plates P which are bolted to the valve sections, the said sections being themselves kept in place by the ordinary attachments of the valve spindle to the valve. The only pressure acting upon the different valve sections and tending to press them on to the valve face is that due to the action of the steam upon the bases of the wedges, and that which acts upon the small portion of the valve not covered by the wedges. Upon the amount of inclination given to the wedges depends the pressure upon the backs of the valve sections. In another modification, the different valve sections are separate from the portion of the valve which is connected to the valve spindle, and the arrangement of wedges is somewhat different, the principle of the appliance remaining the same. Claims: A valve composed of a plurality of parts, each portion being free to adjust itself, and having a certain limited pressure of steam tending to force each section on to its working face; the arrangments of wedges for the purpose described; the two valves as illustrated in the specification, of which the illustrations herewith show one example.—No. 6285. April 25th, 1890. 8*d*.

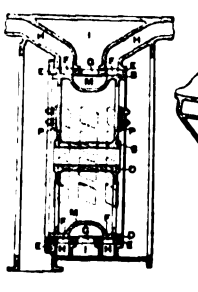


FIG. 1.

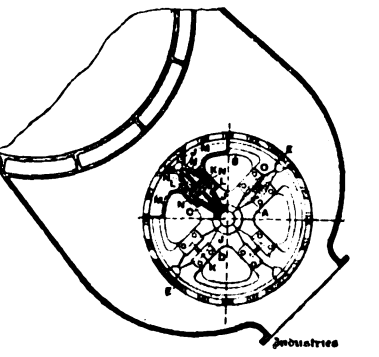
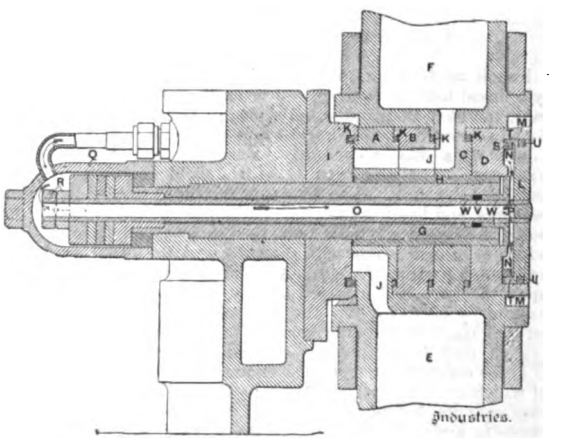


FIG. 2.

ROTARY ENGINES.—*C. H. Brain, London.*—This invention has reference to improvements in fluid pressure engines and pumps of the kind described in Mr. Arthur Rigg's patent No. 6047 of 1885, in which the cylinders are described as being formed with bosses mounted to revolve upon a central bearing, the pistons



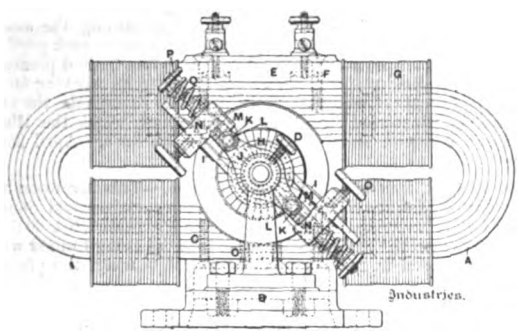
of the said cylinders being connected to a wheel or disc mounted to revolve about an axis out of line with that about which the cylinders rotate. In such engines the inlet and exhaust ports are formed in the cylinder bosses, which work against a faced side cheek provided with corresponding passages. The bosses of the cylinders rotate between the valve and a flange or plate which is fixed to the pin or bearing upon which the cylinders rotate, and the mode of adjustment is such that excessive friction

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is set up, and injurious wear and leakage result. To obviate these disadvantages is the object of the present invention, which is described with reference to the accompanying illustration, which shows so much of a four-cylinder engine of the kind referred to as is necessary to an understanding of the following description:—A, B, C, and D are the bosses of the four cylinders; only parts of two of these cylinders, viz., E and F, are shown. G is the stud or bearing about which the cylinders revolve, which is surrounded by a sleeve H fixed to the boss A so as to revolve therewith. Upon this sleeve the other bosses oscillate during the working of the engine. The valve I is formed with the usual passages, and against its inner faced side the boss A rotates. The passages J J, in the boss, serve alternately for the admission and exhaust of steam to the corresponding cylinder. The packing rings K are placed between the valve and the adjacent boss, and also between the other bosses, all the foregoing parts being arranged as is usual in these engines. The disc or piston L fits within a short cylinder M, formed at the outer side of the boss B; this short cylinder forms, in conjunction with the boss and the disc or piston, an annular steam space or chamber N. The disc or piston L is fixed upon a tube O, that passes through the stud or bearing G, and is in communication at one end by holes P with the steam space N, and at the other end, by a bonnet or chamber Q, with the steam supply pipe of the engine. Nuts R limit the movement to the right of the tube O and disc L. A packing ring S is located between the disc L and the boss D, this ring, when the engine is in action, being pressed by the steam in the chamber N against the face of the boss D and against the rim T of the disc or piston L. A packing ring U is placed between the disc L and cylinder M, and other packing material V forms a tight joint between the stud or bearing G and the tube O. W is a gland that automatically compresses the packing material V against the ring, by the action upon it of the steam admitted to the space or chamber N. The area of the boss A subjected to pressure of steam within the space or chamber N is such, that when the engine is working, the pressure of steam tending to force the bosses towards the valve I is in excess of that tending to drive them in the opposite direction, and which is due to the pressure on the valve I of the steam within the passages J of the respective cylinders. The difference in the two pressures may be a predetermined one, such as to prevent escape of steam between the two surfaces in contact, whilst also obviating excessive friction and wear. It is preferred, as before stated, to place the tube O in communication with the steam supply pipe, as then the difference between the two pressures mentioned will remain constant, notwithstanding variations in the pressure of steam supplied. Claims: In a fluid pressure engine (or pump) of the kind referred to, subjecting the bosses of the cylinders to the pressure of fluid acting in an opposite direction to and of greater amount than that tending to move the bosses away from the valve, for the purpose specified; constructing an engine (or pump) of the kind referred to with a closed steam space or chamber, one side of which is formed by that cylinder boss which is farthest from the valve, the said space or chamber being in communication with a source of fluid pressure.—No. 2338. February 9th, 1891. 8*d*.

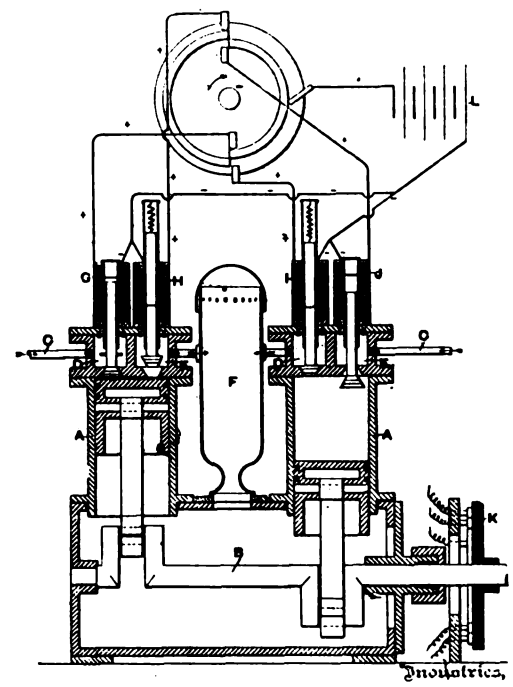
ELECTRICITY.

Dynamos and Motors.—*E. Sechehaye, London.*—The inventor constructs the field magnets of horseshoe form, as shown in the side elevation below, the ends of the limbs abutting against each other. These magnets A A are built up of a series of bent plates fitting closely together and secured together by rivets, the two cores being fixed to the base B by screws C. The abutting ends of the limbs are bored out to receive the cylinder armature D, the several plates of the cores being made, by preference, of such



a length as to form, when fixed together, approximately the cylindrical hollow required, and when the cores are fixed to the base, and have their upper limbs firmly tied together by a plate E and screws F, the cylindrical hollows are accurately turned in a lathe to a diameter slightly exceeding that of the armature windings. The windings G of the field magnets are of the usual construction. The armature spindle is carried in pedestal bearings, and has fixed upon it the armature core, which is composed, firstly, of a tubular part, having two end flanges, one of which is formed in one with the tube, and the other screwed on a threaded portion thereof. A number of iron discs are placed upon the tube, and clamped closely together between the two flanges by screwing up the moveable flange. Any suitable form of armature winding, such as the "Von Hefner-Alteneck" system, may be adopted, or a Gramme ring may be employed. H is the commutator and I the commutator brushes, the holders of which are arranged as follows:—Upon the neck of the armature spindle bearing is mounted the rotatable carrier J, the opposite arms of which terminate in two split clasps K, lined with insulating material and receiving the spindles L, which are nipped tightly therein by means of screws M, when they have been adjusted in position. The spindles L are bent up at right angles, and upon the radial portions so provided are fitted loosely the brush holders P, in which the brushes I are secured by means of screws O. On the screw-threaded outer ends of the spindles L are fitted screw nuts P, and between these and the brush holders are interposed helical springs Q, adjustable to press the brushes with greater or less force upon the commutator. On the spindles L are fixed pins, bent up so as to be parallel thereto, which pins enter holes of somewhat larger size in the brush holders, so that the pins hold the brush holders in position upon the spindle with a sufficient amount of play to allow the brushes I to adjust themselves to the surface of the commutator, so as to obtain perfect contact. When the machine is not in use, the brushes are held out of contact by drawing back their holders against the action of their springs Q until they are free of the pins, and then turning them round until the pins bear with their ends in small recesses U in the end surfaces of the holders, thus holding the brushes securely out of contact. The spindles L being securely held in the split nipping sockets K, the screw nuts and lock nuts on the outer ends thereof, such as are usually employed for fixing them, are dispensed with, and, consequently, as the ends of the spindles can pass closely behind the standards of the bearing, the length of the machine can be reduced to an extent corresponding to the height of such nuts. Claims: Constructing the field magnet cores of dynamos and electromotors of a series of plates bent successively over each other in horseshoe form, the ends of two such horseshoe cores being made to butt against each other, and being secured in position by screws, rivets, or other fastenings, so as to form a closed loop, the inner part of which is cut so as to form circular hollows for receiving the armature; the armature consisting of discs threaded upon a tubular attachment to the spindle, and secured thereon between two end flanges; the brush gear as described.—No. 7981. May 22nd, 1890. 11*d*.

Air Pumps.—*A. J. Boult, London.* (*A. L. Reinmann, A. A. Dittmar, & H. Falkenhausen, all of New York, U.S.A.*)—This invention consists of an air pump in which the suction and discharge valves are actuated by electricity. The illustration below shows an air



exhausting pump in vertical section, the upper part of the figure showing diagrammatically the arrangement of switch and electrical connections. The pump cylinders A each contain a single-acting piston, the two pistons being connected by connecting-rods to cranks set at 180° apart on the crank-shaft B, which receives motion from any convenient source of power. At the top end of each cylinder is fixed a chamber, subdivided by a central partition, and containing in one subdivision a suction valve, and in the other a delivery valve. The suction pipes C, to which the vessel or vessels to be evacuated are connected, enter the two compartments D, and the delivery pipes are led from the compartments E to a trap cylinder F, whence the air passes into the engine casing and so into the atmosphere. Each compartment D contains a mitre suction valve, the compartments E containing similar delivery valves, which open, of course, in an opposite direction to the suction valves. All the valves have their bodies or pistons divided, and suitable packing is inserted in the division so that the valves may make air-tight joints with their seatings. G, H, I, and J are hollow cylindrical electromagnets placed upon the top plates of the chambers D and E. The cores of these electromagnets form valve-stems for the suction and delivery valves. To the top portions of the electromagnets G and H are secured vertical guide casings in which the valve-stems of the delivery valves are suspended by means of springs. The stems of the suction valves are provided with stops, which prevent the valves from dropping too far into the cylinders. These valve-stems or cores have their upper portions made of soft iron, but their lower portions are of brass, so that they may not be magnetised and thus affect the iron portions of the pump. K is an electric commutator or contact maker of hard rubber or other non-conductor mounted on the crank-shaft and rotating therewith. Semi-annular conducting strips are secured to the disc in the positions shown in the diagram at the upper part of the figure, and current from the battery L energises the pair of electromagnets I J alternately with the pair G H, the magnets raising the suction and delivery valves of one pump, whilst the stems of the valves of the other pump are demagnetised and fall into the working position by gravity. In the figure the magnets I and J are just about to be energised, whilst the magnets G and H are just about to be cut out of circuit. The opening and closing of the respective valves is performed simultaneously with the completion of the strokes of the pistons, and the use of complex mechanism for operating the valves is avoided. Claims: An air pump with commutator disc on the crank-shaft regulating the supply of current to electromagnets operating the suction and delivery valves substantially as described.—No. 4403. March 11th, 1891. 8*d*.

CHEMISTRY.

Converting Lead Compounds into Basic Salt.—*J. N. Zeitler, Cannstatt, Germany.*—This invention has for its particular purpose to advantageously utilise the sulphate of lead occurring as main bye-product in the manufacture of acetate of aluminium from alum and acetate of lead, or of acetic acid from acetate of lead and sulphuric acid, in calico printing, &c., for the production of white lead. After determining the quantity of lead contained in the mostly plumbiferous product to be treated, the quantity of carbonate of sodium is ascertained which is required for converting the respective lead compounds—in most cases sulphate of lead—into neutral carbonate of lead, which is done by heating for some time the products to be treated for white-lead—waste products or other compounds of lead, for instance, chloride of lead, nitrates of lead—with the requisite quantity of carbonate of sodium to about 60° to 110° Centigrade. After this operation all compounds of lead have been converted into neutral carbonate of lead. The latter is allowed to subside, and subsequently the liquid above it removed. The carbonate of lead obtained as described corresponds neither in properties nor in composition to white-lead. It is consequently necessary to convert the neutral carbonate of lead into basic carbonate of lead. This purpose is accomplished by boiling the neutral carbonate of lead obtained as described, for some time, with a certain quantity of soda lye, whereby part of the carbonic acid is separated from the neutral carbonate of lead, which is consequently converted into basic carbonate of lead (white-lead). The reaction takes place after the formula:

$$3PbCO_3 + 2NaOH = 2PbCO_3Pb(OH)_2 + Na_2CO_3.$$

The white-lead is left to subside, and after drawing off the sodium solution above it, which can be used for further operations, washed and dried. Claims: The process for converting carbonate of lead into basic salt (white-lead), consisting in treating the carbonate of lead with the requisite quantity of caustic alkali lye.—No. 2812. February 16th, 1891. 4*d*.

MISCELLANEOUS.

Small Arms.—*T. Perkes, London.*—This invention relates to that class of breechloading small arms known as "ejector guns," and its objects are to facilitate the closing of the gun, and to render the mechanism more compact. Hitherto considerable difficulty has been experienced when closing such guns owing to the pressure required to cock the ejecting mechanism when closing the breech. To obviate this difficulty the fore end of the gun is fitted with a rebounding lever, which is operated when the ejecting mechanism is brought into play, either by the ejecting spring or by a special spring. The rebounding lever is held in a neutral position by a catch, and is furnished with a projection which, when the lever is released from the catch, comes into contact with its operating spring, which causes it to rebound after operating the extractor, and thus imparts a return action to the ejector operating mechanism and so allows the gun to be closed with greater ease than heretofore. The catch is fitted with a catch spring whereby it is operated—or the catch may be dispensed with, and the spring itself be formed to act as a catch. The rear end of the catch is prolonged so that it engages with a rod, slide, or lever, or with an extension of the mainspring, any of which are operated by the gun lock mechanism in any convenient manner. Claims: The mechanism to cause a rebound or return action of the ejecting mechanism, to facilitate the closing of the gun. The arrangement of mechanism described for this purpose, to ensure compactness.—No. 2784. February 16th 1889. 8*d*.

Boat-lowering Gear.—*W. Armstrong, West Hartlepool.*—To enable boats to be lowered from a ship and detached from the lowering tackles with facility special davits are supported on pins carried by sockets or double eyes provided on the deck, so as to enable the said davits to swing over the ship's side, by the action of gravity, to a sufficient extent to suspend the boat quite clear of the side. The proper working of the davits is provided for, and sideward motion prevented, by guides formed in beams erected over the deck, and on which the boat's keel rests when the boat is housed. The davits are on the inboard side of the boat, and may be curved to fit the boat if desired, being extended to a suitable height above the boat and inclined sufficiently beyond its centre line to cause it to swing out from the davits when free. Spindles extend between the davits, and are furnished with rollers, from which the lowering tackle unwinds as the boat descends, and with regulating tackle controlled from the boat consisting of a sprocket wheel taking a hand regulating chain and being carried on a shaft which carries also a pinion gearing with a wheel upon the spindle carrying the lowering rollers above referred to. The detaching gear consists of a pair of balanced slip hooks, one at each end of the boat, both hooks being released, when necessary, by a pair of lines led to the centre of the boat, and operating to draw the hooks out of eyes at the ends of the falls, the balance weights causing the hooks, after operation, to resume a position in which they are ready to re-engage. Or the hooks may be unbalanced, so as to fall over upon their backs when relieved of the pull of the tackles upon them. Claims: The general arrangement of boat-lowering and detaching gear as described; the davits constructed to raise the boats from the chocks and to swing the boat clear of the ship's side by the action of gravity; the use of the two modifications of detaching gear as described.—No. 6307. April 25th, 1890. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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SMALL SCREW CUTTING LATHE.

THE accompanying engraving represents a handy little screw-cutting lathe suitable for light work, made by Messrs. Lister & Co., Keighley. The lathe has a 5ft. bed and 5in. centres. A novelty in connection with this tool is the front slide, which is capable of vertical adjustment by a hand-wheel and screw, and which carries the swivel tool rest. The top tool slide may be taken away, leaving a swivel slide with T slots, which may be used for a variety of work, such as light milling, boring, &c. The machine will no doubt be found useful in the cycle trade, or in small shops where a large stock of tools are not available.

PORTLAND CEMENT SPECIFICATIONS.

I.

THE great variations naturally occurring in the quality of Portland cement, as well as the elasticity of the name itself, have compelled makers and users to adopt some form of specification whereby to judge the commodity in which they deal.

Until quite recently it has been tacitly assumed that the words "Portland cement" had a perfectly definite meaning, and that, though the material thus designated might vary within wide limits, yet there was little fear of the name being appropriated for a product wholly different. This assumption has scarcely sufficient basis to warrant its acceptance, for it is by no means easy to define Portland cement in a way which shall satisfy the primary requirements of a good definition—viz., that it shall include all varieties of the thing defined, while excluding all imitations, however close. In view of the fact that it has been seriously proposed to manufacture and sell cement made from blast furnace slag as Portland cement, a satisfactory definition is by no means a superfluity, and, pending the publication of that which appears to us least open to objection, we should be glad to gather from those of our readers conversant with the subject a consensus of opinion on the question, "How should Portland cement be defined?"

Since, then, the very name of the material with which we are dealing is far from precise in its significance, it is by no means surprising to find that equal dubiety exists as to the properties which it should possess. Divergence of opinion first appears, as might be expected, among users the necessities of whose work make them exacting in their demands, and insistent upon the satisfaction of those demands, as they are proportionately more alive to small differences than are others less critical. It is among engineers entrusted with the supervision of the erection of permanent and costly structures that one finds that intimate knowledge leading to what might be termed hypercriticism of the materials they use—a knowledge and power of discrimination that find expression in the specifications they adopt. These divergences of opinion, exemplified by corresponding variations in specifications of different origins, may be traced as arising from differences in the requirements of the users, the extent of their familiarity with the nature and properties of the material they use, their acquaintance with the exigencies of manufacture, and, lastly, from their professional idiosyncrasies. The final cause here indicated may be scouted as being, as it should be, negligible, but those manufacturers who have suffered from what may be termed the magnesia scare will be slow to underrate it.

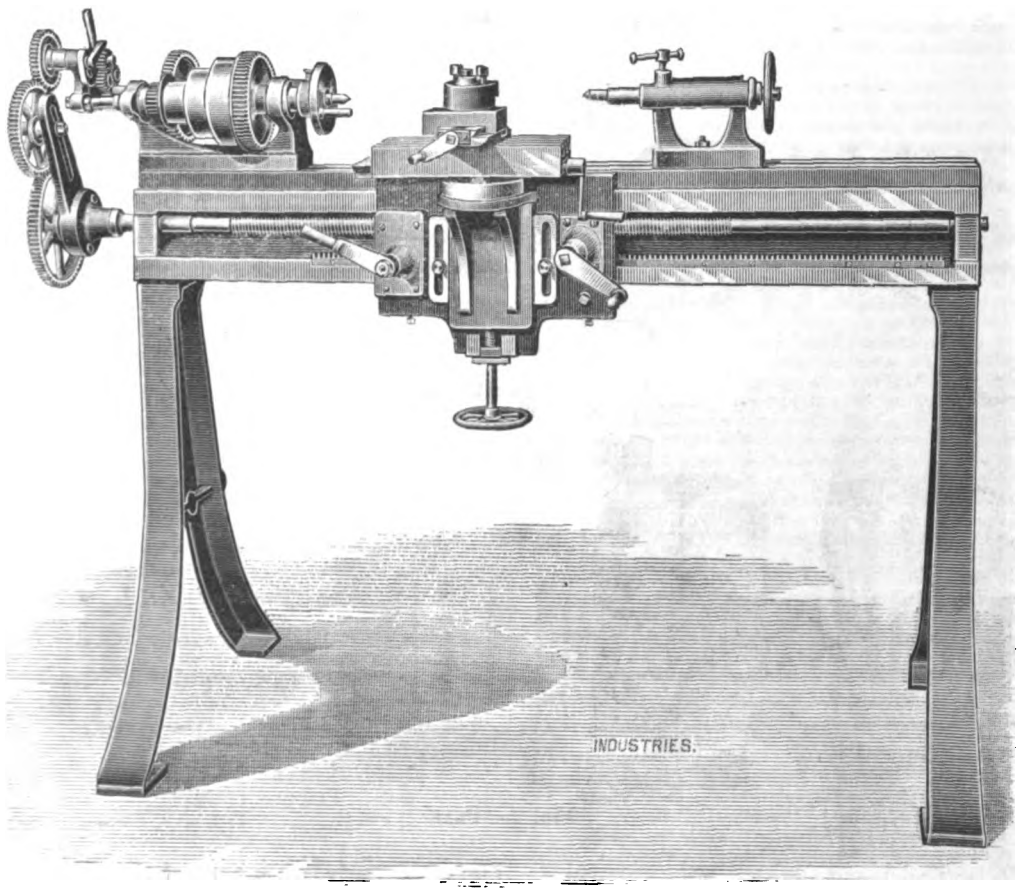
Turning to actual specifications which have been used within the last ten or fifteen years, one is struck by several characteristics which they possess in common. The first is one that may be observed in most specifications of whatever kind—namely, an air of rigour and precision frequently covering looseness and inaccuracy. The second is the statement of the same requirement in different specifications in altered terms, apparently, consciously or unconsciously, adopted to lead to the belief that the specification has been evolved by the drawer from the profundity of his knowledge instead of being bodily annexed from some well-known source. The third is in the insertion of the particular fads of the deviser of the specification, wherein his true originality is amply displayed.

Coming to particulars, and taking a specification for important harbour work dated 1875, we find the first clause relating to the quality of the cement stipulating that it shall "weigh at least 116lb. per striked bushel." Nothing is said as to the mode of filling the measure, and the margin thus left to the skilful manipulator was naturally considerable. Instead of improving this ridiculous weight per bushel clause out of existence, later specifications, as will be seen, have simply endeavoured to give precision to a requirement intrinsically absurd. The same specification requires briquettes of neat cement 2¼ square inch in section to bear a tensile load of 350lb. at two days, 500lb. at four days, and 750lb. at seven days after gauging, the weight to be applied "slowly," and to hang upon them for "not less than one minute" without rupture taking place. These points are not of contemporary interest, but may be profitably compared with the requirements of more modern specifications. The fineness of the cement was to be such that not more than 10 per cent. should remain on a sieve, "the meshes of which shall be $\frac{1}{40}$ of an inch in the open"—whatever that may mean. In spite of this extraordinary wording it is easy to see, and reasonable to applaud, the idea latent in the mind of the drawer of the specification. He was aware of the fact that the fineness of a sieve depends on the area of each actual hole, and consequently that such a phrase as "40 meshes to the inch" is, as it stands, of doubtful meaning. In this respect many more modern specifications might be amended to embody the same idea with advantage.

One other matter may be noticed. It is stated in the specification that an inspector will be appointed to examine and test the cement, and much is left to his discretion. For example, the conditions already adverted to in no way touch the question of the *soundness* of the cement supplied. When it is considered that the very existence of a valuable structure may be terminated by the failure of the cement used in its erection, the imperative need of soundness will be obvious. Soundness in a cement holds the same place as honesty in a man—for those who have dealings with either. A cement may be strong, finely ground, and, to superficial tests, apparently unexceptionable, but if it be not sound it is a great deal worse than useless. At the time when the specification of which we are speaking was drafted, adequate tests of soundness were unknown or little regarded. A lurking sense of the paramount importance of securing it is to be detected by those who can read between the lines. For instance, it is laid down that the inspector will, when necessary, "test the cement with pats and dry briquettes in any manner which he may deem necessary;" further, there is a paragraph to the effect that "no cement will be accepted which, in the opinion of the inspector, is too quick setting, or likely afterwards to "fly" in the work, neither will any cement be allowed to be shipped on account of this contract unless it complies in all respects with the above conditions, and has been approved by the inspector." In this and in other respects, such as the manner of gauging, the amount of water used in that process, and so forth, the inspector is a kind of mechanical Cadi under a palm tree, and is almost unfettered in his judgment. The perusal of later specifications reveals much the same state of things. Now, provided an inspector of knowledge and probity can be secured, nothing better need be desired. His decision will be as much more likely to be equitable, as is the justice of our Cadi likely to be better than that of a more regularly constituted tribunal guided solely by rule and precedent. But the possession of these qualities is by no means a matter of certainty, and it may be readily conceived that a manufacturer undertaking a contract would prefer to be tied by hard and fast conditions, even if they be a little stringent, rather than by decisions the nature of which largely depends upon a personal equation. It is a belief in the existence and reasonableness of this preference that will lead us to consider, in our next article, other specifications, with a view of comparing them with that already dealt with, and of tracing, if possible, any process of evolution that may have taken place in the direction of the elimination of the personal factor and the substitution of accurate physical criteria.

SMALL SCREW CUTTING LATHE.

CONSTRUCTED BY MESSRS. LISTER & CO., ENGINEERS, KEIGHLEY.



GENERAL VIEW.

THE RUSSIAN IRON AND STEEL INDUSTRY.

FROM an official report recently issued on the Russian iron and steel industry, during the ten years of 1879-88, we gather the following particulars:—In 1888 there were in operation in the entire Russian empire 612 iron mines, and iron ore was further raised from 149 lakes. Of the former no less than 522 were situated in the government of Ural, and of the latter, 132 in Finland. The total output of ore, according to the *Iron Age*, amounted to 1,381,000 tons, of which 42,000 tons were lake ore. Compared with 1887, there is an increase of 75,500 tons. Naturally, the Ural shows the highest output — 778,000 tons. The number of works producing pig iron was 132, with 200 furnaces, producing 612,000 tons, of which quantity more than three-fourths was smelted with charcoal. Again the Ural shows the largest output—nearly 400,000 tons. The largest make at one works was 50,000 tons—viz., by the foundries La Nouvelle Russie, in the government of Catherinoslav, where, by the way, coke is solely used in the smelting. Compared with 1887, the make of pig has increased 52,000 tons, or nearly 9 per cent. During the period 1879–88 the manufacture of pig iron in Russia has increased 230,000 tons, or 54 per cent. Up to 1886 the

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MACHINE FOR CLEANING TINPLATES.

Constructed by the Trethewey Manufacturing Company, Pittsburgh, Pa., U.S.A.

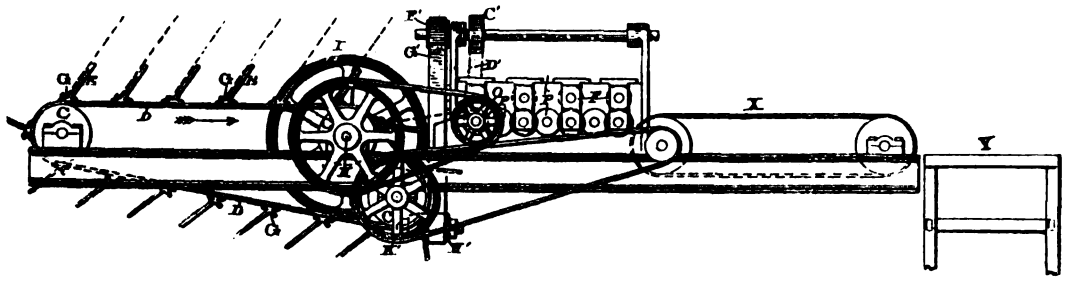


Fig. 1.—Side Elevation.

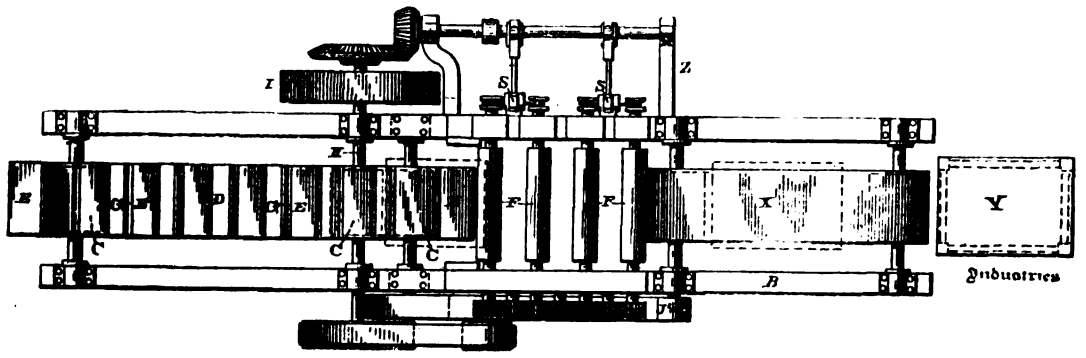


Fig. 2.—Plan.

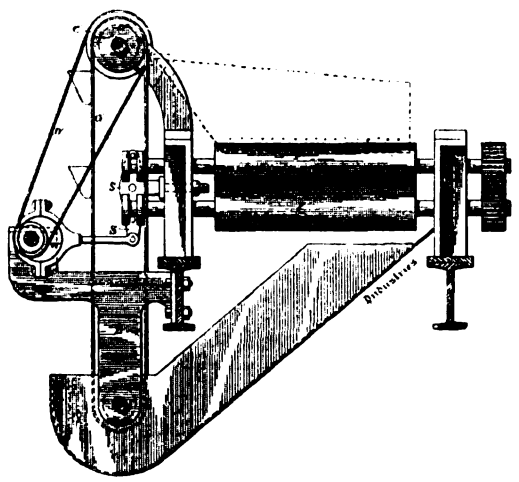


Fig. 3.—End View of Rollers.

increase was slow, amounting only to some 90,000 tons, but since then there has been a rapid progress. The greatest increase—41 per cent.—falls upon the district of Moscow. As regards the bar-iron industry, we learn that in 1888, 173 works were engaged in it, the make amounting to 350,000 tons, an increase since 1887 of only some 4,000 tons. The Russian bar-iron industry shows but slow progress during the period 1870–80, the total increase being only 81,000 tons. Like the bar-iron industry, the Russian steel industry advanced insignificantly in 1888, the manufacture amounting to 211,000 tons, or only 3,000 tons more than in 1887. The production has decreased as much as 37 per cent. in Finland, on account of the standing still of the largest steel works in that country, but increased in other provinces. At the works of the well-known Muta-Bankowa Company, the increase of manufacture amounted to 3,500 tons. During the decennial period referred to the manufacture of steel in Russia has fluctuated very much; for instance, 1880 shows a production amounting to 300,000 tons, whereas, in 1885 it had declined to 180,000 tons. Of the quantity produced in 1888, 1,100 tons were made by casting, 2,300 tons by puddling, 49,500 tons by the Bessemer and 154,000 tons by the Martin process, and 4,100 tons by the Franche Comté process. The number of steel works in the country was 32. The manufacture of steel rails amounted to 61,000 tons. Finally, as regards the relations between the consumption and the iron required to be imported in Russia to cover the former, we learn that the country supplied in 1888, 90 per cent. of the pig iron required, 85 per cent. of the bar iron, and nearly 96 per cent. of the steel. The report also contains a table which shows in the most striking manner the effect exercised of late years by the steady increase of duties in Russia—viz., a falling off of imports and increase of production, particularly as regards pig iron. Thus in 1879 the production of pig amounted to 420,000 tons, and the imports to 180,000 tons; whereas, after ten years of steadily increasing protection, the relative figures were 612,000 tons and 73,000 tons.

MACHINE FOR CLEANING TINPLATES.

The Americans appear to be conscious of the fact that, notwithstanding the McKinley Tariff, it will be impossible for them to compete successfully with South Wales in the manufacture of tinplates unless mechanical appliances are largely adopted in the place of our hand labour. It will be a matter of considerable interest, therefore, to watch the various applications of machinery to operations which, owing to our cheaper labour, have generally been done by hand in this country. Chief amongst these is the rubbing and dusting of the plates after they have received the tin coating—an operation that prepares them for the assorters. This work, which is eminently fitted for women and girls, is accomplished at a cost that hardly reaches 1½d. per box. It would, therefore, appear that there is no great margin for a reduction in the cost of manufacture on this head; nevertheless, if—as may be quite possible—a machine can do the work for the odd ½d., saving the 1d. per box to the manufacturer, we have the possibility of a total saving of £25,000 on six million boxes—a quantity that is below the total make of the last six months.

We are, therefore, pleased to place before our readers several illustrations, representing, in Figs. 1, 2, and 3 a side elevation, a plan, and end view respectively, of a machine for cleaning tinplates, the invention of Mr. Isaac Davies, of Phœnixville, Pa., U.S.A., controlled by Messrs. Davies & Phillips, 200, Walnut Place, Philadelphia, and constructed by the Trethewey Manufacturing Company, of Pittsburgh. It will be seen that the main parts of the apparatus are an endless band D with supports E for the tinplates to lean against as they are carried forward by the motion of the pulleys C. As the belt continues moving in the direction of the arrow in Fig. 1, each plate is carried round and automatically delivered between the first pair of a series of rollers F (Fig. 3), which, in addition to the rotary motion, have a reciprocating motion imparted to them by the levers S worked from the eccentric W. Thus, as the top rollers are moving endwise in one direction, the bottom rollers move in the opposite one, and by this means a thorough rubbing or scouring of the plates passing between them is effected. The plates are then deposited upon the endless belt X, which conveys them to the table Y in the assorting room. The bran, sawdust, or other cleaning material falls into the chute I^1, from which it is readily gathered by buckets attached to the belt G^1 (Fig. 1), and carried up to continue the operation.

The particulars and illustrations are taken from the *American Manufacturer*, but our contemporary does not mention the material of which the rollers are made. It is obvious, however, that they must be covered with leather or some similar material. Nor is it very clear whether the plates are cleaned at one pass, for the bran does not appear to have access to the under side of the plates, and a second passage through the machine with the plates reversed would, in that case, seem necessary in order to complete the operation.

ON TESTS FOR STEEL USED IN THE MANUFACTURE OF ARTILLERY.*

(*Concluded from page* 531.)

There is no contesting the fact that the effects above described do follow sudden changes of temperature; but the action is by no means regular, because both the allotropic and chemical changes in the material are influenced not only by changes of temperature, but also by the state of pressure or tension which such changes tend to produce, so that certain combinations of pressure and temperature may develop much more marked effects than others. This is well illustrated by the changes which take place in drawing and rolling metals and their alloys; they are rendered hard and brittle by mechanical tensions and pressures alone, and often to the same degree as by sudden cooling. The difficulties which surround the framing of a specification for gun-steel were enhanced by the circumstance that till quite lately the steel makers did not manufacture guns, at least for Her Majesty's service, while the gun makers did not produce the steel which they required. Hence it became necessary to test the material practically in the rough forged state, and by a process which aimed more at ascertaining what the steel was likely to do when ultimately treated in the recognised manner, than to determine its properties in the particular state in which it was tested, which was consequently not the condition in which it was to be built into the gun. The specification now in force in Her Majesty's service lays down that the specimens, which are to be cut from the components of the guns in a carefully specified manner, are to be 1in. *diameter* by 4½in. long; they are to be heated to 1,425° Fahr., or a bright red, and quenched in oil of 65° Fahr. temperature, and left in the oil till cold. They are then to be turned down for a length of 2in. to a diameter of 0·533in., and tested by tearing asunder. Bending tests on specimens 4½in. long, and 0·75in. wide, and 0·375in. thick, cut to these dimensions after being oil hardened, are also prescribed. In samples so small the probability is that the internal stresses set up by the oil treatment, even though it is not followed by annealing, are not very severe, and they are greatly relieved, in the specimens tested by tension, by turning off nearly a ½in. all round the operative part. But the temperature at which the hardening is effected lies between two temperatures at which important molecular changes take place in the material. The researches of Gore, Barrett, Osmond, Professor Roberts-Austen, and others, show that at about bright red heat, or 1,500° Fahr., iron undergoes a molecular change, made manifest by the evolution of heat sufficient, if not actually to raise the temperature of the metal, at any rate to retard its rate of cooling. Such evolution of heat must be due to molecular or atomic change, which is clearly reversible. In heating a bar, the rate of absorption must be momentarily increased at the point of recalescence; in other words, the specific heat of the material is increased at a particular temperature; or rather, as a molecular change has taken place, the heat absorbed or evolved should be more correctly called latent. We have no information as to whether a change in specific gravity takes place also; but since liquid iron is more dense than solid, it seems probable that increase of density commences at the point of recalescence, and is maintained when the metal passes into the fluid state. A similar phenomenon is apparent in water, which attains its maximum density at 39° Fahr., and then commences to expand as the temperature falls, and maintains that expansion till converted into the ice into which it ultimately turns. Water colder than 39° Fahr. appears to be an allotropic form of water warmer than that temperature.

The allotropic change which takes place in iron at 1,500° Fahr. is probably accompanied by a change in physical properties, producing what Osmond has called α and β irons. Apparently, when the change takes place in gradual cooling, the β iron, that of the higher temperature, and which Osmond conceives to have hard molecules, passes into the α state, in which he supposes the molecules to be soft. Cooled rapidly, in either state soft iron results; but in the presence of carbon or of some other substances, the β iron is supposed to retain some of its hard nature, and to be the cause of hardening in steel.

In addition to this change in the iron, which forms the main component of steel, it is now demonstrated by the researches of the President, Akerman, Osmond, and others, that the carbon, at any rate of steel, exists in two conditions, namely, either in the form of a definite compound of carbon and iron dissolved in an excess of iron, or as finely subdivided carbon diffused through the mass, and that at certain temperatures association and dissociation take place, the combined carbon becomes diffused, and the diffused carbon combines. The act of combination being a chemical process, might be expected to declare itself in the evolution of heat, and the researches of Osmond, laid before this

* Paper read before the Iron and Steel Institute on the 6th ult., by Dr. W. Anderson, M.Inst.C.E.

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Institute last year, abundantly show that at about the temperature of 1,200° Fahr., or red heat, such an evolution of heat does take place.

Struck by the importance of the researches to which I have drawn your attention, and imagining that the methods pursued by Osmond opened up the possibility of arriving at a knowledge of the condition of large masses of steel with respect to their uniformity of composition and physical condition, I suggested to the Institution of Mechanical Engineers that it could not do better than institute a systematic research into this matter. The proposal was adopted with the utmost readiness; a strong committee, of which our President is a distinguished member, was formed, and Professor Roberts-Austen was requested, adequate assistance being provided, to undertake the work. He readily accepted the task, and I venture to think that already very encouraging success has been met with. It would obviously be improper for me to explain here the means by which the work is being carried out. A report will very shortly be presented to the Institution of Mechanical Engineers. It will contain the fullest information, and I will therefore only state that Osmond's experiments have been repeated, the rate of cooling of specimens has been registered by the most ingenious automatic methods, and curves produced from which it is possible for even an inexperienced eye to detect the two points to which I have drawn your attention. The mode of procedure requires but very small samples, and a few minutes suffice to obtain a record; so that I am sanguine that before very long a method will be arrived at by which it will be possible to determine the quality and conditions of masses of steel, from the mere shavings turned off, far more accurately and rapidly than by means of any test which we are able at present to apply; and this power is of vital importance now that we propose to build up guns of immense masses of steel, the quality of which, though it may be determinable by present methods at the ends, cannot be ascertained without great loss in other parts of their length.

The investigations prove, at any rate, that steel is being treated, or ill-treated, now at temperatures which lie between two critical points, separated from each other by only some 300° Fahr. It has to be treated in masses of ever-increasing magnitude, and the temperatures at which the hardening and annealing are performed can only be judged of by the eye—an extremely unsatisfactory method, considering how much the appearance of a heat is modified by the intensity of the light around. I cannot divest myself of the feeling that the apparently capricious behaviour of steel is due not only to the internal stresses engendered by oil hardening, but also to the circumstance that the chemical condition of the steel, and its molecular structure, are greatly influenced by comparatively slight errors of judgment, or by carelessness in the adjustment of the temperatures at which the operations are performed. The circumstance that within the last two or three years three important firms have undertaken the manufacture of heavy guns from steel of their own producing, and have introduced powerful forging presses, renders it possible to modify our specifications in the sense that more attention shall be paid to the nature of the steel employed, and to the mode of working it, than heretofore. It is in contemplation to provide that open-hearth steel only shall be used; that the ingots shall be treated in a special manner when hollow forgings are to be produced; that a certain minimum amount of work shall be put into the steel, and that annealing from a red heat, or about 900° Fahr., shall always be the last operation, even if the mechanical properties aimed at can be attained without hardening in oil or water.

It is remarkable that foreign nations appear to attach much more importance to determining the elastic limits than is done in Her Majesty's service. The French and American specifications prescribe both the elastic limit and the ultimate strength. The Russian specification defines the elastic limit only, though the ultimate elongation per cent. is prescribed. I believe that the Germans follow the same rules, though I have been unable to obtain any direct information on this point. In Her Majesty's service a limit of permanent extension under a load of 21 tons per square inch is prescribed, and a note is to be taken of any yielding under a less load; but the term "elastic limit" is carefully excluded, on the ground that no such limit can, in fact, be defined.

All foreign nations seem to prescribe hardening in oil, though no mention is made of any particular temperatures, and in all cases the first and the last operation must be annealing, after which only the test-pieces are taken. At the Abouchoff Steel Works the hardening and annealing is practically one operation, the object to be treated being immersed in the oil only for a short period, the duration of which is a matter of judgment, and depends upon the dimensions of the steel. It is then rapidly withdrawn, and returned to the heating furnace, where it is allowed to cool slowly.

It is impossible, within the limits of a paper suited to these meetings, to enter into all the details of the question I have ventured to bring before you. My object is to draw attention to the recent advances in the theory of steel, and to suggest how the knowledge, even now, in our posession must gradually affect our practical work. I trust that the discussion, which will no doubt arise, will give to the world the knowledge and experience which is so peculiarly the dower of the members of the Iron and Steel Institute.

ECONOMICAL PUDDLING AND PUDDLING CINDER.*

In 1784, or a hundred and seven years ago, Cort invented the puddling process, and thus laid the foundation of much of the prosperity of this country during the century which followed. The present importance and vitality of the industry is shown by the remarkable fact that, despite the wonderfully simple method invented by Bessemer, and the beautifully perfect furnace of Siemens, it has required thirty-five years of sharp competition to render the weight of Bessemer ingots annually produced in this country equal to that of the puddled bar manufactured by the old process. This vitality is due in great measure to the fact that, for certain purposes, the characteristic properties of wrought iron render it preferable to mild steel, and is doubtless also in part due to the circumstance that in many cases capital has been invested in an ironworks, and cannot now be easily realised or converted into more modern plant. At all events, the success of the puddling process can scarcely be due to the interest which ironmasters have in the past taken in the more theoretical or scientific aspect of their business, for we find, on examining the literature of the subject in this country, that, with the notable exception of Mr. Henry Kirk, of Workington, one of the original members of the Institute, the contributors have been, almost without exception, either professional chemists or teachers, and may, therefore, like the writer of this paper, be considered amateurs. For our knowledge of the manufacture of cast iron and steel, on the other hand, we depend largely on the work of men connected with the particular branch they studied, and it is somewhat characteristic that the best known, and probably the first systematic, investigation of the changes which take place during puddling was made a year after the Bessemer process was introduced. Even at the present day, despite the fact that this Institute has been in existence over twenty years, there are to be found those who successfully conduct ironworks, and yet have no more understanding of the theory of the process than had Cort himself a century ago.

This apparent want of interest shown by the practical man in the scientific aspects of puddling is probably due in part to the knowledge that the information generally supplied is either incomplete, and not quite what is wanted, or that it is actually incorrect, and consequently misleading. As an example of the first, we are commonly informed that the impurities of the pig iron are oxidised by the oxide of iron present in the fettling, and such an explanation, when it is added that the carbon passes off as gas, while the silicon, phosphorus, and manganese remain as oxides in the slag, is generally considered sufficient. To this it may reasonably be objected that it is very doubtful whether it is possible successfully to puddle a tolerably pure pig with pure ferric oxide alone. It would, at all events, certainly lead to waste of time and metal in the early stages of the process, owing to a deficiency of fusible cinder, would probably lead to thick slag and inferior iron at the end of the process, and would also be very liable to cause the bottom to scurf. These facts show the importance of a due proportion of silica, ferrous oxide, and phosphoric anhydride in puddling cinder in order to ensure the requisite fluidity, a point which is seldom referred to in explanations of the process. But further information is also necessary as to the manner in which the oxide of iron present in the furnace acts upon the impurities of the iron. Thus, if we consider, for simplicity only, the case of carbon, a number of actions are possible, such as—

$$\left.\begin{array}{l}(1.)\ Fe_2O_3 + 3C = Fe_2 + 3CO\\ (2.)\ Fe_2O_3 + C = 2FeO + CO\end{array}\right\}\ \text{With ferric oxide.}$$

$$\left.\begin{array}{l}(3.)\ Fe_3O_4 + 4C = Fe_3 + 4CO\\ (4.)\ Fe_3O_4 + C = 3FeO + CO\end{array}\right\}\ \text{With magnetic oxide.}$$

$$(5.)\ FeO + C = Fe + CO\quad \text{With ferrous oxide.}$$

If 12 parts by weight of carbon be taken as a standard for comparison, and the above equations are arranged in the order of iron reduced and fettling used, we have the following values:—

Equation.		Iron Reduced.		Fettling Used.
(5.)	...	56	...	72
(3.)	...	42	...	58
(1.)	...	37	...	53
(2.)	...	0	...	160
(4.)	...	0	...	232

Hence, taking the two extremes, according to equation (5). 1lb. of carbon would reduce 4⅔lb. of iron, and use 6lb. of fettling; while, according to equation (4), 1lb. of carbon would reduce no iron, but use 19⅓lb. of fettling; yet a well-known Cleveland chemist uses equation (5) to explain the removal of carbon, while the author of a recently issued text-book explains the action according to (4).

Now the most important reaction for the removal of carbon may be some one of the five above represented, or the process may be the result of several, or of all of them together. Again, the reaction by which carbon is removed may be of one kind, and that by which phosphorus is eliminated may be of another, and thus a whole range of possibilities is opened up to view, on which, so far as I am aware, no definite information is at present attainable. And yet these questions are of the greatest practical importance, as their solution would enable us to theoretically predict the yield of an iron of known composition, and to say what quantity and composition of fettling would give the most satisfactory results. At present we only know that some of the "commonest," that is, the most impure irons, give the largest yield in the puddling furnace; but these irons lose most in the mill, the final result being approximately an equal weight of finished iron in each case. The quantity and quality of fettling also is usually arrived at by trial, frequently involving much loss from waste and trouble; and having once been determined, is often regarded as an important trade secret, and is rigidly adhered to, despite the variations which are usual in the pig iron to be treated. These remarks will perhaps be sufficient to indicate the incompleteness of our present knowledge, but it may be well just to point out that the information derived from other processes, or from crucible experiments, will in many cases prove but an unsafe guide to the understanding of the changes which take place in the puddling furnace.

To illustrate my statement that the explanations given of the puddling process are frequently incorrect, and consequently misleading, we have merely to examine the usual chemical and metallurgical text-books. The late Dr. Percy, in his classical "Iron and Steel," was inclined to favour the view that during puddling phosphide of iron was separated by liquation, and he regarded the exact explanation of the removal of phosphorus as obscure. Greenwood, twenty years later ("Steel and Iron," 1884, page 253), favours a similar view, stating that "the rationale of its separation is not clearly understood." On the other hand, Miller ("Chemistry," sixth edition, 1878, edited by Groves, page 624) states that silicon and carbon are removed during the earlier stages of the process, while sulphur and phosphorus resist oxidation, but are afterwards removed by the violent stirring of the puddler when the mass is becoming granular. Bauerman, again ("Metallurgy of Iron," 1882, page 329), who gives a more than usually good account of puddling, says, "The removal of the foreign matters takes place in the following order—first silicon, then manganese, then phosphorus, and, lastly, sulphur." One further illustration will suffice. Hiorns ("Iron and Steel Manufacture," 1889, page 88) gives merely the following naïve explanation:—"The ferruginous slag formed takes up oxygen from the air, causing FeO to pass into Fe_3O_4, which then oxidises the impurities in the order of their oxidisability—viz., silicon, manganese, phosphorus, sulphur, and carbon." It will be sufficient to remark, with regard to this extract, that the order given is not the "order of oxidisability" of these elements, and that when the elements are combined with iron the "order of oxidisability" depends altogether upon circumstances.

These quotations show that even in connection with such an important matter as the removal of phosphorus, one of the most fundamental reactions of puddling, considerable difference of opinion is expressed. Thus one author asserts that phosphorus is removed at the beginning of the process, another that it is eliminated at the middle, a third that it passes out at the end, and a fourth that it is eliminated uniformly throughout the whole operation. To make the matter complete, we only need some one to assert that it never passes out at all! In view of such confusion, and bearing in mind that one reason for the continued prosperity of the puddling process is the fact that it is most suitable for a class of irons too rich in phosphorus for use in the acid processes of steel-making and too poor for the basic processes, it is no wonder that practical men have felt inclined to pay but little heed to the theoretical aspects of their business. The conditions which influence the success of the work in the forge may be divided into two classes, according to whether they are directly or but very indirectly connected with chemical considerations. Of those conditions which are outside the province of the chemist, there is, of course, the fundamental question of finance, which is the backbone of all industry, but which cannot be discussed here. In addition, we have the necessary working conditions, which include:—

1. A furnace of suitable shape, size, and construction.
2. Fuel, which must be cheap, fairly pure, and of high calorific power.
3. Cheap and skilful labour.

In connection with suggested improvements in the first of these conditions, great hopes have been raised and enormous sums of money expended since this Institute was formed. And yet, in this country at all events, rotating or revolving furnaces after extended trial have been abandoned, double furnaces are seldom used, and any mechanical aid to the puddler is quite exceptional. Gas-firing, too, is but seldom employed, since with small puddling furnaces this leads to complications of ports and valves, to reduce which larger furnaces are necessary. Hence, to obtain the full benefit of gaseous fuel, larger blooms and fresh machinery would be necessary, and it is found more convenient to melt and cast the metal, since a sufficiently high temperature is at command, and thus steel is obtained.

At present, therefore, there seems to be no halting-place between the use of the ordinary puddling furnace on the one hand, and the manufacture of steel on the other. In the palmy days of the iron trade, the family of Crofts of Tipton were I believe, the chief furnace-builders of this country; and the furnaces used in Staffordshire, which is the chief wrought-iron making district of the world, and hence may be considered representative, are still almost exactly of the pattern then built. In some cases improvements have been introduced in the methods of cooling the bridge and sides; closed fire-places with forced draught, or fire-bars of special shape are successfully used with small fuel, while the water-cooled doors used by Mr. Yeomans at the Old Hill Works, belonging to N. Hingely & Sons, Limited, are a great advantage to the puddler. Otherwise, so far as I am aware, there has been little alteration during recent years.

In dismissing the third condition of success above enumerated, I dare not attempt to discuss the great questions of to-day, upon which members of this Institute are divided; but I feel confident of this much, that the continuance of the Staffordshire iron trade has been rendered possible only by the fact that during the last fifteen years puddlers of unusual skill have been obtained at moderate wages, and that if this condition of things were seriously altered, it would be most disastrous to the trade of a district already heavily handicapped by its distance from the seaboard.

Among the conditions which come more directly within the province of the metallurgist and chemist, we have the composition, amount, and physical and other properties of—

1. The metal employed.
2. The fettling used.
3. The wrought iron obtained.
4. The cinder produced.

These conditions are naturally closely related to each other, and are to a large extent interdependent. Their proper understanding also necessitates an acquaintance with the nature and sequence of the changes which take place during the puddling process.

To discuss the question of the relative economy of forge irons of different chemical composition would involve more time and space than is at my disposal, and this is less necessary on account of the fact that during the last few years several papers have been published on this particular subject—the more important of which are those by Mr. A. E. Tucker and Mr. H. Kirk—which would well repay the careful perusal of those interested in the matter. In Mr. Tucker's second paper are to be found analyses of upwards of fifty samples of pig iron, most of them forge irons, and in the majority of cases the price of the iron is given with the analysis. Having had several opportunities of examining the large number of analysed samples of forge irons thus collected, I can testify to the interest and value of such a collection. Mr. Tucker emphasises the untrustworthiness of fracture as an indication of composition, and the extraordinary want of relation between some of the market prices of pigs and their real value, both of which are points of great importance. Mr. Tucker further shows how the approximate value of a pig for forge purposes may be estimated, the basis of his calculations being the statement that the process of puddling "consists in the absorption of silicon, sulphur, phosphorus, and manganese, contained in the pig iron, by the oxide of iron used in the fettling and in the removal of the carbon by the reduction of the fettling to metallic iron. We have, therefore, a debit and credit account, a loss in weight due to the bodies named, and a gain in weight due to the production of metallic iron from the fettling." Such a

* Paper read by Mr. Thomas Turner, Lecturer on Metallurgy, Mason College, Birmingham, before the Iron and Steel Institute, on the 7th ult.

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THE NICARAGUA CANAL.

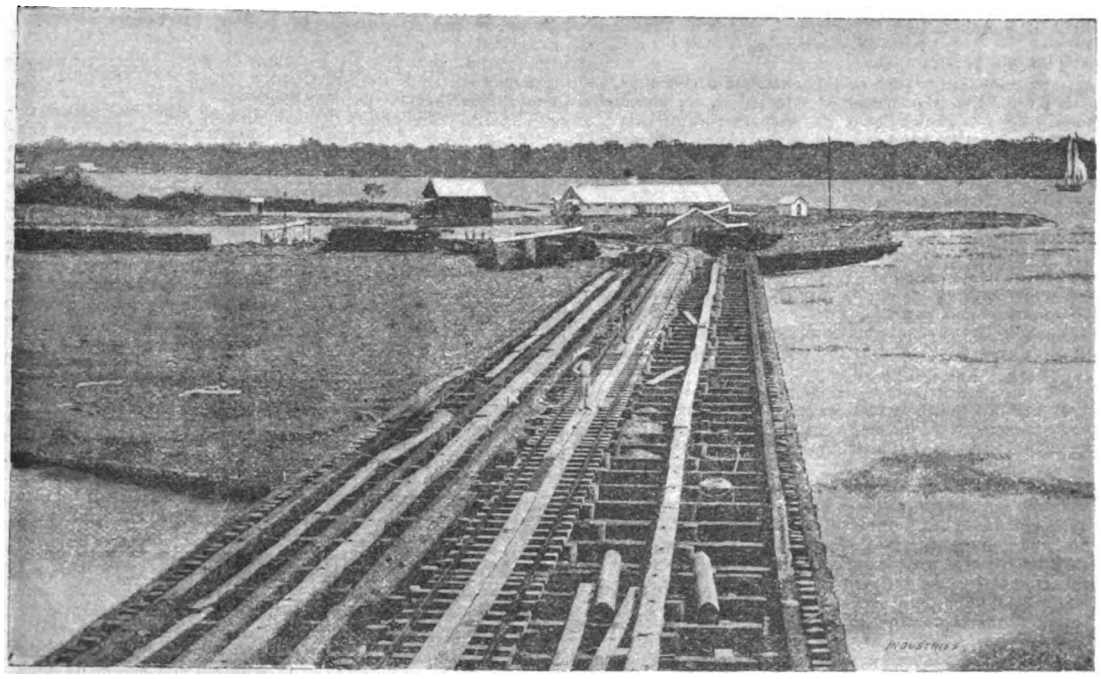


Fig. 13.—The Breakwater at Greytown looking Landward.

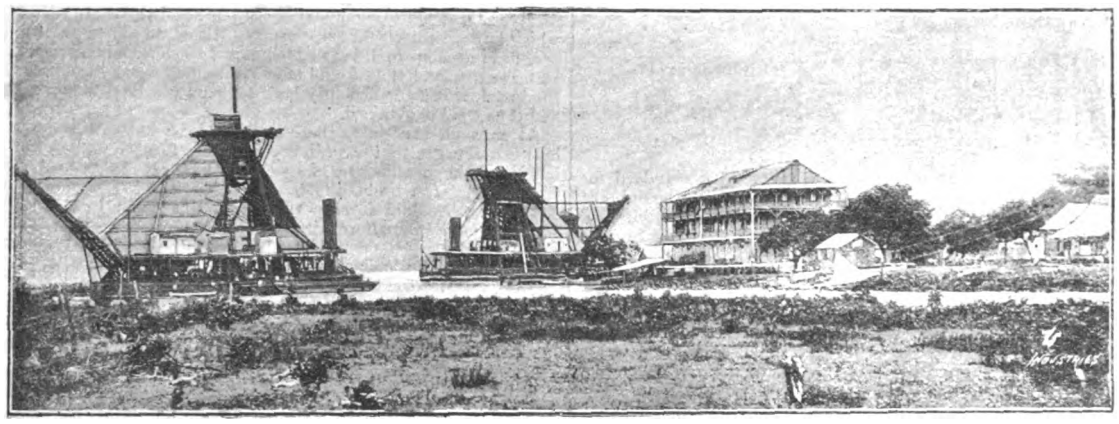


Fig. 14.—Storehouse and Dredgers "Dingler" and "City of New York" at La Fé.

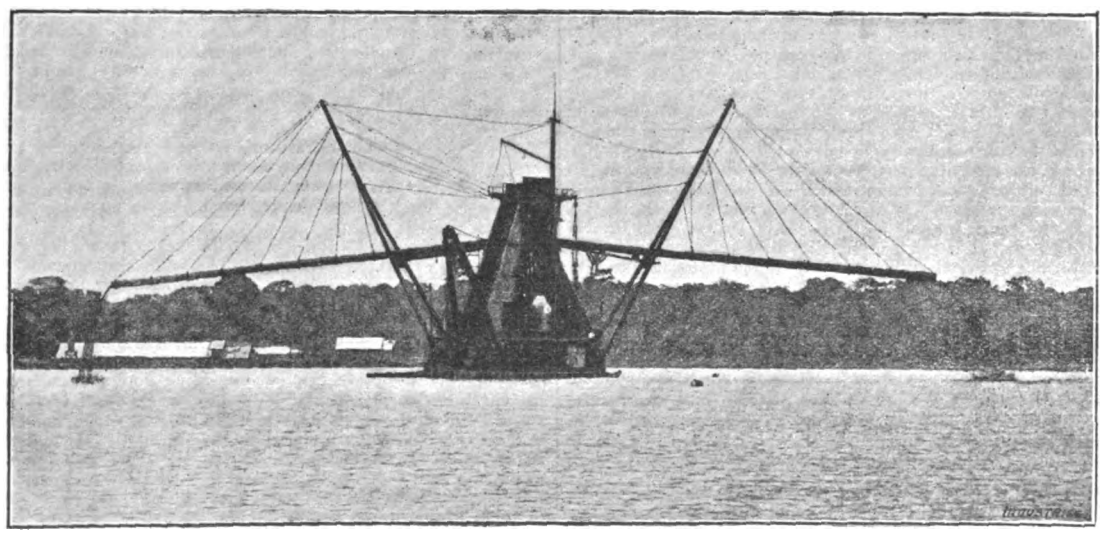


Fig. 15.—Dredger "City of Paris" at Work in Greytown Harbour.

method of calculation is simple, and certainly enables one to distinguish between a good pig and a very bad one; but, after all, it is merely an approximation to the truth. For it is probable that some at least of the carbon is oxidised by ferric oxide without reducing an equivalent quantity of iron from the fettling; and it is pretty certain, on the other hand, that silicon, sulphur, phosphorus, or manganese may, under suitable conditions, be oxidised by ferrous oxide, and thus reduce some iron from the fettling. Hence the rule above given, though useful in many cases, fails to explain why an iron unusually rich in phosphorus and silicon often gives the largest yield of puddled bar, while a very pure iron will also yield a greater weight of puddled bar than that of the pig iron charged into the furnace, and an intermediate iron, of what may be considered good ordinary quality, loses 3¼, 5, or more per cent. of its weight. It is in order to explain these apparent anomalies that, as I have previously pointed out, more accurate knowledge is required with reference to the action of oxide of iron on the various impurities in puddling.

Before leaving this part of the subject it may be well to give the approximate composition of forge pig iron of typical kinds, as used in South Staffordshire:—

	No. 1.		No. 2.		No. 3.		No. 4.
Carbon.....	2·60	...	3·60	...	3·00	...	not given
Silicon.....	1·20	...	1·25	...	2·00	...	·992
Sulphur	·08	...	not given	...	·10	...	·144
Manganese...	·50	...	·50	...	·25	...	·693
Phosphorus..	·57	...	1·00	...	1·80	...	1·233

No. 1 is an analysis of South Staffordshire all-mine pig, a turn of six full heats of which would require about 26½ cwt. of pig and 13 cwt. of fettling, while it would yield about 27½ cwt. of puddled bar. No. 2 is the composition of a standard pig for puddling, as used by Mr. Tucker for purposes of comparison; this will work into puddled bar with a loss of about 3½ per cent. No. 3 represents a cheaper part-cinder mixture used in South Staffordshire, and which is not very different from Cleveland pig. No. 4 shows the average consumption of a half-year's pig iron of all sorts, best, crown, and common together, as given by Mr. Kirk in his paper above mentioned, and the yield, as verified from the firm's books after stockstacking, showed a loss of exactly 3¼ per cent. With an iron of this composition, Mr. Kirk has shown that seven heats per turn may be regularly obtained. I need scarcely add that such results are not merely unusual, but unexcelled.

The presence of some silicon is necessary in forge iron for the ordinary or "boiling" process, as otherwise the iron is "dry" and unsatisfactory in the furnace, though this can be to some extent remedied by the use of hammer slag or other silicious fettling. Generally, the cheaper forge iron in Staffordshire are too silicious and "hungry." This requires more time, uses more fettling, makes the cinder too thin, and gives a brittle bar. Some phosphorus is also an advantage in puddling, as it prevents the cinder from getting too thick at the end of the operation, and thus causing a variety of red-shortness. Too much phosphorus, on the other hand, leads to waste of iron and fettling, and renders it impossible to produce a good fibrous iron, unless, indeed, an unusually large proportion of fluid cinder is used, and the boil is conducted at the very highest attainable temperature. The presence of manganese is an advantage, as it indirectly assists in the more complete elimination of phosphorus. It is not possible to lay down any hard and fast lines as to a best or typical composition of pig for forge purposes. This will vary largely according to the local conditions, the fettling employed, and the quality of the product. In this country the pig iron made from the clay ironstone of South Staffordshire, South Wales, and West Yorkshire, is of the highest reputation, and, chemically, is all that can be desired; while, when it can be obtained, such an iron as that used by Mr. Kirk can be thoroughly recommended.

(To be continued.)

THE NICARAGUA CANAL.

VI.

WORK SO FAR ACCOMPLISHED.

(Concluded from page 533.)

On the 25th of May, 1889, the first expedition for the construction of the canal left New York, and landed near Greytown at the proposed entrance to the channel on the 3rd June.

The indispensable preliminary to the formation of the canal itself was, of course, the improvement of the harbour of Greytown. The first operations were necessarily of a pioneer character, and attended with considerable difficulties. Temporary shelters for the protection of men and stores had to be erected, and means of transport along the route of the canal through swamps and virgin forests to be provided. It was also necessary to establish telegraphic communication with the nearest station, over 100 miles distant from the coast, and between the various camps and the base of operations. Owing to the absence of a harbour, from causes already explained, ships have hitherto been obliged to anchor about two miles off shore, and all machinery and supplies had to be landed in lighters through a shifting entrance and over a dangerous bar.

The formation of a channel from the sea into the bay was, under such conditions, the first work required, and this was put in hand as soon as practicable. A breakwater is in process of construction, and, under cover of this, the dredging of the entrance channel is being carried on.

According to the most recent report of a party of engineers and scientific men, who returned to New York from a tour of inspection of the canal works on the 6th ult., the breakwater at Greytown, a view of which we give in Fig. 13, now extends 1,000ft. into the sea, and there is a depth of 14ft. of water where previously the bar existed blocking the entrance to the harbour. In the early part of the present year the first steamer passed over the site of this bar. Six large dredgers are on the spot, of which two are at work, while three more will shortly be ready. Three of these—the "Dingler," "City of New York," and "City of Paris"—are shown in Figs. 14 and 15. The excavation of the channel to a depth of 17ft., with a width of 270ft., has been accomplished for a distance of half a mile, the proposed depth being 30ft. For a distance of over ten miles the dense vegetation covering the country has been cleared from the line of the canal. Two views of the clearing work are shown in Figs. 18 and 19 on page 564. Many miles of broad gauge railway are already built, part of which is to connect Greytown with the site of the Eastern Divide Cut. Of this latter portion ten miles has now

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THE NICARAGUA CANAL.

(*For description see page* 556.)

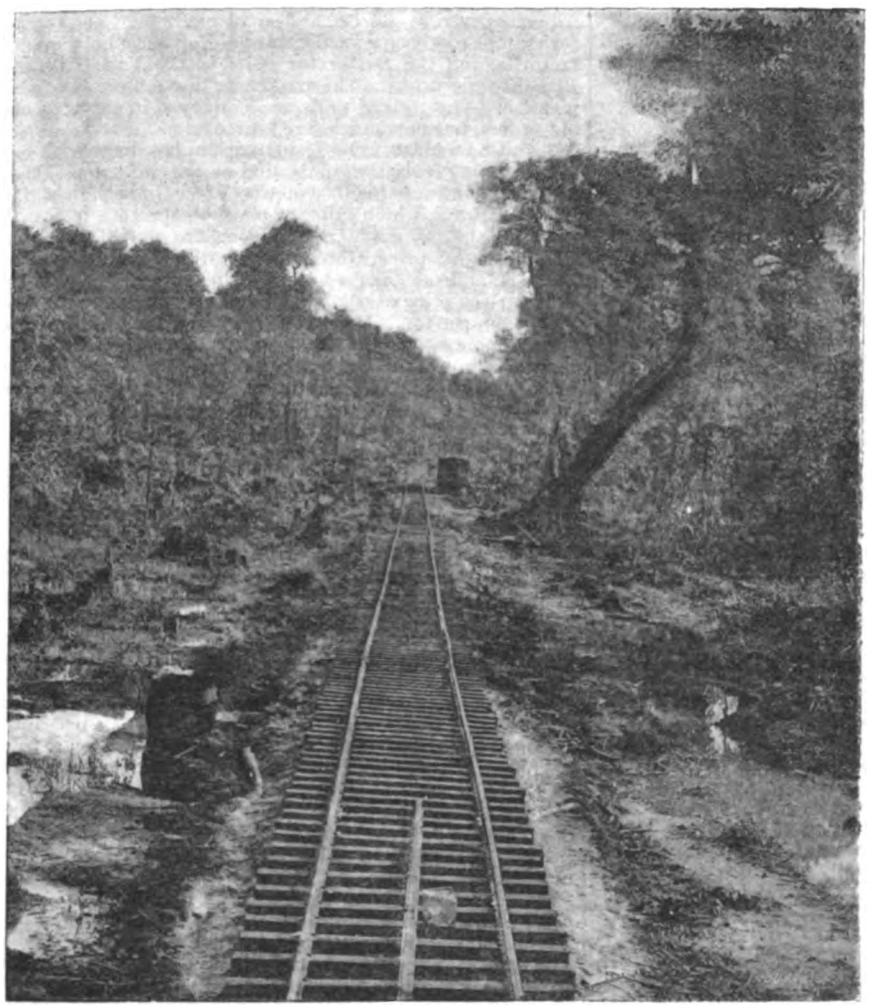


FIG. 16.—COMPLETED RAILWAY THROUGH SWAMP OF GREYTOWN.

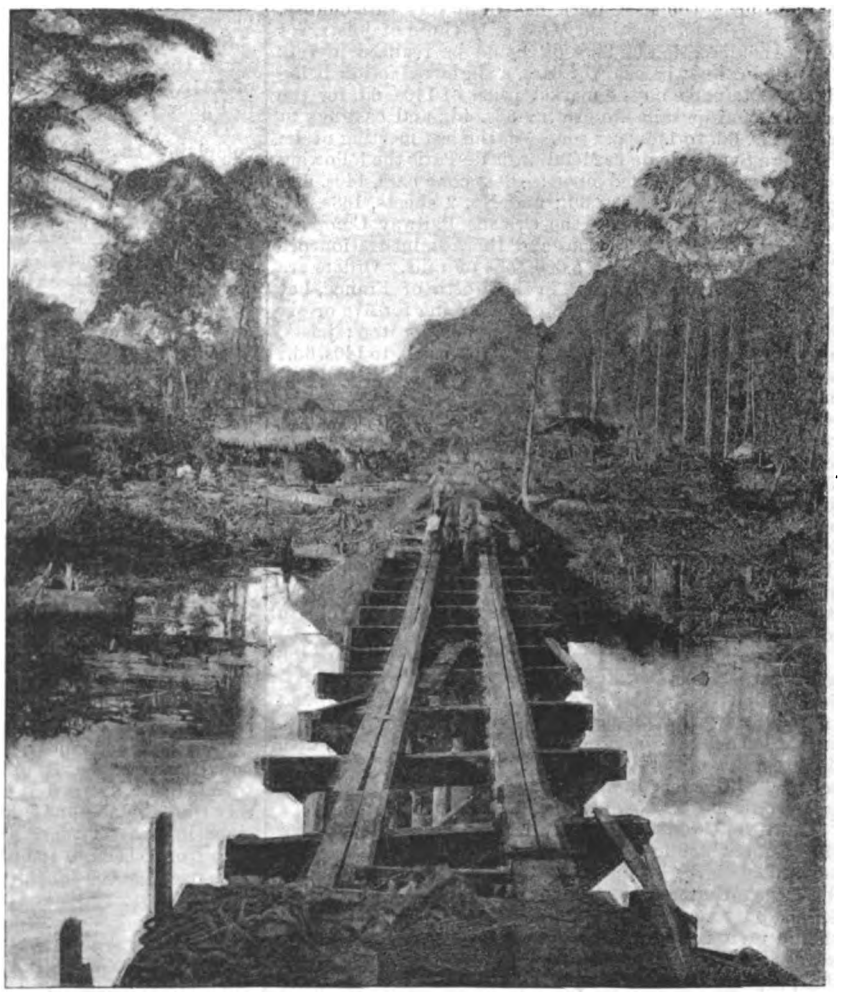


FIG. 17.—RAILWAY BRIDGE ACROSS BENARD CREEK.

been constructed, parallel with the line of the canal, for the transportation of men and machinery, so that the work may be pushed forward simultaneously at different points. We give above, in Fig. 16, a view of the completed railway through the swamp of Greytown, and Fig. 17 shows the railway bridge which has been constructed across Benard Creek. Besides this, machine shops and storehouses, docks and wharves, together with fifty buildings, including hospitals, offices, and quarters, have been erected by the company, some of which we illustrated in our last issue. As the water in the vicinity of Greytown is unfit for human consumption, an aqueduct, thirteen miles in length, has been made, which brings a supply of pure water from the mountains.

Before concluding these articles, we may mention that the Committee of Foreign Affairs of the United States' Senate unanimously recommended a short time ago that a Bill should be brought forward providing for a Government guarantee of the principal and interest of $100,000,000 of bonds to be issued by the Nicaragua Canal Company. We learn, however, from the United States' Consul-General in London, that this Bill has not yet been passed, although its prospects of success at the beginning of the year were decidedly hopeful.

THE STEAMSHIP OF THE FUTURE.

A STEAMSHIP to cross the Atlantic in three days is coming within the sphere of practical engineering and naval architecture, if we are to place any reliance on the opinions of Mr. Carl Schurz, of New York, the President of the Hamburg-American Packet Company. That gentleman was recently tackled by an interviewer, and expressed himself as a great believer in fast time. In his opinion it was quite possible to build ships which could perform the run from New York to Liverpool in three days, and without any greater danger than in the case of the six or seven day steamers of the present day. Mr. Schurz, although sixty years of age, hopes to see his idea carried out during his lifetime if we go on improving at the rate we are going now. He points out that twenty-five or thirty years ago any one would have been ridiculed if he had predicted that ships could cross the Atlantic as they are doing now in a little over six days. He thinks, however, that three or four day ships would not carry freight and passengers, but only the latter, and as the passenger traffic to Europe is constantly increasing this could be done at such rates as to make it profitable. Nowadays, in the regular season, all the ships are crowded to their utmost capacity. People have more money to spend, and not only are more people travelling, but there are more who are taking the expensive lines.

Mr. Schurz has formed his ideas as to the designs of the steamships of the future. They will, he states, be considerably larger than the present vessels, and of course will require engines of greater power in proportion to their size. They must have two distinct sets of boilers, two sets of engines, two shafts, and two screws, both sets working independently of each other, and separated by one solid longitudinal bulkhead, running from the keel to the upper deck, and dividing the vessel into two non-communicating halves, each of which is fully equipped to propel the ship, so that an accident occurring to one side of the ship will in no way affect the other, whose machinery will continue to propel and work the ship with the greatest ease. The water-tight compartments will confine to one compartment any accident that might happen.

In connection with the foregoing we may state that some of the most prominent shipbuilders on the Clyde have been credited with the intention of building a steamer which will be able to cross the Atlantic in five days as soon as they got shipowners enterprising enough to give them the order. Several such orders are said to have been "in the air" for some time, but nothing definite yet appears to have been settled. Possibly the shipowners are waiting until the subject has been a little more discussed by engineers and shipbuilders before they undertake the risk, which involves such a large amount of capital. In the meantime, however, the builders of the "City of Paris" and the "City of New York" have so far taken the matter out of the sphere of speculation as to produce a model of a steamer which is designed to cross the Atlantic in five days. Messrs. James & George Thomson have a reputation which places everything they propose at once within the range of practical engineering, and we have little doubt that they are perfectly competent to perform all they promise. The model is exhibited at the Naval Exhibition, and, although it is impossible to ascertain details from it, still a general idea may be formed. From the engine coamings it would appear as if it were intended to have two sets of engines, placed tandem, driving each screw, giving four complete sets of engines. The "City of Paris," with two sets, each indicating 10,000 h.p., made a speed of 21 knots with nine boilers. If the engines and boilers were doubled in the new ship, it would be possible to have an aggregate power of 40,000 if it were needed, and this should be more than sufficient to give the speed necessary to cross the Atlantic in five days. We should, indeed, imagine that a mean between this and that developed in the "City of Paris"—that is, 30,000 h.p.—would be sufficient, but this can only be ascertained, even approximately, when we know the design of the hull, and after experiments are made with it, for at the higher speeds all calculations are largely matters of guess. Of course, on this point, considering the great competition among shipbuilders for the leading places, Messrs. Thomson do not feel inclined to give much positive information. The subject, however, is one of great scientific and practical interest, and we shall be pleased to have the opinions of some of our readers regarding it.

FATAL ACCIDENTS IN WELSH MINES.

FROM a report of the Government Inspector of Mines for South Wales recently issued, we learn that South Wales is in an unfavourable position as regards safety in working. The proportion of tons raised per life lost in South Wales is 90,410, against a proportion of 167,763 tons raised per life lost as an average throughout the kingdom. In Durham, where the mines appear to be the safest, the proportion is 388,149 tons raised per life lost. In South Wales one person is killed for every 338 employed, the average for the kingdom being one killed for every 528 employed, and for Durham one killed for every 1,080 employed.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 9th June, 1891.

IRON.—The amount of business done on the Paris iron market during the past week has been very satisfactory. Prices were well sustained, especially those of joists, for which the quotation of 148s. 6d. could be realised in full. The same cannot be said for bars, a slight reduction being always obtainable on the market price of 140s. 6d. for the latter. Old iron rails are firm at 88s. 4d., and castings at from 112s. 6d. to 114s. per ton. At the last meeting of La Chambre Syndicale de la Métallurgie de Paris the following quotations were decided upon:—Best coke bars, 140s. 6d.; joists (1st quality), 152s. 6d.; and No. 2 sheets, 168s. 8d. per ton. It is stated that the Orleans Railway Company are going to order 12,400 tons and the Administration des Chemins de fer de l'Etat 5,000 tons of rails. Orders are not so plentiful as they were in the North of France, but the works have enough to keep them going for five or six months. Bars are quoted at 120s. 6d. per ton; joists, according to the width of flange, from 124s. 6d. to 140s. 6d.; best angles, 124s. 6d.; wide flat bars, 136s. 6d.; puddled sheets, 2mm. thick, 160s. 6d.; those of 3mm. and upwards, 144s. 6d.; and boiler plates from 168s. 9d. to 184s. 9d. per ton, according to quality. In the Ardennes the situation seems to be slightly better than it was in the previous week. The price of 120s. 6d. per ton is well sustained by the rolling mills, and the foundries are fully occupied. The contract for pipes for the Paris (Vigne and Verneuil) water supply, amounting to 3,400 tons, was adjudged on the 30th ult. in part to the Société d'Aubrives, and the remainder to the Société de Commentry-Fourchambault. In the Meurthe-et-Moselle and Haute-Marne districts there is no change to be noted.

COPPER, TIN, AND LEAD.—The official quotations for the past week on the Paris copper market were as follow:—Best Chilian bars, £59 5s.; ordinary Chilian bars, £57 5s.; ore (Chilian) in ingots, £59 15s.; and best selected, £60 18s. per ton. There has been no change in the price of tin with the exception of Cornwall, which is now quoted at £102 15s. per ton. Lead has improved slightly in value, the latest quotation being £13 5s. per ton.

THE LATE COLONEL LEBEL.—Colonel Lebel, the inventor of the rifle which has been adopted by the French Government, died on the 7th inst. at Vitre. After serving during the Franco-German war, and having been taken prisoner at Sedan, on returning to France he was appointed to the charge of a musketry school near Tours. He was afterwards appointed on the commission which was formed for the purpose of discovering a new form of gun, and was director of the Normal School of Shooting at Chalons when the gun of which he was the inventor was adopted.

ELECTRIC LIGHT INSTALLATION.—The Corporation of Saint Etienne invites tenders for the lighting of the theatre in that town. The cost of installation is estimated at £920.

ELECTRIC TRAMWAY.—La Société des Tramways de Paris et du Département de la Seine are about to start, on the 1st prox., a regular service of cars worked by electricity from the Rue Lafayette, near the Opera, to St. Denis, over a line having some very steep gradients. The rolling stock is to consist of twenty carriages, which are being constructed by Mr. George Averly, of Lyons, after an American model. They will carry fifty-four passengers and attain a speed of ten miles an hour.

LEAD IN ALSACE-LORRAINE.—A deposit of lead ore has just been discovered in the neighbourhood of Thann, near Mulhouse. A company has been formed, and experimental works have been commenced which are expected to give satisfactory results.

A SUBAQUEOUS TUNNEL.—The Western Railroad of France will, it is said, build a tunnel under the Seine, near Quillebœuf. The total length of the tunnel is 14,760ft.; 6,560ft. of this is through solid ground, and the tunnel will be driven by the usual methods. The 8,200ft. which passes under the bed of the river will be in a soft alluvial deposit, and will be built with cast-iron lining, circular in section.

BERLIN, 8th June, 1891.

THE IRON MARKET.—The Upper Silesian Works recently tendered at Breslau to supply 1,500 tons of rails at £6 4s. per ton. In February and March the Breslau tenders for rails were at £6 6s. 4d., and the last tenders at Bromberg were at £6 3s. 5d. The Laura Works tendered for 900 tons, and the Frieden Works for 550 tons at £6 4s. The United Royal and Laura Works tendered for 72 tons of outer fishplates, and 66 tons of inner fishplates, at £68 11s. per ton, and for 8 tons and 21 tons of cast-iron or welded bedplates at £61 4s. per ton. The Frieden Railway Construction Works have fixed the price of fishplates at £6 0s. 5d., and the Laura Works at £6 2s. 5d.

THE COAL MARKET.—Statistics given at the general meeting of the Holland Mining Company show an increase in the cost of production. The average wages paid for an eight hours' day were given as follows:—Hewers of rock, 4s. 11d.; hewers of coal, 4s. 7d.; timber and repairing work, 3s. 2d.; barrowmen and brakemen, 2s. 6d. The average of miners' wages is thus 3s. 6d. These figures show a rise of 16 per cent. in miners' wages as compared with 1889, and a rise of 39 per cent. as compared with 1888. The cost of production during 1890 has increased by 10d. per ton as compared with 1889, which is equal to a rise of 15 per cent. Of this increase, 6d. is paid in higher wages, 2d. in higher taxes, and the remainder for the increased price of materials. A contract for the supply of 50,000 tons of compressed fuel has been awarded by the State Railway management in Hanover to the Patent Fuel Union in Dortmund.—Important seams of coal have been discovered between Bayreuth and Neumarkt in Bavaria.

SALT INDUSTRY.—A company has been formed in London under the title of the Hanover Salt Company, with a capital of £175,000, in order to work the rock salt strata near Celle, in Hanover.

TRAFFIC ON GERMAN RAILWAYS.—For some time past complaints have been made both by manufacturers and by the general public as to the traffic management on the Prussian State Railways. A deficiency in the supply of waggons has often been felt by coal merchants, and numerous complaints are made as to the rates for passengers and goods. This unsatisfactory state of affairs on the Prussian railways has been attributed to the want of competition, and the excellent working of English railways has been adduced as a proof of this. The management of the three Berlin tramway companies in view of their increased traffic has been brought forward as a further proof of the benefits of competition. During the year 1890 the traffic in Berlin was as follows:—

	Thousands of Persons.
Great Berlin Tramway	121,250
Berlin-Charlottenburg Tramway	5,631
New Berlin Tramway	14,076
Steam Tramway	2,064
General Berlin Omnibus Company	19,193
New Berlin Omnibus and Parcel Delivery Company	6,928
Total	169,142

As the population of Berlin, including Charlottenburg, is 1,650,885, each inhabitant must have travelled on an average more than a hundred times. If these figures be compared with those of the passenger traffic on the Prussian railways, which shows a total of 250 million persons with a population of about 30 millions, it is seen that each person travels on an average 8⅓ times during the year. The railway traffic is, therefore, capable of being largely developed, since in Prussia there are, besides Berlin, twelve cities with from 50,000 to 100,000 inhabitants, and sixteen cities with over 100,000 inhabitants.

VIENNA, 8th June, 1891.

THE COAL MARKET.—Whilst the demand for coal, especially for industrial purposes, increases from day to day, the strike continues in some districts of the North-West of Bohemia. Those mines which are still in operation are the more actively employed, and there is every prospect that they will continue so. The North Bohemian Coal Mining Company made a profit of £17,346 5s. during the first four months of the current working year, which shows an increase of £3,265 4s. as compared with the corresponding period of the previous year. The Lankowitz Coal Company pays a dividend of 3 per cent. for the past year.

THE IRON MARKET.—The condition of the iron market shows little alteration, but a slight improvement is visible as regards pig iron and rolled iron. Prices are very favourable, and the demand for iron for constructive purposes continues active notwithstanding the advanced state of constructive works. Orders for railway rolling stock increase every day, so that works will be fully employed for some months to come. In Hungary, where there is still a large scope for various industries, the state of the market is encouraging, and many new works are under contemplation, whilst old works are being extended. There is every prospect that the favourable condition of the market will continue.

ELECTRICAL ENGINEERING.—Twenty-six Austrian firms, of which twenty-two firms are in Vienna, are taking part in the Frankfort Electrical Exhibition. Messrs. Ganz & Co., who are represented by the "Helios" Company at Cologne, and by whom their patents are taken out, will probably show some improvements in electrical tramways. The electrical department of this firm is to be extended, and the projected extension is nearly as large as the old works. Messrs. Kremenetzky, Mayer, & Co. have also completed an important extension of their works. These are marked evidences of the actual progress of this industry. Some annoyance is felt at Berlin by reason of the extension of the concession granted to the International Compressed Air and Electricity Company. The company has not paid a dividend this year, and will probably cease to attempt to establish itself in Vienna.

PRODUCTION OF SUGAR IN AUSTRIA.—In the month of April 62,400 tons of sugar were exported, and the home consumption was 24,861 tons. The production from August, 1890, to April, 1891, is given as follows, in tons of raw sugar:—

	1890–1891.		1889–'890.
Original stores	79,320	...	39,620
Net production from August to April	715,342	...	689,912
Exported	348,058	...	328,233
Home consumption	214,180	...	217,599

BRUSSELS, 9th June, 1891.

THE IRON MARKET.—The market shows some improvement, and manufacturers hope to maintain prices. Some important awards of contracts have been made during the past week. The Ougrée Steel Works have contracted for 290 tyres at £10 per ton, and Messrs. Cockrill for 800 tyres at the same price. The Société d'Estampage has contracted for 400 fishplates at £19 4s., and Messrs. Acoz for angle fishplates, iron at £6 3s., and steel at £7 3s. The tender for cramps has been awarded to the Northern bolt manufactories, and the tender for bolts to the Van Calk and Blanchisserie works. The market for raw material remains inactive. The rolling mills are employed in carrying out old orders, but new orders are scarce.

THE COAL MARKET.—The situation has improved, but there is some hesitation in dealing at present prices. The award of contracts for 430,000 tons of coal for the Belgian State Railways, which will take place on the 16th inst., will show the state of the market. If sellers should try to obtain too high a price, German coal will be introduced into Belgium, and soon cause a lowering of prices. The attempt to lower the price of coke has failed, and it is still quoted at 14s. 5d. per ton. During the first four months of the year, as compared with the corresponding period of 1890, the imports of coal have decreased, whilst the exports have been maintained. As regards coke, the reverse is the case.

	1890.	1891.
Import of coal ...	524,362 tons.	494,655 tons.
Import of coke...	10,200 „	48,859 „
Export of coal ...	1,430,017 „	1,486,704 „
Export of coke...	460,335 „	335,040 „

BRUSSELS AS A SEAPORT.—The important project of making Brussels a seaport has been under the consideration of the Department of Industries. A plan of the proposed canal on the scale of 1 to 500 has been made, and work is to be commenced on the western section. The construction of the harbour has been discussed, and the joining of the canal with the Ruppel has been considered by a committee of engineers. The lines of the canal have been planned, and it has been decided that it will be necessary to construct large embankments. Several syndicates are in course of formation in order to carry out the works, but an English syndicate which has been negotiating for the construction of the canal appears to have the best chance of success.

NEW TRANSATLANTIC LINE OF STEAMERS.—A new line of steamers between Belgium and Canada is about to be started by a company which has been formed for that purpose. As the commercial situation is very unsatisfactory, Belgian trade is trying to find an outlet in distant countries. The exports from this country during the first two months of this year show a diminution of 16 per cent. on those of the preceding year. Belgian trade might profit by the dispute which has arisen in Canada as to the proposed commercial treaty between that country and the United States.

A LARGE TEXTILE COMPANY.—Four of the largest textile weaving establishments at Alost have been amalgamated, under the title of the "Société Anonyme Union Textile." The firms which have become amalgamated are Messrs. Govaert Frères, M. Elias Cools, Messrs. L. De Ruddere et Cie., and Veuve Borremaus-Van Melkebeke.

DÜSSELDORF, 9th June, 1891.

THE IRON AND STEEL MARKET.—The demand for iron and steel has rather increased, but, notwithstanding this favourable circumstance, prices are in general as low as before. The slight increase in the price of Thomas (basic) pig, which was mentioned last week, has strengthened the market, while the upward movement of the Glasgow market has been without influence on business. All brands with which the English market enters into competition have maintained their former prices without change. Manufacturers of plates and sheets are fairly well employed. Wrought-iron boiler plates are quoted from £8 6s. 6d. per ton to £8 11s. 5d., and ordinary plates at about £7 7s., while Siegen sheets are from £6 7s. 4d. to £7 2s. Bar iron is quoted at £6 17s., and makers are anxious to obtain new orders. The State Railway management at Elberfeld invites tenders for 2,000 tyres and 1,000 waggons, and makers of railway material and rolling stock are well employed. The same may be said of the bridge building works; the Gutehoffnungshütte have just got an order for 560 tons for bridges over the Saale. There is no news at present of a prolongation of the rail and girder syndicates, whose agreements terminate towards the end of this year.

THE COAL MARKET.—The coal market continues very active. In the public award of contracts at Altona the prices asked for locomotive coal were, in few instances, below 10s. 3d. per ton, and only 8,000 tons were offered at 10s. On behalf of English firms there were tenders for 240,000 tons from 12s. 9d. to 16s. 8d. c.i.f. Hamburg Harbour. No decision has yet been arrived at. It may be estimated that the freight from the Ruhr district to Hamburg is on an average about 5s. The shipments of coal on the Rhine for Southern Germany are unusually brisk.

NEW STEEL WORKS.—Some new steel works, the "Westfälische Stahlwerke," were opened recently at Bochum. The manager is Mr. Koehler, who was formerly in the service of the "Westfälische Stahlindustrie." The new works has two converters, of ten tons capacity each, and a

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row of basic open hearths. The chief manufacture will be that of rails.

A Deep Boring.—A hole has recently been drilled by a diamond drill near Schladebach, in Saxony, to a depth of 4,560ft., for the purpose of testing a coal formation. Three and a half years were occupied in drilling the hole, which is about 11in. in diameter at the top and 2in. at the bottom.

AMSTERDAM, 8th June, 1891.

Important Harbour Works at Amsterdam.—The Amsterdam Chamber of Commerce has just presented to the Town Council a memorial in support of the scheme, prepared by the civil engineers, Messrs. Tak van Poortvleit, Van de Wall Bake, and Hendrichs, for the extension and amelioration of the present harbour works in the Dutch capital. The main features of the scheme are the development of the existing jetty and warehouses, constituting what is called the Commercial Quay, the building of docks and new warehouses around it, and the transfer of the railway, now running on the jetty, to a viaduct to be constructed alongside the Prins Hendrikkade, or Parade, which bounds the north side of the city. To the eastern docks the removal of the railway will be of great assistance in developing navigation, as the constant closing of the railway bridge over the entrance is a serious hindrance. In the memorial of the Chamber of Commerce it is pointed out that the chief cost of the new works will have to be borne by the State and the railway companies concerned, as their property will thereby be benefited to a considerable extent, more particularly the State, as the Royal dockyard and Government wharves are now seldom accessible, owing to the railway line.

The Telephone in Holland.—The shareholders of the Dutch Bell Telephone Company have held their annual meeting. The report laid before them was of a very satisfactory nature. Business has much increased, both in Holland and in the Dutch East-Indian towns where the company holds concessions. A dividend of nearly 8½ per cent. on the share capital has been announced by the Board.

The Goldfields of Guiana.—In the dispute with France as to the right boundaries of the goldfields in French and Dutch Guiana, Holland has recently scored an important victory. The Emperor of Russia, acting as arbitrator in the dispute, has given his award, which practically acknowledges the rightful claim of Holland to the whole of the disputed territory between the Lawa and the Tapanahoni rivers, subject only to the private rights of individual Frenchmen, already legitimately acquired. Henceforward the Lawa River must be considered the boundary between French and Dutch Guiana.

STOCKHOLM, 6th June, 1891.

The Large Gefle Strike.—This strike has now been compromised, and its conclusion has caused much satisfaction. The matter in dispute has been referred to a committee of five persons, of whom each side chooses two, and these four the fifth. Pending the decision of the committee, the Kopparberg-Hofors Company partly regulates wages by the men's price list, whereas the Korsnös Company adheres partly to last year's price list.

The State Telephones.—The development of the Swedish State telephone system continues at a rate to which probably few parallels can be found—at least, in Europe. A Government grant of £33,300 voted last October has already been spent, chiefly in the purchase of private telephone companies at Arboga, Sala, Eskilstuna, Karlshaum, Karlskrona, Romilby, and Sölvesborg, and in extending other telephonic systems. The number of telephones has thus been increased from 3,800 to 5,500, which means an addition of about 45 per cent., and corresponds to a calculated increase in the gross receipts from £20,220 to £30,555, or rather more than 50 per cent. These extensions will now be followed by numerous others, calculated at an expenditure of about £26,100, in addition to which their connection with the large system of State telephones will entail a further outlay of about £8,880, making a total of £34,980. The acquirement of these telephone companies will increase the number of subscribers by about 2,000, and the yearly receipts by about £8,330, but it is confidently expected that a very material subsequent addition will follow. Other localities have applied to the State Telephones management for connection with their system, including some important centres in the mining districts, such as Nora, Lindesberg, Kopparberg, Ramsberg, Ludvika, and Smedjebakken. The constant increase of subscribers in Stockholm makes large extensions necessary. The sum required for all these new extensions is estimated at £55,500.

The Ystad Match Manufactory.—The match works at Ystad, which belong to the Swedish Match Company, Ld., and which have been closed since this company's stoppage in 1889, have now been started again with about the same number of workpeople as before.

Removal of Duty on Ships.—The fact of the duty on ships having been done away with is likely to benefit English builders, who have, for the last year or two, been almost debarred from competing with Swedish builders. A Wiken syndicate has, for instance, decided to order a 900 tons vessel in England at a price of about £10,000, and other orders are sure to follow.

COPENHAGEN, 6th June, 1891.

The Bacon Factories.—The contemplated amalgamation of all the Danish bacon factories, co-operative as well as private, does not altogether seem to meet with the approval of those interested. Several of the factories have declined to accept it in its present shape, and it is specially urged that the interest of the farmers is not sufficiently considered. In order to remove this objection several representatives for the various agricultural societies have been invited to join the committee.

The Frederiksholm Lime and Brick Works.—The Frederiksholm Lime and Brick Works, situated near Copenhagen, have recently considerably increased their plant, which makes it possible to complete the manufacture of bricks in a shorter time, whereby the cost is reduced. During last working year the sales amounted to £50,928, and the profits to £7,229. A sum of £1,660 was added to the sinking fund, and a dividend of 6 per cent. was declared.

The Ringkjobing Fjord.—A committee has now been formed to consider the question of an additional entrance to the Ringkjobing Harbour, on the west coast of Jutland. It is proposed to make a cutting through the Nordevand and the Godel dam.

MADRID, 8th June, 1891.

The Altos Hornos Company.—At a meeting of the Altos Hornos Company of Bilbao, which was held last month, a satisfactory report was presented. During the year 1890, 26,826 tons of pig iron, 21,253 tons of rails, and 26,530 tons of bar iron were sold by the company. The net profits were £36,580, and, after allowance had been made for depreciation, and a sum had been placed to the reserve fund, a dividend of 7 per cent. per annum was declared, and an extra sum of £1,200 was to be divided among the shareholders. It was decided to make a call of 10 per cent. on the shares, which is to be applied to the purchase of land and to the establishment of a battery of coke ovens. It seems probable that the Coppée system will be adopted, as was done at the works of Señor Martinez Rivas.

Electric Incandescent Lamps.—Gas being very expensive in Madrid, it seems probable that the electric light will be used here more extensively than in any other town of the same size. The number of incandescent lamps required for renewals in Madrid and neighbouring towns will no doubt be sufficient to employ a factory giving an output of 2,000 lamps daily. Imported lamps cannot be sold here under 2s. 9d. each, even if the importer be satisfied with a small profit, and the lamps could be made here as cheaply as in any other place. The law requires industrial use of a patent within two years of the granting of the patent, otherwise the patent becomes void, and under this condition none of the patents relating to incandescent lamps are now valid in this country. Any person could now apply for a five years' patent to work Edison's, Swan's, or any other lamp, and at present there is no manufactory of electric incandescent lamps here.

Privileges of the Banco de Espana.—A considerable and well-grounded agitation has been carried on among the industrial and commercial classes against the granting of certain privileges to the Banco de España in return for a loan made to the Government by that bank. Owing to this movement the Government has been completely defeated, and the proposed law will be considerably altered.

Pyrites Mines.—An offer to rent the pyrites mines of El Castillo de los Guardias for five years at a rental of £10,000 has been accepted. In order to make the working of these mines successful, a railway to Seville must be constructed, or some arrangement must be made with the Rio Tinto Railway Company.

The Rio Tinto Company.—The construction of a railway from Belmez to join the Zafra and Huelva Railway, and the supposed purchase of coal mines at Belmez by persons connected with the Rio Tinto Company, seem to indicate that some change is to be made in the management of this company. The company has proposed for some time past to erect blast furnaces in order to deal with the hematites of this rich district.

NEW YORK, 30th May, 1891.

Two Proposed Bridges.—The Vice-President of the New York Central Road has stated that the company will make a bridge across the St. Lawrence River from Cape Vincent to Wolfe Island, and from Wolfe Island to Kingston. With this bridge and an agreement with the Canadian Pacific Railroad, trains can be run through from British Columbia to New York. A charter has been applied for to bridge across the Niagara River, near the whirlpool rapids, for electric or steam railway purposes. It is proposed to construct an electric railway from American Park to the river bank, thence across the proposed bridge to the Canadian side, and finally to Canadian Park. This is the principal object in view, but the Bill will make the construction of a steam railway possible.

A New Valve Gear for Locomotives.—Mr. W. J. Lewis, of St. Louis, is introducing a new valve gear for locomotives which does away entirely with links, eccentrics, eccentric straps, and rocking arms. The gear has been successfully applied to a locomotive on the "Cotton Belt" Railway.

Electric Train Signalling.—Mr. W. P. McCann, of Sterling, Ill., has brought out a device for signalling railroad trains between stations, transmitting messages by signal in mines, and calling policemen to patrol boxes, and for any other purpose of a similar nature. The plan for signalling trains is to have incandescent electric lights placed every mile between stations. In case it is necessary to signal a train after leaving one station and before it reaches the next, then, by an arrangement of switches, the light is turned on in any lamp desired. In case of accident, or of a train running on another's time, all the lights between the two stations would be turned on, and the first one seen by the engineer would be a sign to stop. Telephones would be placed on every electric light pole, and the engineer could then communicate with the nearest station and learn the orders which it was desired to communicate.

New Tinplate Company.—A company has been organised, with a capital of £200,000, to be known as the Welsh-American Tinplate Company. Works for the manufacture of tinplate are to be erected in Eastern Pennsylvania, the plans embracing the building of four tin mills, with a productive capacity of 2,000 boxes per week. Ultimately the plant is to be increased to twenty mills, with an annual capacity of 500,000 boxes.

Forestry at the World's Fair.—Not the least important of the great divisions of the World's Columbian Exposition is that devoted to Forestry. Mr. W. I. Buchanan, Chief of the Department of Agriculture, who is at present in charge of the Forestry Department, has entered actively upon the work of enlisting the various timber and lumber interests and State Forestry Bureaus in this important feature of the Exposition.

PHILADELPHIA, 29th May, 1891.

Meeting of the American Society of Mechanical Engineers.—The next meeting of this Society, which is to be held at Providence, R.I., from June 16th to 19th, promises to be a very interesting one. The following papers will be read:—"Two Rope Haulage Systems," by Mr. R. Van A. Norris; "The Premium Plan of Paying for Labour," by Mr. F. A. Halsey; "Test of a Triple-Expansion Engine," by Mr. J. P. Hurthorn; "A Belt Dynamometer," by Mr. S. P. Watt; "A New Belt Testing Machine," by Mr. G. I. Alden; "Flexure of Thin Elastic Rings," by Mr. De V. Wood; "Applications of Hirn's Analysis to Engine Testing," by Mr. R. C. Carpenter; "Applications of Hirn's Analysis to Multiple Engines," by Mr. C. H. Peabody; "Notes Regarding Calorimeters," by Mr. R. C. Carpenter; "Jet Propulsion," by Mr. J. B. Webb; "Performance of a Steam Reaction Wheel," by Mr. J. B. Webb; "Heat Transmission through Cast-iron Plates Pickled in Acid," by Mr. D. Royse; "Steam Engine Efficiencies," by Mr. R. H. Thurston; "Effect of the Steam Jacket on Cylinder Condensation," by Mr. W. W. Bird; "Method of Dividing an Index Plate into 1,000 Equal Parts," by Mr. W. A. Rogers; "A Machine for Cutting Perfect Screws," by Mr. W. A. Rogers; "Steel Castings," by Mr. H. L. Gautt; "Manganese Steel," by Mr. H. M. Howe; "Comparison of Economy of Compound and Single Cylinder Corliss Engine," by Mr. D. S. Jacobus, "Performance of a Pumping Engine against a Head of 2,000ft. of Water," by Mr. J. E. Denton; "A Blast Furnace Blowing Engine," by Mr. F. W. Gordon: "Some Experiments with a Screw Bolt," by Mr. J. McBride; "Mechanical Stokers," by Mr. W. R. Roney. The Society has also arranged several excursions and visits to the important industrial establishments in the neighbourhood.

End of the Great Coke Strike.—Mr. Wise, a master workman, has advised all strikers to go back to work, and the strike is practically over. The week before the strike the production of the region was 101,700 tons, last week it was over 60,000 tons. It is estimated that the loss occasioned by the strike both to manufacturers and men will be between £800,000 and £1,000,000. The manufacturers are carrying out their threat that when the strike was over they would punish the leaders, and over 1,000 men, who were leaders or active committeemen, have been refused work.

Naval.—The Naval Ordnance Bureau has carefully tested and accepted 300 steel armour-piercing projectiles of 6in. calibre, made by the Carpenter Steel Company, of Reading, Pa.

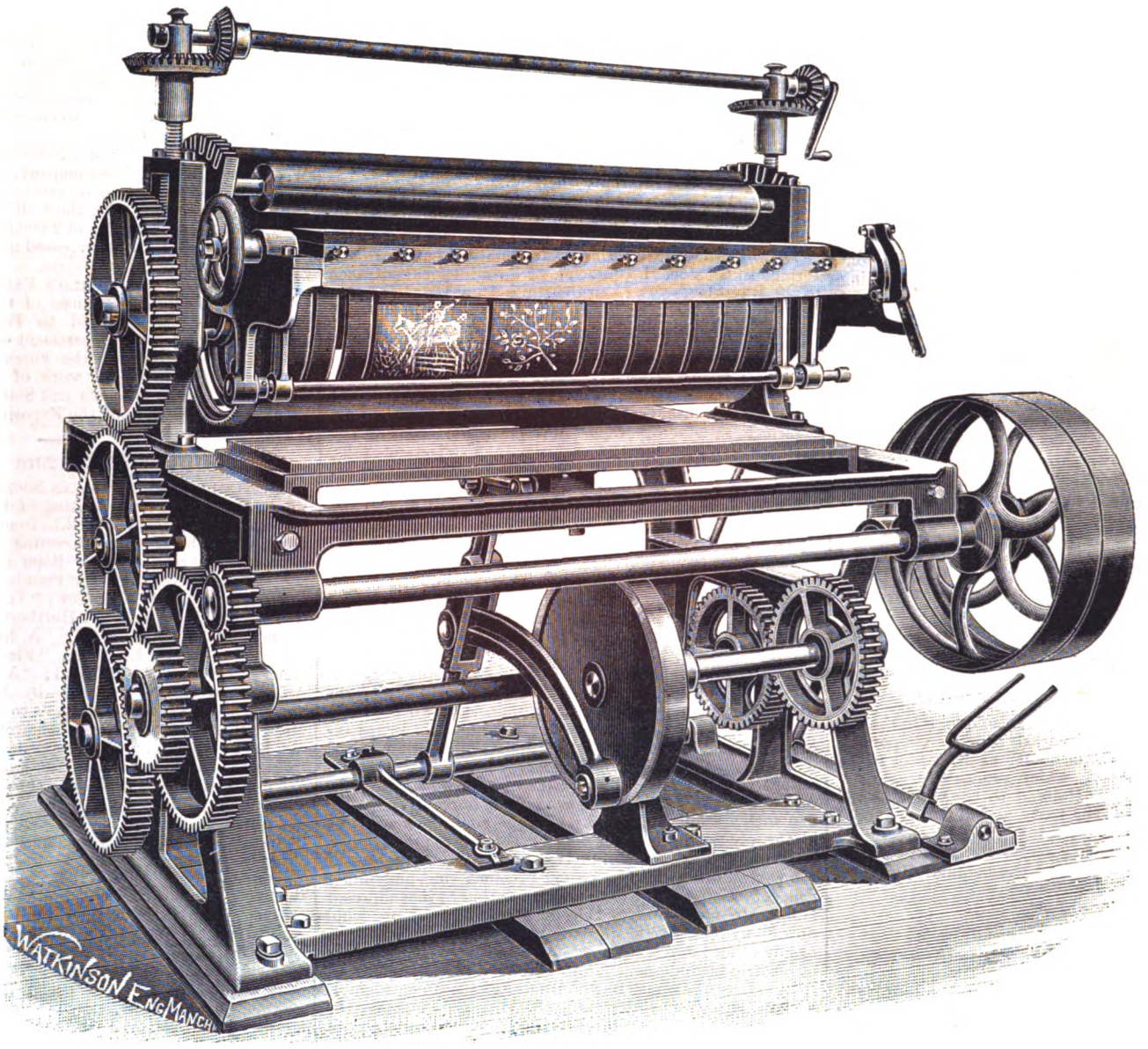
Renewal of the Standard Works Strike.—When the strike at the Standard Steel Castings Company was settled a few days ago, it was with the understanding that most of the old hands would be taken back. This was not done, only a very small proportion of the original strikers being selected. The men have decided to continue the strike indefinitely.

Telephone Company.—A company has been formed under the title of the Illinois Pulsion Telephone Company, at Chicago, Ill. The corporation has for its object the building and leasing of a line of private telephones throughout Illinois. The State right for the use of the Pulsion or acoustic system of telephones, which is claimed to be superior in many respects to the Bell system, has been secured from the New Hampshire Company, owners of the patent. The capital stock of the new company is £100,000.

Railroads.—The report of the Michigan Southern Railroad for 1890 showed gross earnings exceeding £4,000,000, the largest in its history. Articles of incorporation have been filed with the Secretary of the State of Illinois of the Muscatine, Rock Island, and Peoria Railroad Company, capital £400,000. The lowest rate on record, 5c. per bushel, is being charged for carrying wheat from Chicago to New York. The grain goes by the lakes to Buffalo, thence to tidewater by the Erie Canal. Of the 5c. charged, the lake boats get 1½c., the Buffalo elevators ⅞c., and the Erie Canal boats the remainder.

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THE "ARGUS" CLOTH STAMPING MACHINE.



General View.

THE "ARGUS" CLOTH STAMPING MACHINE.

The machine which we illustrate above is constructed for the purpose of stamping designs or trade marks on piece goods, which has hitherto been done by hand. It consists of a revolving cylinder, on which is fastened the metal blocks of the design or pattern to be stamped, a sliding table, which works directly beneath the revolving cylinder, and a disc crank for working the sliding table. The machine is power driven by means of the usual fast and loose pulleys, which are fixed to a cross shaft at the back of machine. On the opposite end of the driving shaft is fastened a small pinion wheel, which gives motion to all the working parts. On one side of machine is arranged a train of wheels (in direct communication with the pinion mentioned above), one portion of which gives motion to the revolving cylinder, and the other portion motion to the sliding table by means of a cross shaft underneath. This cross shaft gives motion by means of a pair of spur wheels to a second shaft, on which is fastened a disc crank. This crank is coupled to the sliding table by means of a connecting rod and a series of levers, thereby giving motion to the table and a speed equal to the surface of the cylinder. The bearings of the cylinder are constructed so that the cylinder may be raised or lowered at will, according to the thickness of the piece goods to be stamped.

The colour feeding arrangement is at the back of the machine, and consists of a roller and ductor, which can be regulated by means of suitable screws, &c. The motion of the colour roller is obtained from the end of the cylinder shaft by means of a cam, ratchet, and pawl, the throw of the ratchet being regulated so as to give more or less colour as required. Between the colour roller and the cylinder is suspended a composition or treacle roller, which transfers during every revolution of the cylinder a sufficient quantity of colour from the feed roller to the colour slab. The latter occupies about one-third the circumference of the cylinder, and is opposite to where the metal blocks or design is attached. The colour is transferred from the slabs to a series of composition rollers, which are arranged circumferentially round the cylinder, and these rollers again transfer the colour to the metal blocks.

The method of fastening the blocks or designs to be stamped is a very neat one, and allows a separate design to be arranged while one is at work. This is carried out by means of duplicate circular thin steel plates, which are made to fit the cylinder. After the design has been arranged, the blocks being used may be taken off, and new ones adjusted in a few minutes.

The advantages of this machine consist in simplicity of construction, facility of working, moderate size, and comparative cheapness. The stamps used are less expensive than the old copper wire stamps when the latter are somewhat complicated in design. The method by which the stamps for this machine are produced ensures an accurate reproduction of any special Oriental or other characters on the design which may be required. The speed at which the work can be done largely exceeds that of hand stamping.

Particulars of this machine may be obtained from Messrs. J. C. Norbury & Sons, 108, Portland Street, Manchester.

CLYDE SHIPBUILDING FOR MAY.

For the first time since January the output was exceeded in point of tonnage by the new work booked, and quite an impetus has been given to the shipbuilding industry in the lower reaches of the river by the large orders secured by builders there during the month. In the middle and upper reaches of the river, however, the existing state of matters is anything but gratifying, and the orders booked in these districts just balance the output. Altogether the new work contracted for aggregates fully 22,000 tons, and of this amount about 14,000 tons were secured by firms in Greenock and Port Glasgow. Messrs. Caird & Co. were particularly fortunate, they having received instructions to build three large steamers of 9,500 tons—two, of 3,000 tons each, for the Peninsular and Oriental Steam Navigation Co., and one, of 3,500 tons, for the Gulf Line, which will practically be a repeat of the "Gulf of Bothnia," the particulars of which are mentioned below. Messrs. William Hamilton & Co., Port Glasgow, and Messrs. Russell & Co., Greenock, each received instructions to build a steel sailing ship of 2,200 tons; an order for a 2,500-ton sailing ship was placed with the Fairfield Shipbuilding and Engineering Co., Govan; while Messrs. Barclay, Curle, & Co., Whiteinch, and Messrs. Chas. Connell & Co., Scotstoun, are each to build a steel sailing ship of 2,000 tons.

The output of work reached a total of 20,024 tons, of which 8,546 tons were contributed by sailing vessels and yachts.

The following are the particulars of the vessels launched:

Single-screw Steamers.

"Alice Taylor," steel, 600 tons, 1,400 i.h.p., built by Messrs. William Hamilton & Co., Port Glasgow, and engined by Messrs. George Clark, Sunderland, to the order of Mr. Robert Taylor, Dundee.

"Asteria," steel, 500 tons, 680 i.h.p., built by Messrs. Scott & Co., Bowling, and fitted with triple-expansion engines by Messrs. Muir & Houston, Kinning Park, for the coasting trade of Mr. William Robertson, Glasgow.

"Diamond," iron, 156 tons, 300 i.h.p., built by Messrs. Mackie & Thomson, Govan, and engined by Messrs. Muir & Houston, Kinning Park, for the North Sea fishing trade of the Kingston Steam Fishing Company, Hull.

"Earl of Devon," sister ship to the "Diamond," by the same builders, and for the same owners.

"Elcano," steel, 50 tons, 130 i.h.p., built by Messrs. J. Fullerton & Sons, Paisley, and engined by Mr. William Kemp, Govan, for Spanish owners.

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"Grouse," steel, 360 tons, built and engined by Messrs. Caird & Co., Greenock, for the Clyde and Irish trade of Messrs. G. & J. Burns, Glasgow.

"Gulf of Bothnia," steel, 3,500 tons, 5,000 tons deadweight capacity, 2,000 i.h.p., built and fitted with triple-expansion engines by Messrs. Caird & Co., Greenock, for the general trade of the Greenock Steamship Company.

Hopper barge, steel, 300 tons, 350 i.h.p., built and engined by Messrs. William Simons & Co., Renfrew, for the Preston Corporation.

Hopper dredger, 400 tons, 300 i.h.p., built and engined by Messrs. William Simons & Co., Renfrew, for the Indian Government.

"Kweilin," steel, 1,800 tons, 1,200 i.h.p., built and fitted with triple-expansion engines by Messrs. Scott & Co., Greenock, for the China Navigation Company.

"Ruby," sister ship to the "Diamond" and "Earl of Devon," by the same builders, for the same owners.

"Siphora Worms," steel, 1,600 tons, 1,400 i.h.p., built and fitted with triple-expansion engines by Messrs. Lobnitz & Co., Renfrew, to the order of Messrs. Worms, Josse, et Cie., Paris.

"Tramandaby," steel, 910 tons, 700 i.h.p., built and fitted with triple-expansion engines by Messrs. Scott & Co., Greenock, to the order of the Companhia de Paquetes Brazil Oriental, of Rio de Janeiro.

Twin-screw Steamers.

"Clutha No. 9" and "Clutha No. 10," each of 150 tons, built by Messrs. Murray Brothers, Dumbarton, and fitted with compound engines by Messrs. Matthew Paul & Co., Dumbarton, to the order of the Clyde Navigation Trustees, for their harbour service.

"Tynwald," steel, 1,000 tons, built and engined by the Fairfield and Engineering Shipbuilding Company, Govan, for the Isle of Man Steam Packet Company.

Paddle Steamer.

"Lorna Doone," steel, 350 tons, built by Messrs. Napier, Shanks, & Bell, Yoker, and fitted with compound diagonal engines by Messrs. D. Rowan & Co., Glasgow, for Messrs. Edwards, Robertson, & Co., Cardiff, for service in the Bristol Channel.

Sailing Vessels.

"Cromdale," steel, 1,850 tons, built by Messrs. Barclay, Curle, & Co., Whiteinch, to the order of Messrs. Donaldson & Rose, Aderdeen.

"Earl of Dunmore," steel, 2,200 tons, built by Messrs. Russell & Co., Greenock, to the order of Mr. J. D. Thompson, Grangemouth.

"Samaritan," steel, 2,000 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, to the order of Messrs. William Thompson & Co., St. John's, New Brunswick.

"Thistle," steel, 2,300 tons, built by Messrs. Chas. Connell & Co., Scotstoun, to the order of Captain J. D. Clink, Greenock.

Yachts.

"Dora," 10-ton centre-board yacht, built by Mr. James Adam, Gourock, for Messrs. R. & B. Allan, Glasgow.

"Irene," composite, 40-ton cutter, built by Messrs. A. & J. Inglis, Partick, to the order of Prince Henry of Prussia.

"Kite," wood, 13-ton cutter, built by Messrs. Fife & Son, Fairlie, for Mr. J. H. Lister.

"Lahloo," wood, 5-ton cutter, built by Mr. J. Ninian, Largs, for Mr. J. W. M'Lintock.

"Myrta," wood, 5-ton lugger, built by Messrs. Fife & Son, Fairlie, for Mr. W. C. Connell.

"Thalia," composite, 59-ton cutter, built by Messrs. Fife & Son, for Mr. J. A. Inglis, Glasgow.

"Thelina," wood, 5-ton lugger, built by Messrs. Fife & Son, for Mr. John Connell.

"Vashti," wood, 5-ton lugger, built by Messrs. Fife & Son, for Mr. P. M. Inglis.

"Volva," wood, 8-ton cutter, built by Messrs Fife & Son, for Mr. Geo. Watson.

In addition to the above the Abercorn Shipbuilding Company, Paisley, shipped to China two composite sailing vessels of 23 tons each, and Messrs. Alley & M'Lellan, Polmadie, shipped to the River Plate a steam launch of 50 tons.

Analysis of Launches.

	Steamers. No.	Steamers. Tonnage.	Sailing Vessels No.	Sailing Vessels Tonnage.	Yachts. No.	Yachts. Tonnage.
Great Britain ...	11	8,468	3	6,350	8	110
France	1	1,600	—	—	—	—
Spain.....	1	50	—	—	—	—
Germany	—	—	—	—	1	40
New Brunswick	—	—	1	2,000	—	—
Brazil	1	910	—	—	—	—
River Plate	1	50	—	—	—	—
India.....	1	400	—	—	—	—
China	—	—	2	46	—	—
Total.....	16	11,478	6	8,396	9	150

Notices of Meetings.

THIS WEEK.

Royal Institution.—Friday, June 12th, at 9 p.m. Lecture on "The Rate of Explosion in Gases," by Professor H. Dixon, F.R.S. Saturday, June 13th, at 3 p.m. Lecture on "The Scientific Study of Decorative Colour," by Professor A. H. Church, F.R.S.

Physical Society.—Friday, June 12th. Papers to be read: "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power," by Professor W. E. Ayrton, F.R.S., and Dr. W. E. Sumpner; "A Clock for Pointing out the Direction of the Earth's Orbital Motion in the Ether," by Professor O. Lodge, F.R.S.; "Some Experiments with Leyden Jars," by Professor O. Lodge, F.R.S.; "The Construction of Non-inductive Resistances," by Professor W. E. Ayrton, F.R.S., and Mr. Mather.

NEXT WEEK.

Royal Statistical Society.—Tuesday, June 16th, at 7.45 p.m. Paper to be read: "Results of the Recent Census, and Recent Death-Rates in the Largest English Towns," by Mr. N. A. Humphreys.

Royal Institution.—Wednesday, June 17th, at 4 p.m. Faraday Commemoration Lecture by Lord Rayleigh, F.R.S.

Society of Engineers.—Wednesday, June 17th. Visit of members to the Linde British Refrigeration Company's Ice Works at Lower Shadwell and the City and South London Electric Railway Company's Depôt at Stockwell.

Royal Meteorological Society.—Wednesday, June 17th, at 7 p.m.

Chemical Society.—Thursday, June 18th, at 8 p.m. Papers to be read: "The Action of Sulphuric Acid on Dehydracetic Acid," by Mr. N. Collie; "The Refractive Power of Certain Organic Compounds at Different Temperatures," by Dr. W. H. Perkin, F.R.S.

PRICES CURRENT, 10th June, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars.....	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates.....	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 10 0	.....	7 0 0	London.
" Angles	6 12 6	.....	7 2 6	"
Crown Sheets	7 0 0	.....	7 10 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates.....			7 5 0	"
" Ship and Girder			6 10 0	"

PIG IRON.

Middlesbro' Warrants, No. 3.	40/4½	Cash.
Scotch Warrants, m/n	48/6	"
Hematite Warrants, m/n	49/7½	"

Stocks in Stores.	Scotch	515,836—Inc.	for week 2,539	Tons.
	Middlesbro'	128,424—Inc.	" 2,273	"
	Hematite.....	140,146—Dec.	" 768	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	62/6	.....	56/-	f.o.b. Glasgow.
Gartsherrie	58/6	.....	54/6	" "
Summerlee	60/-	.....	56/-	" "
Langloan.....	61/-	.....	56/6	" "
Glengarnock	59/-	.....	52/-	" "
G.M.B. ex store	48/6	.....	48/6	" "

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton.....	1/9
Do. at Broomielaw, Glasgow.....	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)...	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay).....	5/-

METALS.

Spelter: Ordinary	£24	10	0	to	24	15	0
Copper: British Cakes and Ingots	58	10	0	"	59	10	0
" Chili Bars, G.O.B.'s	55	2	6	"	55	10	0
" Other sorts, G.M.B.'s (equal to Chili Bars) ...	55	2	6	"	55	10	0
" Manufactured (strong)...	66	0	0	"	67	0	0
Lead: Common Pig	13	7	6	"	18	10	0
" English Sheet.....	14	2	6	"	14	5	0
Tin: Straits	93	15	0	"	94	2	6
" Australian	93	15	0	"	94	5	0
" English Ingots	97	10	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: Since our last report the market has been fairly steady, although values of raw have been variable. Current quotations for Chili bars, however, are practically the same as this day week, to-day's prices being £55 2s. 6d. to £55 10s. cash. Manufactured continues firm at £66 to £67, "strong."

Tin has advanced during the week, but to-day the market has rather a weaker tendency.

Lead has improved, and there is a little better inquiry.

Spelter has advanced considerably, and prices are higher on the Continent than here on account of a brisk demand for manufactured zinc. Stocks are small everywhere, and all the smelters have their production sold some months ahead, so that prices are likely to advance further.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals .....lb.		0 0 5½	to	0 0 6¼
" " Liquid .....gal.		0 1 0	—	.....
" Citric .....lb.		0 1 7½	—	.....
" Oxalic ..... "		0 0 8½	—	.....
" Sulphuric .....ton		1 15 0	—	.....
" Tartaric .....lb.		0 1 3	—	.....
Alum: Lump (powder 10/- ex.) ...ton		5 12 6	—	.....
Ammonia: Carbonate .....lb.		0 0 3½	—	.....
" Muriate (Grey).....ton		23 0 0	—	.....
" " (White) ..... "		30 0 0	—	.....
" Sulphate..... "		11 0 0	—	11 2 6
" Liquor.....lb.		0 0 3	—	.....
Antimony .....ton		75 0 0	—	.....
Bleaching Powder..... "		6 12 6	—	.....
Bisulphide of Carbon ..... "		18 0 0	—	.....
Borax ..... "		29 0 0	—	.....
Benzole (90 %) .....gal.		0 3 11	—	.....
" (50/90 %) ..... "		0 2 11	—	.....
Copper Sulphate .....ton		15 10 0	—	.....
Copperas ..... "		2 0 0	—	.....
Kieserit .. .. "		.....	—	.....
Lead: Nitrate..... "		21 0 0	—	.....
" White Sugar..... "		26 0 0	—	.....
" Brown " ..... "		19 10 0	—	.....
Potash: Bichromate .....lb.		0 0 8¾	—	.....
" Caustic.....ton		21 10 0	—	.....
" Carbonate ..... "		20 0 0	—	.....
" Chlorate .....lb.		0 0 5½	—	.....
" Prussiate (Yellow) ..... "		0 0 10½	—	.....
" Sulphate (Basis 90 %) .....ton		4 0 0	—	.....
Precipitate: Red.....lb.		0 3 4	—	.....
" White ..... "		0 3 0	—	.....
Salts: Epsom {Bags.....ton / Casks ..... "		3 0 0	—	.....
		3 15 0	—	.....
" Glauber ..... "		1 10 0	—	.....
Sulphur: Sublimed Flowers ..... "		10 10 0	—	.....
" Recovered..... "		7 0 0	—	.....
Soda: Ash .....deg.		0 0 1 1/16	—	0 0 1¾
" Caustic (White 70%).....ton		10 17 6	—	.....
" " " 60% ..... "		9 12 6	—	.....
" " (Cream 60%)..... "		9 7 6	—	.....
" Crystals ..... "		3 2 6	—	3 3 0
" Bicarbonate ..... "		6 10 0	—	.....
" Hyposulphite ..... "		7 5 0	—	.....
Solvent Naphtha .....gal.		0 1 5	—	.....
Tartar, Cream of .....cwt.		4 19 0	—	.....
Zinc Sulphate.....ton		7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Bleaching powder and caustic soda continue to move off steadily at unchanged prices, and soda ash is in good demand. There is not much business passing in sulphate of ammonia, but the market is steady. Crude carbolic is again weaker, and there is no disposition to purchase except at figures much below those asked by sellers. Benzoles are also lower. Caustic potash is firm; carbonate of potash a little easier. Sulphate of copper is yielding slightly for spot delivery. Yellow prussiate of potash continues firm and in good demand.

OILS.

		£ s. d.
Cocoanut: Cochin.....per tun		34 10 0
" Ceylon..... "		29 10 0
Cottonseed ..... "		21 0 0
Cod ..... "		24 0 0
Lard ..... "		34 10 0
Linseed..... "		21 7 2
Olive, Spanish ..... "		45 0 0
Palm, Lagos ..... "		25 10 0
Rapeseed: English..... "		30 10 0
Seal: Pale ..... "		26 0 0
" Brown ..... "		.....
Sperm ..... "		50 0 0
Whale ..... "		22 0 0
Turpentine.....per cwt.		1 8 9
Coal.....per gal.		.....
Petroleum (Refined)..... "		0 0 5¾
Spirit		0 0 7¾

An Extensive Exhibit.—Messrs. Siemens & Halske have sent us a little volume of 150 pages devoted to a description of the various items of their exhibit at Frankfort. They exhibit everything electrical from a central station dynamo to a telephone, and their work seems to cover the whole range of electrical industry. We will refer to their exhibit more fully in a later issue.

We have received from Messrs. Richard Frères, of Paris and London, a copy of their new illustrated Catalogue of Measuring, Controlling, and Self-Registering Instruments for Scientific and Industrial Purposes. The catalogue is divided into three parts—viz., instruments for engineering purposes, electrical purposes, and meteorological purposes, and particulars are given of all the firm's well-known specialties.

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HOME INDUSTRIES.

LONDON, 11th June, 1891.

The Money Market.—The abandonment of the attempt to maintain rates to protect the Bank reserve has been followed by a complete breaking away of the money market, and considerable withdrawals of bullion are likely to take place. Undoubtedly the greater ease in the market has been very welcome in many quarters, but there are misgivings that we may have yet to pay dearly for assuming too quickly that the situation was quite safe. The fear of a possible call on the Baring guarantors has been set at rest. The Bank of England makes it clear that not only is no call probable now, but that under no circumstances is one likely to be made. The stock markets have been uninteresting and featureless. The settlement, which occupied the greater part of the week, disclosed no essential change in the character of the account open, though continuation rates were generally easier through the greater cheapness of money. Consols have been weakened by fears of gold exports. The Indian sterling loans have been influenced by the issue of a new loan, which, though successful, tended to bring down the prices of the existing stocks. Foreign bonds have shown a tendency toward strength, though no one puts much faith in the permanent firmness of such securities as Spanish and Portuguese. The market for Argentines is uneasy, with no real firmness, but occasionally shows a tendency to rally. Home railways remain quiet and featureless, and, until a revival in Wall Street takes place, no well-sustained movement can be looked for in Americans. The minor markets present no feature, those for mining and industrial shares being almost wholly neglected.

Institute of Marine Engineers.—At a meeting of the Institute of Marine Engineers, held on the 2nd inst., under the presidedcy of Mr. F. W. Wymer, Mr. Gray continued his lecture on "The Metacentric Elements of Stability." Mr. Gray said that the subject of his lecture could be well studied in Mr. White's "Manual of Naval Architecture," and his object had been merely to induce the members to read up the subject. Captain McKirdy said that it would be desirable if some simple method could be given whereby a captain could ascertain how a vessel's stability is being increased or reduced while she is being loaded. It is proposed to resume the session for the reading of papers in September, when it is expected that Mr. James Weir will read a paper on "The Economy of the Marine Engine."

The Royal Observatory.—On the 6th inst. the annual visit of the Board of Visitors to the Royal Observatory took place, and a large number of persons accepted the invitation of the chairman, Sir W. Thomson, to inspect the instruments. Among those present were Sir George Airy, the former Astronomer Royal, and Dr. Gill, the director of the Cape Observatory. During the past year a transit room has been erected in the courtyard, and an octagonal tower at the south end of the grounds. The instruments used for the determination of longitudes will be placed in the transit room, which will be also used for the instruction of naval officers in the methods of determining the latitude and longitude of maritime stations. The octagonal tower will be used as a physical observatory. The 28in. refractor which is being constructed for the observatory by Sir H. Grubb is almost completed. The Astronomer Royal suggests in his report that the present buildings should be extended, so as to make the observatory worthy of its important position.

Fothergill Prize of the Society of Arts.—Under the will of Dr. Fothergill (1821) funds were bequeathed for the offer of medals for subjects, in the first instance, relating to the prevention of fire. A Society's gold medal, or £20, is now offered for the best invention having for its object the prevention or extinction of fires in theatres or other places of public amusement. In cases where the invention is in actual use, reference should be made to places where it could be inspected. A full description of the invention, accompanied by such drawings or models as are necessary for its elucidation, must be sent in on or before the 31st December, 1891, to the Secretary of the Society of Arts, John Street, Adelphi, London. The Council reserve the right of withholding the prize, in case there is nothing in their opinion deserving the award, or sufficiently complying with the conditions of the competition.

Faraday Centenary.—H.R.H. the Prince of Wales has fixed 4 p.m. on the 17th inst. for the delivery by Lord Rayleigh of the first of the two lectures in connection with the centenary of the birth of Michael Faraday, and 9 p.m. on the 26th inst. for the second of the lectures, which will be given by Professor Dewar.

Shipments of Wine.—Messrs. J. R. Parkington & Co. state that the shipments of port for May amounted to 8,695 pipes (Great Britain, 3,372 pipes), making 38,189 pipes for five months, against 37,710 pipes in 1890. The sherry shipments were 5,124 butts, making 28,172 butts for five months, against 26,521 butts in 1890.

Royal Meteorological Society.—The offices and library of this Society have been removed to more commodious rooms at 22, Great George Street, Westminster, S.W., to which address all communications should be forwarded.

The Society of Architects.—It is proposed that the annual excursion of this Society shall this year be made to Belgium, and be extended over a fortnight. It is intended that the party will travel *vid* Dover to Ostend, thence to Bruges, Ghent, Brussels, Louvain, Malines, Antwerp, Liège, Namur, Mons, Tournay, Oudenarde, Courtray, and home from Ostend. The secretaries will be glad to hear from any members who intend to join the party.

MANCHESTER, 11th June, 1891.

The Ship Canal.—It has been officially announced that it is expected that the Ship Canal will be opened for traffic as far as Ellesmere Port during July, and that the River Weaver traffic will be taken in a short time afterwards. This indicates a considerable advancement of the works, which are making rapid progress throughout the section. The railway diversions are approaching completion, some of the bridges being in a very forward condition. The Manchester City Council has adopted a resolution that the number of directors should be fifteen instead of twelve, of whom five should be members of the Council or nominated by it. It was resolved to endeavour to get a clause introduced into the Bill before Parliament to that effect.

New Meteorological Observatory. — The City Council has determined to establish an observatory on a plot of land owned by it in one of the crowded and populous districts in the city. Hitherto all the meteorological observations made in Manchester have been obtained in the suburbs, and it is thought they are more or less misleading as to the actual conditions prevailing within the city. A very complete set of instruments has been fitted, and in view of the recent results obtained by analysing the rain falling in the city, and the large percentage of sulphuric acid found therein, valuable results will probably be found to follow the observations taken.

The Salt Trade.—The owners of salt mines who are at present outside the bounds of the Salt Union, Ld., have agreed to take joint action to protect their interests, and a committee has been appointed to arrange with the directors of the Salt Union a basis for unity of action.

The Manchester Technical School.—Sketch plans for the new building to be used for the above purpose have been submitted to the Council of the Whitworth Institute. A deputation of the Council are visiting the principal schools in France, Germany, and Switzerland, in order to ascertain any facts which may be useful in determining the construction of the building or the special subjects taught.

New Pier.—What is practically a new pier is being erected at Lytham from the designs of Mr. W. Trafford Gunson, by Messrs. De Bergue & Co., Ld., of Manchester. The works include a new jetty, a large pavilion, and a considerable extension of the promenade space. The Blackpool Corporation are about to erect a large tower similar to the Eiffel Tower, the plans for which have been accepted. The design is generally similar to the Eiffel Tower.

Union of Lancashire Dyers and Finishers.—A strong feeling of dissatisfaction prevails in the Manchester home trade at the action of the local dyers and finishers, who have formed a union and issued a new list, showing a substantial advance in prices. A sum has been deposited by each member of the union, and is, we are informed, liable to confiscation in case of any attempt at underselling.

Technical Evening Classes.—The Manchester School Board instituted, under the Technical Instruction Act, a series of evening classes, for the purpose of instruction in various technical subjects. A sum of £1,000 was last year allotted to the Board by the City Council, and a number of classes were organised, about which Mr. C. H. Wyatt, the clerk to the Board, has recently given some interesting particulars. The total number of students increased from 3,165 in 1889 to 5,933 in 1890, this arising undoubtedly from the increased facilities provided. During the past session 2,115 art students entered the classes, 1,957 took subjects connected with engineering and kindred industries, and 818 studied chemistry. In commercial subjects there were 7,788 students, as against 2,707 in the preceding year. The cost of the classes for the session was £2,458, and it is intended to expend, in the coming session, a sum of nearly £4,000. In view of the fact that this has been more or less of an experimental series, their success has been very marked.

The Linen and Jute Trades.—Business this week has scarcely been satisfactory. Linen yarns, which in ordinary times are consumed extensively in Kidderminster and other carpet centres, meet with a small sale, owing to the fact that carpet looms are only partially employed. The same remark applies to jute carpet yarns. The linen departments in the local home trade firms experience some difficulty in finding orders, and the results of the June and half-yearly stocktaking will probably show that the goods on hand exceed the quantity anticipated by buyers. For shipment there is not much business, and trade with the United States, according to the returns of Manchester agencies of American firms, is below the average. There has, however, been a steady demand for some of the Continental markets, but Australian business has fallen off considerably, and Canadian orders will probably not improve for some little time. There is a gloomy feeling generally, and, as will have been seen from the Board of Trade returns, the unfavourable outlook which has been noticed in these reports during the past few months has unfortunately been confirmed.

The Age of Half-timers.—Following the example of most of the operatives' associations in Lancashire the North-East Lancashire Weavers' Association has pronounced against any advance of the age at which children can work half-time. The feeling in favour of the present arrangement is almost unanimous on the part of the operatives, but we have found more than one manager of successful concerns doubtful about the wisdom of employing half-timers from an economical point of view.

GLASGOW, 11th June, 1891.

The Iron Market.—The state of excitement and uncertainty in the pig iron market last week still continues, although the legitimate demand is very small. The price of warrants at the beginning of last week was 59s., a price which had not been reached since January, 1890, when, after three months of brisk demand for shipment, the falling off in export orders brought the price down. The situation recently has been wholly different. Export and home trade are alike dull, production has increased, and the movements in prices have been brought about entirely by speculation. "Bears" in Glasgow and London had opened heavy accounts, and when they considered the moment opportune had insisted upon delivery of the warrants they had bought. Those sellers who had oversold were obliged to go into the market, and thus, while the "bears" acted as spectators, the price mounted rapidly in their favour. It would appear as though now all, or almost all, the iron bought by them were in the possession of the "bears," and thus the state of the market really depends upon the manner in which the unloading takes place. As it is understood that a large quantity of the iron they hold was bought by them at 42s., they can sell at a price below the present market rate, reduced as it has been by a sharp reaction, and yet make a handsome profit. If, however, they are too eager to realise a profit the market may be depressed until their margin disappears. At present the most sagacious speculators appear to be holding their hands, uncertain as to the course which events will take. It is reported that the "bear" speculations have been carried out by some of those who have been most strenuous in their opposition to the Pig Iron Warrants Bill.

Shipbuilding.—The Clyde shipbuilding yards are unusually destitute of new orders, many of them having their stocks less fully occupied than they have been for some years. On the 9th inst. Messrs. D. & W. Henderson & Co. launched the "Numidian," a steamer of 4,900 tons, for the Allan Line. The steamer "Scot," just built by Messrs. Denny Brothers for the Cape service, has quite fulfilled the expectations of the builders. The measured mile trials at Southampton realised a mean speed of 18·8 knots, the horse-power developed being 11,656. The "Scot," which will carry the mails from Southampton on 24th July, will be on view in the Thames in about a week, in order that she may be inspected by those interested.

The Threatened Shipbuilding Strike.—Although discussions and conferences are still proceeding, the dispute between the Clyde shipbuilders and their workmen is likely to be settled on the basis of a compromise. On the 8th inst., owing to some sections of the men being ignorant of the progress of the negotiations, work was practically at a standstill in several yards, but in some of these the difficulty was surmounted by the removal of the notices of reduction pending a settlement of the dispute. It is expected that a strike will be definitely averted by arrangements to be made at conferences to-day and to-morrow.

Engineering.—A pair of double-decker steel cages, the largest and heaviest of their kind in Scotland, have just been made by Messrs. Archibald Baird & Son, Clyde Steel and Engineering Works, Hamilton, for Messrs. John Watson, Ld., Earnock and Eddlewood Collieries. The cages are the first of this type turned out by a Scottish firm. Each is 6ft. ¼in. by 6ft. 11in. They are capable of raising daily from 1,300 to 1,500 tons of coal. Each cage weighs about 3 tons.

(From our own Correspondents.)

LIVERPOOL, 10th June, 1891.

The Timber Trade.—The arrivals from the British North American Colonies during the past month have amounted to close on 5,000 tons, against 6,476 tons in the corresponding month last year. Values remain unchanged, and the stocks are generally too heavy, although they have been considerably reduced. Both waney and square yellow pine have had little sale, buyers preferring to wait for the new imports. The stock of red pine is ample, and prices low. There has been a moderate import of New Brunswick and Nova Scotia spruce deals, with satisfactory deliveries; the stocks are large. The demand for red pine is limited, and stocks are small. The stock of Saxon pitch pine is moderate, and there has been a large consumption; the stock of hewn is light. There has been a good inquiry for first-class oak, but the stock is still heavy. The stock of elm has been reduced to a moderate compass, but there is no change in value. The consumption of ash is small, and the stock heavy. The late auction sales of mahogany were well attended, and full prices obtained. The arrivals during last month amounted to 1,825 tons, against 680 tons for the corresponding month of last year. The market is bare of Honduras, the cargo per "Ellisif" having been sold; Tabasco is in good demand, and the next arrivals will meet with a ready sale, the market being bare.

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ELECTRIC LIGHTING OF LIVERPOOL AND TOXTETH.—The Bill to confirm the provisional order granted by the Board of Trade to the Electric Supply Company for extending their operations in Liverpool and the district, has passed unopposed through the House of Commons, £20,000 being required to be *bonâ fide* subscribed and appropriated.

PROPOSED GEOGRAPHICAL SOCIETY.—A preliminary meeting for the purpose of taking into consideration the advisability of establishing a Geographical Society for Liverpool was held on the 6th inst. The success of the Manchester Geographical Society has fully shown the usefulness of an association of this nature.

SHEFFIELD, 10TH JUNE, 1891.

THE IRON AND STEEL MARKET.—There is no improvement in the general condition of the iron and steel trades report. The price of raw materials and labour shows little, if any, signs of decreasing. Forging and rolling mills are working short time. The Rolling Mills Association has increased its discounts, which means that rolling will be done for less money.

ARMOUR PLATE TEST.—Messrs. Vickers, Sons, & Co., Limited, have had one of their 10½in. all-steel plates tested on board the "Nettle" at Portsmouth, with most satisfactory results. The shots were three "Holtzer" projectiles, and two "Palliser," each weighing 100lb. The first Holtzer projectile broke in the plate, the second rebounded broken, and the third rebounded intact. Both Palliser shots were broken up. The plate, which is similar to those being constructed for H.M.S. "Centurion," was not seriously damaged.

MARINE ENGINEERING.—There is an almost total absence of work in connection with shipbuilding. Nearly all the work undertaken by firms in connection with orders under the Naval Defence Act is completed, and casting and forging manufacturers are not so well employed as previously.

EDGE TOOLS.—There is a fair amount of trade in edge tools of most kinds. Farmers are ordering scythes, and other agricultural implements, for the hay harvest, while the quantity of sickles sold proves that reaping machines are either unknown or difficult of use in some parts of the world.

CUTLERY.—Cutlers are complaining of a deficiency of orders for the poorer descriptions of cutlery. The better qualities, which bear a less import duty on entry into foreign ports, are selling fairly well.

THE ETHICS OF INDUSTRY.—A lecture, entitled "The Ethics of Industry," which was read before the St. Andrew's Literary Society by Mr. C. A. Kirby, and which deals with the evils of unrestricted competition in trade, has just been reprinted. In this lecture the author says that "competition has in its day been a power for good in the way of incentive to exertion and discovery," but that "if still useful within certain limits, competition may at present be largely overdone." The author traces the history of the profit sharing system, and advocates its extended adoption as a means of improving the present condition of workers.

NORTH STAFFORDSHIRE, 10TH JUNE, 1891.

THE IRON TRADE.—There is no improvement in respect of either prices or demand. The collapse in the Scotch market was quite anticipated, and cannot be said to have exercised any influence on the course of local markets. Bars are being sold at prices ranging from £5 12s. 6d. to £5 15s. per ton, and pig iron from 38s. for cinder iron to 42s. 6d. for forge qualities. It is rumoured that there is to be a further restriction in the output of the crude metal through one or more blast furnaces being blown out. Most of the forges are only working four days per week, and some are at a standstill altogether. Under the sliding scale ironworkers' wages underwent a reduction of 2½ per cent. last week.

THE COAL TRADE.—As is usual at this time of the year the demand for house coal shows signs of falling off, and prices are weaker. The supply of manufacturing fuel is largely in excess of the demand, and general reductions are being conceded to induce business, though there has been no corresponding alteration in the cost of production.

CARDIFF, 10TH JUNE, 1891.

IRON AND STEEL.—The condition of the steel trade is unaltered. Makers are well supplied with orders for Bessemer bars for tinplate works, but as the stoppage of nearly all the tinplate establishments in July has now been definitely determined upon, there is not much prospect for bar makers after this month. There is a better inquiry for steel rails, principally for small parcels in light sections. Heavy sections are quoted at £4 10s. to £4 12s. 6d. Rubio ore second-class quality has been sold at 12s. 3d. to 12s. 6d. per ton c.i.f. Cardiff and Newport, but for best sellers are firm at 12s. 9d. to 13s. Several cargoes of African ore have arrived this week.

COAL AND COKE.—The steam coal market is not quite so active this week. Colliery owners are well supplied with orders up to the latter part of the year. The question of additional dock accommodation is being much discussed, and the suggested scheme for forming a Harbour Trust to assume control of the Bute and Penarth Docks and provide an additional dock on the West Mud is finding general favour. Steam coal is quoted at:—No. 1 quality 15s. 3d. to 15s. 6d.; No. 2 quality, 14s. to 14s. 9d.; No. 3 quality, 13s. 3d. to 13s. 9d.; No. 4 quality, 12s. 9d. to 13s. Household sorts are weak. Coke is in limited demand, prices for furnace being 19s. to 19s. 6d.; foundry, 21s. 6d. to 22s. 6d.; special foundry, 24s. to 25s.

A NEW OIL DISTRIBUTOR FOR SHIPS.—An oil distributor has been brought out by Captain C. C. Conves, of Penarth, and tried with satisfactory results on the s.s. "Arrow." The new invention distributes oil in a perfectly even and continuous flow from the bows of the vessel. It consists of a circular tank or reservoir above a cylinder, and this is fixed in the fore-peak of the ship, as near the bow as possible, and at such a height as to be a little above the waterline when the cargo is on board. Two small copper pipes run from the lower part of the cylinder out through the bows (one on each side), and by means of brass cocks the oil in the cylinder is allowed to run out just over the broken water caused by the passage of the vessel. The pipes at their outlets are not above $\frac{1}{16}$in. in diameter, so that the quantity of oil they allow to run out is small, though quite sufficient to subdue the heaviest seas. A strong steel piston works on a spindle rod through the cylinder, and forces the oil through the pipes when the cocks are open, so that the jets flow several feet out beyond the bows, and prevent the water coming inboard. The cocks are quite separate, and will allow of the oil being distributed on one side only if need be. The reservoir will hold about seven gallons of oil, and the cylinder about five, which will last some four hours with the two jets full on. Seal oil has been tried with the best results, but other kinds of crude oil can be used at pleasure.

BARROW-IN-FURNESS, 10TH JUNE, 1891.

HEMATITE.—The collapse of the "ring" in warrants has led to the entire suspension of business during the week, with the result that stocks remain steady at exactly the same amount as the previous week—viz., 139,543 tons. The demand on both home and foreign account is comparatively small. Warrants have been reduced in price to 48s. per ton net cash, and Bessemer qualities are quoted at 50s. per ton net f.o.b. Forty-one furnaces are now blowing, compared with forty-five in the corresponding week of last year, and there are thirty-six furnaces standing idle.

STEEL.—The steel trade is quiet, and orders are not plentiful either in the Bessemer or the Siemens-Martin departments. At Barrow the works have orders in hand which will keep them employed for the remainder of the year, but in West Cumberland two of the large works have very few orders, while the only other works of any importance have not enough contracts to enable them to keep their mills fully employed. Heavy rails are at £4 11s. 6d., light rails at £5 15s., and colliery rails at £6 15s. per ton. Steel ship plates are in quiet demand at £6 2s. 6d. per ton, angles at £5 10s., and steel boiler plates £6 15s. per ton.

SHIPMENTS.—The shipping trade shows a slight improvement. The exports of pig iron and steel for the past week amounted to 25,467 tons, compared with 18,702 tons in the corresponding week of last year. The shipments to date this year represent 437,528 tons, against 474,565 tons in the corresponding period of last year, a decrease of 37,037 tons.

MIDDLESBROUGH, 10TH JUNE, 1891.

PIG IRON.—The tone of the iron market was more cheerful yesterday than it has been for some time past, though very little business was done. During the last few days of last week prices fell rapidly, brought about by the decline in the value of Scotch warrants, until on the 5th inst. Cleveland warrants were quoted at 39s. 1½d., and on the 8th inst. at 39s. Some sellers would even accept 38s. 9d. Yesterday, however, prices recovered a little, and Middlesbrough warrants were advanced to 40s. cash sellers, and 39s. 9d. cash buyers. Merchants quoted 39s. 6d. for prompt f.o.b. deliveries of No. 3 G.M.B., and 39s. 3d. would readily be paid. Some business has been done in grey forge at 37s. 6d. per ton, but 37s. 9d. is about as little as will be taken. Mixed numbers of local hematite can be bought at 51s. per ton. The stock of pig iron in Connal's stores continues to increase, and up to the 8th inst. there were 128,219 tons, an increase of 2,650 tons for this month.

IRON AND STEEL.—In the finished iron and steel trades there is no improvement, and work is slack at most of the mills and forges. Quotations are, however, maintained, and are as follow:—Common bars, £5 12s. 6d.; best bars £6 2s. 6d.; iron ship plates, £5 10s.; steel ship plates, £6; iron angles, £5 5s.; steel angles, £5 15s., all less 2½ per cent. for cash on the 10th of the month and f.o.t.—In the annual report of the Darlington Iron and Steel Company, recently issued, the directors recommend a dividend of 7 per cent. on preference shares and of 4s. per share on ordinary shares. Last year no dividend was paid on ordinary shares. Messrs. Bolckow, Vaughan, & Co. have secured an order for 5,000 tons of those small pigs known as "copper catches" from a Spanish firm.

SHIPMENTS.—The shipments of pig iron from this port continue to be satisfactory, and amounted to 23,950 tons up to the 8th, as against 23,795 tons for the corresponding period of last month. Of the 23,980 tons, Scotland took 12,710 tons, England and Wales 2,615 tons, and 8,625 tons went to foreign ports.

NEW HARBOUR NEAR MIDDLESBROUGH.—For some two or three years past the Skinningrove Iron Company has been constructing a harbour in the bay close to the works, which are situate on the Yorkshire coast, about twenty miles east of Middlesbrough. At present they have to send any iron they may have to ship up to Middlesbrough at considerable cost, but this harbour will enable the company to ship direct, besides which it can get supplies of fuel by sea. The work is now nearly completed, and the company expects to be loading vessels early next month.

SUNDERLAND, 10TH JUNE, 1891.

THE SHIPPING AND COAL TRADES.—There is no improvement in the condition of these trades. The freight market continues to be depressed. During last week 68,399 tons of coal were shipped at this port, an increase of 2,458 tons over the previous week. 33,769 tons went coastwise, and 34,630 tons to foreign ports, as well as 300 tons of coke, 400 tons of patent fuel, and 30 tons of firebricks. There was also shipped coastwise 250 tons of patent fuel, 180 tons of coal tar, 180 tons of steel plates, 130 loads of timber, 5,000 dozen glass bottles, 25 tons of cement, and two cargoes of miscellaneous goods.

IMPORTANT HARBOUR WORKS.—Recently Sir John Coode made a careful examination of the entrance to the River Wear and the new pier at Roker, now under construction, and considered three sites for the proposed new South Pier. He reported to the River Wear Commissioners in favour of the proposal of Mr. H. H. Wake, engineer to the River Wear Commissioners. It was decided to adopt Sir John Coode's recommendation, and to proceed at once with constructing about one-half the length of the new pier, which is to be 2,870ft. in length, and is to cost about £100,000.

NEWCASTLE, 10TH JUNE, 1891.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock during the week ending the 6th inst. amounted to 113,571 tons, being a decrease as compared with the corresponding week last year of 5,704 tons.

ENGINEERS AND PLUMBERS.—The dispute between these sections of operatives, which for some weeks past has put a stop to work in the engineering department of Messrs. Palmer's establishment, Jarrow, has now caused the work on four vessels in course of construction to be suspended, and the Howden Yard, belonging to the firm, has been temporarily closed. At other engineering works on the river notices to terminate engagements have been served on the fitters and other workmen; and this action of the employers is attributed to their desire to put an end to the unseemly conflict at Jarrow. The plumbers have signified their willingness to have the dispute referred to arbitration, but the engineers object to that mode of settlement. The engineers are consequently responsible for the present deadlock, which, if it continues for any considerable length of time, is bound to bring about most calamitous results.

SHIPBUILDING.—The signs of coming slackness are becoming more noticeable at many of the shipbuilding establishments, and, though one or two of the largest yards still maintain an appearance of briskness, it is clear that the quantity of prospective work is limited. Several vessels have been launched lately, and the berths they occupied still remain vacant. During the present year scarcely any orders have been received, and any new work that has been begun was simply the outcome of negotiations completed in the summer or autumn of last year. A reduction of wages will doubtless be asked for shortly.

CEMENT WORKS.—There is just now a good demand for Portland cement, both for local use and for exportation, and the whole of the works in the district are kept briskly employed. Messrs. Wailes, Dove, & Co., of St. Nicholas Buildings, are very busy with the manufacture of their marine cement for ships' bilges.

CHEMICAL AND COPPER WORKERS' UNION.—The first annual report of the Chemical and Copper Workers' Union, which has just been issued, states that many advantages have been obtained by chemical and copper workers through their connection with the Union. Wages have been increased, and hours of work have been reduced. It is not stated how far the increased cost of production has made these manufactures unremunerative. Regret is expressed in the report that the chemical and copper workers are not represented on the Labour Commission.

ASSOCIATION OF STUDENTS INST.C.E. — Under the auspices of the Newcastle-upon-Tyne Association of Students of the Institution of Civil Engineers, an excursion to the Manchester Ship Canal has been arranged to take place on the 26th and 27th inst.

THE S.S. "MARIA."—This vessel, which was launched on the 23rd ult., has been electrically lighted by Messrs. Ernest Scott & Mountain, Ld. The installation consists of a Tyne combined engine and dynamo, and 66 lamps of 16 c.p. each.

THE TIMBER TRADE.—Nineteen cargoes of timber from North Sea ports arrived in Tyne Dock a few days ago, a fact which shows that the import season has now fairly commenced. The timber being chiefly for mining purposes, will find a ready market, and much of it is already consigned to collieries in various parts of the county of Durham. In the saw mills business is moderately good, and at most of the timber yards stocks, which, after the spring sales, had become much reduced, are already beginning to be replenished.

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THE NICARAGUA CANAL.

(*For description see page* 556.)

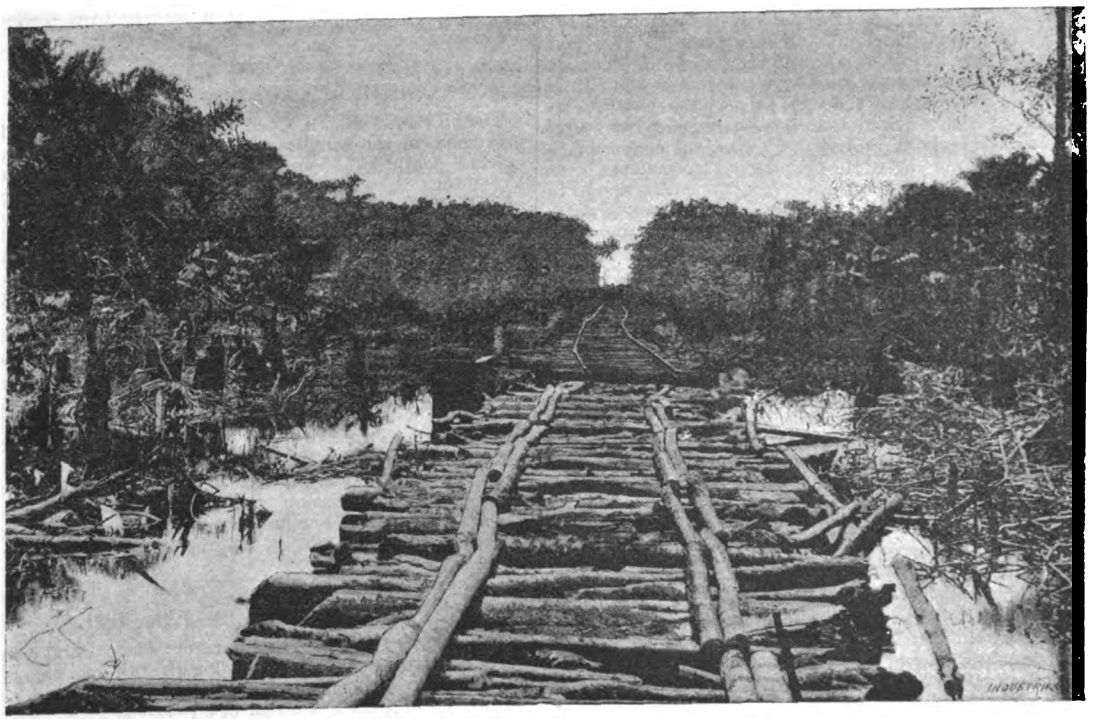


FIG. 18.—RAILWAY THROUGH SWAMP—CORDUROY WITH TIES, AND RAILS IN BACKGROUND.



FIG. 19.—GIANT OF THE FOREST ON THE RAILWAY ROUTE.

THE BATH AND WEST OF ENGLAND AGRICULTURAL SHOW.

THIS show was opened at Bath on Wednesday, the 3rd inst., and closed on Monday last. As our readers are aware, it is for the most part a reproduction on a smaller scale of the Royal Agricultural Show, not merely in general character—this must necessarily be the case—but in the details of exhibitors and exhibits. With few exceptions, therefore, there was in the machinery and implement department nothing that calls for special notice. Most of the leading firms of agricultural engineers were represented, and exhibited the usual display of portable and traction engines, ploughs, horserakes, turnip and chaff cutters, &c., of the types with which we have now become familiar.

As usual, a considerable number of gas engines were exhibited, and among these was one by Messrs. Crossley Bros., provided with one of their new self-starting appliances, which, we believe, has not been previously shown at any public exhibition. The arrangement is extremely simple, and is said to answer perfectly. When the crank is in its mid-position on the forward stroke, and the piston consequently about half stroke—the space behind it being filled with air only at atmospheric pressure—gas is admitted by an auxiliary pipe and opening, entirely independent of the usual gas admission valve. A branch from this auxiliary pipe supplies a small horizontal gas jet which is lighted previously to starting and projects its flame over a short vertical mouthpiece or chimney communicating with the interior of the cylinder. The mixture of air and gas issuing from the chimney is ignited by the jet, and as soon as the flame assumes the blue colour indicating an explosive mixture, the igniting jet is shut off and an explosion immediately follows, which starts the engine. A "Weatherhogg" paraffin engine, similar in general construction to the benzoline engine by the same maker, first exhibited at Windsor in 1889, was to be seen at work at the Bath Show. The design, however, has been considerably improved, and whereas the engine shown at Windsor was intended for use with benzoline only, that at Bath was actuated by ordinary paraffin. The latter, too, was of the fixed horizontal type, while the former was arranged on wheels as a portable machine.

Among minor apparatus, not having any very intimate connection with agricultural pursuits, we noticed a plate and dish washing machine by Messrs. Crees & Co., of Warminster, Wilts. Under ordinary circumstances this is intended to be driven by hand, but the sample on view at the Bath Show was worked by a small electric "Whitehall" motor, manufactured by Messrs. Easton & Anderson.

At the Royal Agricultural Show last year, Messrs. Hornsby & Sons showed, for the first time, a rotary divider for reaping machines, but which, for one reason or another, was not actually attached to a machine; at the Bath Show such a divider was exhibited as an integral portion of one of the firm's reapers. It is stated to be more effective than the ordinary divider, especially for heavy and tangled crops.

Locally—in Bath and the surrounding agricultural district—very great interest appeared to be excited by the show, which was well attended. In connection with dairy appliances, a gold medal was offered for the best means of determining the amount of butter fat in milk, and a second gold medal for the best method of testing the acidity in milk. There were two competitors—the same firms—for each prize, but the judges recommended that the medals should not be awarded.

HIGHER SPEED ON INDIAN RAILWAYS.

THE demand for higher speed on Indian railways has been met hitherto by the convincing arguments that the lines are mostly unsuitable for fast travelling, and that it would not pay to run fast trains. As regards the latter contention, it is sufficient to say that public opinion has virtually compelled the East Indian Railway to expedite their mail trains, and the tendency is for other lines to follow suit. The unsuitability of railways in India for fast speed is, states *Indian Engineering*, a myth. It has been absolutely proved that trains travel smoother when going at considerable speed than they do if the pace is slow. The main directions in which improvement in travelling in India may be effected are in increased speed of mail trains and in better carriages. In England and on the Continent a very noticeable change for the better in the carriages has been effected of late years, but in India progress has been slow, and there are many desirable improvements which should be carried out.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 12TH JUNE, 1891.

SAFETY IN OCEAN TRAVELLING.

AT the present time, when we hear so much about swift ocean travelling, and when proposals are being made to still further increase the speed of steamers, it is well to consider the question from the side of safety, so that the public may form some idea of the probability of increased danger, which is usually supposed to accompany increased speed. Few persons would be inclined to shorten an ocean voyage if they ran a great risk of suddenly ending their days by so doing. Therefore a glance at the past history of the subject may be interesting. From the time of the inauguration of Atlantic Ocean transit in 1838, until 1879, 144 steamers of all classes were lost in that trade. Some of these, however, were not very important. The first which was lost was the "President," which disappeared mysteriously in 1841. It is a somewhat noteworthy fact that during the next thirteen years only one life was lost through the loss of an Atlantic steamer, and that was in the "Columbia," of the Cunard Line, which went ashore in 1843. From 1854 the losses became very frequent, and are probably to be accounted for by the change which was being made from sailing vessels to steamers, and the want of experience, not only of the officers in charge, but also of the shipbuilders and engineers who were responsible for the construction of the ships and engines. In 1854 the steamship "City of Glasgow," with about 480 persons on board, disappeared, leaving no trace behind, and in the same year the "Arctic," of the Collins Line, and one of the fastest steamers then afloat, was sunk in a collision off Cape Race, and 562 persons perished. Two years later the "Pacific," of the same line, disappeared, leaving no trace behind. A remarkable fact in the history of the Allan Line is that, between 1857 and 1864, it lost no fewer than nine steamers. The Hamburg-American steamer "Austria" was, in 1858, burned at sea, with a loss of 471 lives. Of the more remarkable losses since that date may be mentioned the Inman liner, "the "City of Boston," in 1870, the White Star liner "Atlantic," the German steamer "Schiller," the North German Lloyd steamer "Deutschland," the Hamburg-American steamer "Pomerania," and the French steamer "Ville du Havre." When we analyse the causes of the losses up to 1879 we find that twenty-four vessels never reached the ports for which they sailed, their fate being veiled in mystery, ten were burned at sea, eight were sunk in collisions, and three were sunk by ice. Since 1879 it is satisfactory to find that the number of losses have not been nearly so numerous. The most memorable are the burning at sea of the "Egypt," of the National Line, and the "City of Montreal," of the Inman Line, both without loss of life; the stranding of the "State of Virginia," and the sinking of the "State of Florida," by collision with a sailing ship, and of the "Oregon," in collision with a coal schooner. These facts are so far satisfactory that they show a great decrease in the list of accidents during what may be considered the modern period of the steamship. This may be accounted for by the fact that, having passed the transition period, the officers in charge were more thoroughly acquainted with their duties, and the ships and engines were more efficiently constructed. The record of last year is of a most satisfactory kind. Notwithstanding all the risks from collisions, hurricanes, icebergs, and other causes, we find that nearly 2,000 trips were made from New York alone to various European ports, and that about 200,000 cabin passengers were carried, in addition to 372,000 immigrants, all without any accident. The risk of collision has been very much reduced by the adoption of the system of "steam lanes," suggested by Professor M. F. Maury—that is, of having definite courses for the steamers, based on calculations as to probable areas of fog and ice. If any accident should occur to a steamer there is thus every probability that assistance will be rendered by one of her companion ships.

The improvements which have taken place in the methods and appliances of navigation have, no doubt, added much to the safety of the ships, and this has been increased also by the higher standard of education, and consequently of intelligence, than formerly was found, both among officers and men. Sir William Thomson, in a volume of papers recently published, has said: "It is a common saying that sailors are stupid; but I thoroughly and heartily repudiate this statement, not from any sentimental fancy, but from practical experience. No other class of artisan is more intelligent; and, moreover, sailors' wits are kept sharp by the ever nearness of difficulties and dangers to be met by ready and quick action." Sir William himself has done much to improve navigation, not only by his writings on subjects directly connected with it, but also by his inventions. His improved compass and his sounding apparatus are to be found in all first-class steamers, and his influence has been felt in many direct and indirect ways. We would refer to the volume of papers above mentioned on subjects relating to navigation for full details regarding these, and also for suggestions which may come to be of great practical utility in the future. He expresses the opinion that the regulations for preventing collisions at sea contain everything that human wisdom has been able to devise for diminishing the chances of collision. The action of the recent Maritime Conference at Washington showed that the members agreed with this opinion, as they proved very conservative in their policy. They declined to adopt a large number of resolutions sent in from more than one country of importance, and contented themselves with a number of not very important amendments, and with the passing of some new rules for the marking of wrecks and the removal or destruction of derelicts. Considerable improvements have been made in recent years in lighthouse arrangements, but Sir William Thomson would like to see all the lighthouses flashing out their characters like electric signals, instead of the present rather slow revolving method. A certain advance has been made in another direction in the application of the Morse alphabet to marine signalling by sounds. Sir William is anxious that lighthouses should be able to flash light signals. He says that a lighthouse, to fulfil the reason of its existence, must not only be seen, it must be recognised when seen. He argues that there has not hitherto been amongst lighthouse authorities quite enough determination to make every effort to give a distinctive character to coast lights which science and common sense have placed at their disposal. The dangers from collisions with

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icebergs have been reduced by the useful charts which are issued by the Hydrographic Bureau at Washington. From the records of this Office it appears that from 1882 to 1890 thirty-six steamers were more or less injured by ice in the North Atlantic, although some of these were freighting and coasting vessels. Probably the commonest explanation of the fate of missing ships is collision with ice in fog or in the darkness of the night. In case of accident, the number of boats now available is much larger than formerly, but to ensure that all the passengers in one of the large Atlantic steamers should be accommodated would require a very great amount of space.

We need not go into details of the improvements which have taken place in the construction of the ships and engines, as we have drawn attention to them from time to time. A large number of bulkheads is the most important point which requires attention in order that safety may be ensured, and, in fact, these and double bottoms are prime necessities. The bulkheads should not only be transverse, but also longitudinal, so that the engines driving separate screws may be quite self-contained. There can be no doubt that the bulkheads saved the "City of Paris" last year, and that was the case in spite of the fact that the longitudinal one was damaged by the breakage of the engines. It seems rather odd that the twin-screw and separate engines did not commend themselves to shipowners and shipbuilders at an earlier period, as they had been in common use in the Royal Navy. Of course in the Navy the arrangement was adopted on account of its advantage in manœuvring, but the security afforded by it in case of accident to one set of the engines is a sufficient reason for its being adopted in large passenger steamers. This has already been recognised by the proprietors of some of the most influential lines. The improvement in the quality of the materials used in the construction of ships and engines, as well as in the methods of working them, has done much to lessen danger, and we are convinced that our shipbuilders and naval engineers are now in a position to take a considerable step in advance as regards speed without lessening the safety of ocean travelling.

PROGRESS IN INDIA.

The great problem in India, which has been confided to the people of this country to solve, is one which deserves more attention than it receives from our politicians and legislators, as it is one of great complexity, and on its right solution will depend, not only the welfare of millions of our Eastern fellow-subjects, but also to a very considerable extent the continued prosperity of many of the industries of this country. The statement which is laid every year before the House of Commons, exhibiting the moral and material progress and condition of India, may, in a sense, be regarded as an elaborate balance-sheet, showing from year to year the measure of success which is attending our rule in the East, and the numerous problems—political, economic, industrial, and financial—that are constantly calling for solution. It affords a great deal of material, not only for study, but also for discussion, if only sufficient interest could be excited in it. While we do not think it desirable that the House of Commons should be made a court of review of the doings of the Government of India, we think it a misfortune that greater interest is not taken in our great dependency.

Possibly one of the most important movements, and the one which is likely to have most effect on the future of India, is the development which is taking place in local government. No fewer than 755 towns in British India have been formed into municipalities, and, besides these, many district and local boards have extensive powers of various kinds. In these and other ways the people of India are learning practically how to govern themselves. Of course, difficulties and differences of opinions occur, but with regard to the main objects on which municipal funds are spent—namely, water supply, hospitals and dispensaries, streets and roads, drainage, sanitation, and education—the general opinion seems to be that municipalities do more for the benefit of their citizens than was done before by Government officers. In the matter of water supply and sanitation considerable progress has been made, but, of course, a great deal still requires to be done. When we consider that during the past ten years the population has increased by 29 millions, and that it now reaches a total of 286 millions, we have some idea, not only of the magnitude, but also of the rapidly increasing complexity, of the problem, and that, in the matter of education especially, the development has not kept up with the increase of population. The sea-borne trade of British India increased during the year by a hundred million rupees. From an industrial point of view, possibly the most important fact is that the imports of cotton goods declined 4 per cent., and metals and machinery increased 24 per cent., both facts being indicative of the industrial development which is taking place in India. Machines and the materials for making them are being imported, while the factories are beginning to turn out textile and other products sufficient for the wants of the people. The output from Indian coal mines during 1889–90 was upwards of two million tons of coal, or 19 per cent. more than in the previous year. The intellectual activity of the country was represented during the year by 9,725 new books and publications, including, however, new editions of old works, and of these about nine-tenths were in the vernacular languages. On the whole, the statement of progress in India is one which we can contemplate with considerable satisfaction.

CORNELL UNIVERSITY.

In keeping our readers informed of the educational progress of the world, we have very often found it necessary to refer to institutions in the United States of America as illustrations of the arrangements which are necessary in order that the educational wants of the times may be supplied, for, notwithstanding the progress which has been made in this country, it cannot be denied that more original ventures are made in America than here. Of all the institutions to which we have from time to time referred, no one fulfils the ideal of a modern university better than Cornell University, the managers of which have steadily kept in mind the wish of Ezra Cornell to found an institution where any person can find instruction in any study. It not only has faculties in the older departments of learning, but its scientific side is practically a technical school, in which instruction can be obtained in all the modern scientific professions. We have at different times given an account of the constitution and development of the University, so that we need not now repeat details. We wish, however, to direct the attention of those of our readers who are specially interested in the subject of education, to an illustrated description of the University, which has been written by Frank C. Perkins, Associate Member of the American Institute of Electrical Engineers, and published at the Art Printing Works of Mathews, Northrup, & Co., Buffalo, N.Y., and which gives a pictorial and descriptive view of the opportunities offered by Cornell University for general and technical education. The general courses include those leading to degrees in arts, philosophy, letters, and science, and for these the facilities offered are very complete indeed. But it is to the technical courses that we wish specially to allude. These include agriculture, architecture, chemistry, civil engineering, electrical engineering, mechanical engineering, and law. In 1890–91 the corps of instruction contains the names of one hundred and seven professors and instructors, besides twenty-five special lecturers. The number of students enrolled during the same year is 1,382, of whom more than a hundred are pursuing graduate courses. We are especially interested in the Sibley College of Mechanical Engineering and the Mechanic Arts, of which Professor R. H. Thurston is the director, and in which there are twelve other professors and instructors. It includes all the necessary lecture and class rooms, extensive drawing rooms, workshops of equal extent, a mechanical laboratory for the prosecution of engineering investigations and scientific research, and for the instruction of graduate and professional engineers, as well as for the somewhat extensive course of instruction in methods of experimental work provided for undergraduates.

COOPER'S HILL COLLEGE.

A report has been in circulation that it had been decided to close the Indian Engineering College at Cooper's Hill, but we are officially informed that there is no truth in the report, and that, on the contrary, its class accommodation is at present being enlarged.

Ever since its institution by the Duke of Argyll, the College at Cooper's Hill has been the subject of considerable controversy and discussion. The Institution of Civil Engineers protested against its being started, because it was of opinion that it was desirable to have in the Indian engineering service men with different kinds of training, and therefore, to a certain extent, with different types of mind. It was pointed out that "in the proposed College the minds of the pupils will all be moulded in the same forms. There will be none of the emulation of different schools of thought and action, and none of that independence and originality of resource which have produced the best engineers."

The immediate cause of the foundation of the College was the difficulty of obtaining properly qualified candidates for the Indian engineering service under the system of open competition. It was found that the best of the young men in the profession would not come forward, and that those who did were for the most part merely crammed for the examination, and were not *bonâ-fide* engineers. The provision for experience in office and practical work was very often got in a very perfunctory manner, and was more formal than real, some men actually keeping their offices, not for executing actual works, but for the purpose of scheming proposals or making imaginary designs, so that their pupils might obtain a qualifying certificate. Since the College was instituted, however, there has been a great advance in all departments of engineering education, and there would not now be the slightest difficulty in obtaining a sufficient number of men who had passed through a college course of study and at the same time possessed a good acquaintance with practical work. There can be no doubt that, if the conditions of service in India were somewhat modified in the manner in which we have at different times indicated, there would not be the slightest difficulty in keeping the Public Works Department well supplied with thoroughly qualified men. There is only one department for which provision would have to be made, and that is forestry, for the study of which as yet no proper facilities exist in this country. But now that the Agricultural Department is taking up the subject of agricultural education, this could easily be arranged, as a slight addition to the subjects of some of the colleges would give all that is wanted—at least, all that can be done in this country, where there are few forests. At present the students of Cooper's Hill College have to spend some time in France and Germany in the forestry departments there, and this could still be done by those who were selected for India.

THE PETROLEUM WEALTH OF RUSSIA.

In view of the great interest which is attached to the development of the use of liquid fuel, we give a few details of an article which recently appeared, on the petroleum wealth of Russia, in the *Economiste Russe*. The extraction of naphtha is confined almost exclusively to the Caucasus, in the peninsula of Apchéron, and principally in the environs of Baku. After the annexation of Baku to Russia the petroleum industry was at first a monopoly, which brought into the treasury, from 1821 to 1872, an annual revenue of 87,000 roubles. This monopoly was suppressed in 1872, and an excise duty imposed, the yield of which to the Imperial Exchequer in 1888 was nearly 7,000,000, and in 1889 over 9,000,000 roubles. From 1832 to 1862 the production was confined within narrow limits, and it varied from 255,500 poods to 358,300 poods annually, the pood being equivalent to 36lb. avoirdupois. From 1863 to 1868 it rose to between 538,900 and 998,900 poods, and continued to rise until it amounted to 1,685,229 poods in 1869, the year from which its enormous development dates. In 1870 the production amounted to 1,704,465 poods, in 1875 to 6,285,728, in 1880 to 20,736,949, in 1885 to 115,000,000, and in 1889 to 206,897,100 poods, of which the environs of Baku supplied about 99 per cent.

The principal companies engaged in the extraction of petroleum are the Nobel, Caspian, Baku, Caspian and Black Sea, with other smaller companies in the neighbouring districts. The petroleum extracted from the wells is carried by pipes to the large stations or reservoirs, and thence distributed in the same manner to the works. The system was inaugurated in 1877. The distilleries are, for the most part, established at Baku, where they form a special district, which is known as the "black town." In 1889 the number of distilleries was 147, and their total product amounted to 181,590,232 poods, of which 62,000,000 were light oils, 1,000,000 heavy oils, and 113,000,000 residues. The working of petroleum at Baku is placed under the direction of a committee of experts, established in 1886. The greater part of the petroleum extracted is consumed in the interior of the empire. It is carried from Baku by the Caspian Sea, then by the Volga to Tsaritsyne, from which place a certain amount goes up the river, but the greater part is carried by rail, in tank waggons, to all parts of European Russia.

Petroleum intended for foreign markets is shipped chiefly from the port of Batoum, and the amount exported continues to grow rapidly. In 1883, refined

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petroleum only represented 41 per cent. of the total exports: whereas in 1890 it was 84 per cent. In the year 1889, over 6,000,000 poods of lighting oils and benzene were exported from Russia to the United Kingdom, 4,000,000 to Austria, 3,000,000 to Germany, 2,000,000 to Italy, 2,000,000 to Belgium, and smaller quantities to Holland, Roumania, Spain, Denmark, Sweden, Norway, Greece, France, &c. Turkey took in the same year 7,000,000 poods, Persia 336,000, and Japan 330,000 poods of lighting oils and benzene. In 1888, 77 per cent. of the total exports were effected *viâ* Batoum, and in 1889, 80 per cent. The article concludes by quoting the opinion of Professor Mendeleef to the effect that there is no indication of an approaching failure of the petroleum supply of the Baku basin, leaving out of the question the other districts of Russia which still await the development of their naphtha wealth.

THE RECENT CENSUS AND LARGE TOWNS.

Some interesting results of the recent census as regards the twenty-eight large towns which are dealt with in the Registrar-General's weekly returns have recently been published. According to these returns the population of the twenty-eight towns amounted to 9,398,000, which shows an increase of about 1,000,000 over the population in 1881, or at the rate of about 12 per cent. The rate of increase during 1881 to 1891 has therefore diminished in comparison with the period 1871 to 1881, when it was computed to be 16½ per cent. It has been observed that when the growth of the population has reached a certain stage, the rate of increase has a tendency to diminish, but the large increase in the number of emigrants during the last decade as compared with the preceding decade must be considered as helping to prevent the apparent rate of increase of population from being maintained.

It was recommended by a departmental committee, which was appointed in February, 1890, that a quinquennial census of a limited scope should be taken midway between the full decennial censuses, in order that more accurate statistics may be available between those dates. The statistics recently obtained show that the population of the twenty-eight towns is less by 64 per cent. than had been estimated by a comparison of the returns of the births and deaths during the intervals. The following table shows with respect to some of the more important of the twenty-eight towns the population according to the census of 1891, the population according to the census of 1881, and the increase during the decade 1881 to 1891:—

Towns.	Population. Census 1891.	Population. Census 1881.	Increase or Decrease. 1881-91.
London	4,221,452	3,816,483	+404,969
Bristol	222,049	206,874	+ 15,175
Birmingham ...	429,906	400,744	+ 29,162
Nottingham ...	212,662	186,575	+ 26,087
Liverpool	517,116	552,508	− 35,392
Manchester ...	506,409	341,414	+164,995
Salford	198,717	176,235	+ 22,482
Bradford	210,938	183,032	+ 27,906
Leeds	369,099	309,119	+ 59,980
Sheffield	325,304	284,508	+ 40,796
Hull	184,267	154,240	+ 30,027
Newcastle	187,502	145,359	+ 42,143
Cardiff	130,283	82,761	+ 47,522

The growth of the population of London within the registration district is thus shown to be at the rate of 10 per cent. Liverpool is the second city in England as regards population, and Manchester is third, with 506,409 inhabitants, which shows an increase of 48 per cent. over the previous census. The large increase in Manchester is largely attributable to the greater area included in the last census. Glasgow is stated to have a population of 532,282. Cardiff has increased at the rate of 57 per cent.; Newcastle, at the rate of 29 per cent.; Leeds, 19 per cent.; Oldham, 19 per cent.; Hull, 19 per cent.; Huddersfield, 17 per cent.; Blackburn, 16 per cent.; and Derby, 16 per cent.

Letters to the Editor.

ARTILLERY STEEL.

To the Editor of "Industries."

Sir,—The interesting paper contributed to the Iron and Steel Institute by the Director of Ordnance, a portion of which appears in your issue of last week, is evidence that in future the character of the material of our artillery will receive the scrutinising attention that its supreme importance commands.

Without referring to the part of the contribution that describes the more or less hypothetical—shall I say fanciful?—phenomenon, I should like to make a few comments on the assertion made by Dr. Anderson, that, "like ice and water, steel and cast iron have a greater volume in the solid than in a liquid state." My experience and theoretic investigations tend to show quite the contrary, and that, like most, if not all, metals, both iron *per se* and in its carbide form as steel expand with the addition of heat, according to well-known coefficients of measure of dilation (*vide* Fizeau, *Annuaire du Bureau des Longitudes*, 1885), until a temperature is reached that destroys the static molecular integrity, and the metal becomes fluid. Even then the volumetric dilatancy proceeds *pari passu* with the increase of temperature; consequently the liquid condition must be of greater volume than its cold one. Otherwise—and here is a question for Dr. Anderson—if the cold condition occupies a greater volume than the fluid one, would not the metal, on cooling, burst or fracture the moulds containing it?

In my contribution to the discussion on Professor Greenwood's paper, Vol. XCVIII. Minutes Inst. C.E., page 200, I attempted to enunciate by calculation the formulæ, the molecular density, or equivalent specific gravity, and degree of volumetric increase of metal (steel) heated to melting point, and inversely the volumetric reduction in cooling from the fluid to the solid condition, which may be taken to equal $\frac{-22}{6967}$ of the fluid mass.

Inversely the cold steel, of a volume x, occupies a volume y when melted thus:—

$$x + \left(\frac{x + 22}{6967}\right) = y.$$

The explanation of the fact that sometimes a piece of cast iron thrown into a bath of molten steel floats on the surface is obvious.

When a pig or ingot is run or cast on cooling from the outside inwardly, the shell or outside surfaces of the ingot cool initially to near size of the internal dimensions of the mould, the internal part of the mould or casting, on being cooled, leaves gas-enclosed cavities equivalent to $\frac{23}{6967}$ of the total mass or bulk of metal.

So that actually the pig or ingot is a compound of metal and enclosed gas cavities, and its compound density and specific gravity is very little different from that of the fluid metal; and when this cold compound metal and air is thrown into the bath of steel and becomes heated, the effect of the expanded gases is evolved, and the bubbles of escaping carbon-monoxide from the metal in process of decarbonisation sometimes forces the added metal above the surface.

Let Dr. Anderson try the experiment of throwing into a bath of *dead melted steel* a piece of iron or steel of a thoroughly dense character—a portion of a steel rail or tool steel, or a broken cast-iron pipe will do—and I think he will find it disappear below the surface and remain there until melted.

Mr. Snelus draws attention to the fact that if cold steel ingots are placed in a furnace they sometimes blow up like guns. This is not, I think, so much due to internal molecular stress as to the expansion of the enclosed gases in the cavities.

A simple thermodynamic calculation will show the enormous pressure that will be exerted by the rigidly enclosed gases; as they are compressed by the influence of the added heat this effect clearly accounts for the violent rupture.

If steel ingots are imperfectly cast, oil-hardening can only partially restore molecular equilibrium. The range of useful effect of the oil is the limit of its temperature below volatilisation point—say 600°—whereas the initially internal stress is a function of 2,500° at the temperature of solidification.

The same remarks apply to annealing, but in a less degree, as the range of useful effect may be equivalent to 1,100°. If a metal is cast in a perfect state of equilibrium it requires neither annealing nor yet oil-hardening, and no mechanical treatment will improve its general characteristics, as the density of a perfect metal is unalterable, and the specific gravity is always a true index of the physical value of the metal.

There are many other points raised in Dr. Anderson's important, instructive, and inviting communication, which are deserving of attention and might *benefit by critical analysis*.

It is, I suggest, desirable, in producing metal suitable for guns or projectiles, to so cast it that its contraction cavity co-efficient x, or $\frac{22}{6967}$, shall be reduced to the lowest practicable extent; otherwise no system of treatment—chemical, thermic, or mechanical—will restore absolute molecular contact or perfect density, and consequent neutrality and freedom from internal stress of steel or iron.

Yours, &c.,
London, 6th June, 1891. B. W. Thwaite.

THE ATLANTIC MAILS.

To the Editor of "Industries."

Sir,—Will you or some of your readers kindly tell me where I may obtain the Parliamentary paper giving the times of passage in 1890 of all the steamers carrying the above mails? You directed your readers' attention to the return a short time ago.

I have tried the General Post Office here, but they do not know anything about the paper. Therefore, if you give the information desired, you will much oblige,

Yours, &c.,
X. Y. Z.

Belfast, 5th June, 1891.

[The paper referred to is "House of Commons Returns," 116, for this year, and is entitled "American Mail Service." It may be obtained from Messrs. Eyre & Spottiswoode, East Harding Street, London, E.C. Price 1½d.—Ed. *Industries*.]

THE LONDON POLYTECHNICS.

To the Editor of "Industries."

Sir,—Your interesting leading article last week, on the London Polytechnics, directs attention to a subject which should be very carefully considered, and not be allowed to drift into conventional or official lines. I have taken a great interest in the subject of education, and especially of technical education, and I must confess that I have been very much disappointed at the spirit in which the work is taken up even by those who are most enthusiastic. They seldom distinguish between the imparting of information and the giving of a good education to the students. They also fail to recognise that a man may be well informed about many things, and yet be very imperfectly educated.

In a recent report of the National Association for the Promotion of Technical and Secondary Education the opinion was expressed that "if the present movement for technical education is to end in the mere multiplication of science and art classes, formed by incompetent teachers dependent on grants for their livelihood, it may be that the resulting evil will outweigh the good. If the Technical School of the future is to consist of an ill-assorted collection of such classes as are found by experiment to be the most 'paying' from the point of view, not of the education of the boy, but of the remuneration of the teacher, omitting all those humanising studies which are 'merely' educational and not grant earning, the cause of secondary education will not be advanced, but rather thrown back by the change. What is wanted is more elasticity in method and more intelligence in teaching, and unless these results are achieved, very little good can be done."

When recently visiting the Regent Street Polytechnic I was very much struck with the great amount and the variety of the activity about the place. I was specially pleased with the great attention paid to physical development and to recreation, for when these are not overdone—as unfortunately they too often are—they are likely to do the students more good than many of the formal subjects with which they are crammed. Professor Laurie, of Edinburgh, in one of his addresses, published some time ago, said: "Give me a man with an intelligent mind and with a moral purpose in life, honest in his resolves, honourable in his aims, and I will guarantee you in that man the best manufacturer, the best merchant, the best weaver, the best engineer, the best plumber; given the necessary amount of knowledge of business and I will guarantee you against a railway king or a shoddy millionaire." The educational articles which have appeared in your journal have always taken this view of the subject, and I hope you will keep your eye on the development of the London Polytechnics, for on the lines which these take will depend the future welfare of a large number of the youth of London, and, therefore, also the welfare of the country.

It is to be hoped that your advice will be taken, and that the Institutes will be allowed to grow gradually, and be designed so that they may be extended, for, as you point out, their nature is so different from that of any institutions which have been hitherto carried out that the whole question cannot be considered to be beyond the experimental stage, and it would be a great mistake to make them all of exactly the same type.

Yours, &c.,
London, 8th June, 1891. Teacher.

CHANGES IN IRON PRODUCED BY THERMAL TREATMENT.

To the Editor of "Industries."

Sir,—Mr. E. J. Ball's paper "On the Changes in Iron Produced by Thermal Treatment," recently read before the Iron and Steel Institute, is most interesting. It affords, I think, a plausible explanation of the discrepancies summarised by me in *Industries* of April 15th, 1887, in which stress is laid on the importance of noting the variations in temperature in the working of steel.

I therein show the connection which *must* logically exist betwixt temperature and chemical composition, suggesting that the fusion point of iron must vary in accordance with its chemical composition, whence it follows that each variety of steel must be worked at a temperature corresponding to its fusion point.

Mr. Ball has demonstrated that the changes in iron produced by thermal treatment are in accordance with (as regards carbon) its chemical composition. Steel containing $\frac{1}{10}$th carbon, reaches its maximum tensile strength, when hardened, at about 1,300°. This temperature once exceeded, the tenacity of the metal diminishes, although the extensibility increases. With $\frac{2}{10}$th carbon the greatest tenacity is obtained at about 1,000°. Here the relation existing betwixt temperature and the quantity of carbon contained is distinctly shown; further additions of carbon also produce corresponding changes, until at last the point of maximum tenacity disappears almost entirely. It is quite probable that other elements, such as sulphur, &c., may lead to similar modifications as suggested by Mr. Ball.

Further, it is shown that a high carbon steel can be rendered brittle by being simply heated to 1,400°, the incipient fusion point of steel. I have commented on this in my letter previously referred to, in which I stated that differences in steel may be traced to variations in temperature, and that, strictly speaking, steel of a given chemical composition must be worked at a certain temperature corresponding to its composition to ensure good results. I further acknowledged that I knew of no means of ascertaining this, the critical temperature, stating only that it must be a fixed number of degrees below the melting point.

I have in my possession a steel rail which is as brittle as glass—in fact, weaker than crude iron—containing only ½ per cent. carbon, and hitherto the cause of this extreme brittleness has remained unexplained.

It is probable that the brittle rail must have been accidentally treated in a somewhat similar manner to that of Mr. Ball's sample. It is urged that the change is due to a form of iron existing only at temperatures approaching the melting point of the metal, but rendered stable at lower temperatures by hardening or by the pressure of carbon; and certainly, having regard to the recent researches of Osmond and others, this seems probable. I am of opinion, however, from certain researches, as yet very incomplete, that so-called iron contains another more volatile body, and presumably of an intermediate fusion point, betwixt iron and manganese, but I do not wish to insist upon this, as, so far, I have been unable to demonstrate its presence by isolating it from iron.

When I wrote my letter to you in 1887, I was, of course, quite ignorant of the researches of Osmond, and, in fact, I do not wish it to be inferred that my remarks constitute a claim to priority. This letter simply goes to show how practical experience, extending over a long period, seems, on the whole, to confirm the recent researches of Mr. Ball and others.

Yours, &c.,
Metallurgist.

South Wales, 9th June, 1891.

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MANNESMANN TUBES FOR HIGH PRESSURE TRANSMISSION.

(From our Berlin Correspondent.)

At a recent meeting of the German Industrial Union, held in Berlin, Dr. W. Siemens gave some interesting information on the use of Mannesmann tubes for the transmission of naphtha at high pressures. Dr. Siemens owns the Kedeberg copper mines and foundries in the Lesser Caucasus, the working of which was rendered difficult by the scarcity of coal and wood. Naphtha, which exists in bulk at Baku as raw petroleum, or the distilled form of it known as "masut," has been, therefore, utilised as a substitute for coal and wood in the working of copper. It is forced into large round furnaces, constructed after the pattern of Mr. F. Siemens, by steam at high pressure in the form of spray. Sufficient heat is thus produced to melt the ore after it has been mixed with the necessary fluxes, and the copper regulus is separated, which can then be further treated in similar furnaces. The transport of the "masut" was attended with great difficulty, as the works are situated on a high plateau, which descends with steep sides to the Kur steppes. The road from the railway station to the foot of the plateau passes over a steep mountain range more than 3,300ft. high, so that mechanical transport was alone practicable. Cable railways and toothed wheel railways were projected, but the great difficulties of the ground, and the unfavourable experience of Dr. Siemens with regard to the use of cable railways, caused both these methods to be abandoned. The use of a tube was then suggested, by which the "masut" might be pumped up from the low-lying railway station. It was found that a pressure of about 1,500lb. per square inch would be necessary, and no tubes had been constructed hitherto which would bear such a working pressure except the Mannesmann seamless steel tubes. For some little time past one of these tubes has been in operation at Messrs. Siemens' works in the Caucasus. Its length at present is only 14½ miles, whilst the distance from the railway station to the works is about 28 miles. The tube at present raises the "masut" to the top of the plateau, but it is proposed to continue it as far as the works, although the transport on the plateau might be effected by other means. The pumps, which were made by Messrs. Humboldt, at Kalk, near Cologne, have been placed at the foot of the mountain, and raise the naphtha, at a pressure of 1,320lb. per square inch, from a reservoir at the station to a reservoir which has been constructed on the top of the plateau. The internal diameter of the tube is 100mm., and it is 4½mm. in thickness. Completed tubes in long sections have been tested, with a pressure of 2,250lb. per square inch, at the works of Messrs. Mannesmann, at Kommotan and Remscheid. The pump has raised hitherto 22 tons daily, but this amount might be increased considerably, since the pressure could be safely raised. There is no leakage in the pipe. Dr. Siemens stated that the erection of the installation would have been impossible except by using the Mannesmann tubes. He thinks that there would be no difficulty in constructing tubes which would bear a pressure of thousands of pounds per square inch, and that transmissions of high pressures for various purposes will henceforth come into more extensive use.

NOTES ON PATENT LAW.

V.

(Continued from page 496.)

The rule that a complete specification must describe the patented invention with such clearness as to enable a competent person, without further direction or experiment, to make the patented article or perform the patented operation, is one that has given rise to much discussion, although, in principle, it is perfectly clear. The principle, as we stated in our last article, is that the reader of the specification may be able to learn from it to practise the patentee's art or to produce his article, very much as he would have learnt if he had been bound apprentice to the patentee for the purpose. Now, this seems to imply a very high degree of precision and great fulness of detail, since otherwise a written description could hardly be supposed to be in any sense equivalent to workshop training. But the force of the principle has been somewhat broken by the rule which has obtained in courts of law that the reader who is to be so instructed is not one who brings a mind quite uninformed to the consideration of the subject, but, on the contrary, one already skilled in the art to which the specification relates. Otherwise it is plain that the rule would have run to absurdity. If every patentee were obliged to start with the elements of his subject as he would if he were beginning to instruct an apprentice in his workshop, it is plain that every specification would assume the proportions of an encyclopædia, and would be overwhelmed with practically useless matter. But if the patentee can take for granted on the part of his readers a general acquaintance with the state of knowledge and familiarity with existing practice in the trade with which he is concerned, the principle already laid down comes to no more than this:—He must with the utmost fulness and particularity specify every step which is novel in his process, and not such as workmen versed in the industry would ordinarily and customarily take. And this is, indeed, the effect of the multitudinous decisions which have been given upon this point. The late Master of the Rolls, Sir George Jessel, stated it in the year 1876, with his accustomed clearness, in the following terms:—"It is plain that the specification of a patent is not addressed to people who are ignorant of the subject matter. It is addressed to people who know something about it. But then there are various kinds of people who know something about it. If it is a mechanical invention . . . . you have, first of all, scientific mechanicians of the first class, eminent engineers; then you have scientific mechanicians of the second class, managers of great manufactories, great employers of labour, persons who have studied mechanics, not to the same extent as the first class, the scientific engineers, but still to a great extent for the purpose of conducting manufactories of complicated and unusual machines, and who, therefore, must have made the subject a matter of considerable study, and in this class I should include foremen, being men of superior intelligence, who, like their masters, would be capable of invention, and, like the scientific engineers, would be able to find out what was meant even from slight hints, and still more from imperfect descriptions, and would be able to supplement so as to succeed, even from a defective description, and, even more than that, would be able to correct an erroneous description. That is what I would say of the two first classes, which I will call the scientific classes. The other class consists of the ordinary workman, using that amount of skill and intelligence which is fairly to be expected from him—not a careless man, but a careful man, though not possessing that great scientific knowledge or power of invention which would enable him by himself, unaided, to supplement a defective description or correct an erroneous description. Now, as I understand, to be a good specification, it must be intelligible to the third class I have mentioned, and that is the result of the law."

But even with these explanations the rule will not seldom be hard to apply. The case which Sir George Jessel was discussing was a simple one, because it related to a mere mechanical invention, and mechanicians of every degree of accomplishment in the scientific and practical knowledge of mechanics are easily found and commonly known. But a very large proportion of modern patents relate to chemical processes and electrical appliances. In these cases it is often impossible really to address oneself to a reader of the standing of a workman, because the subject lies wholly out of his range. Take, for example, the numerous inventions in recent years for turning petroleum or coal tar to use for industrial purposes. These mostly depend upon reactions between complicated chemical substances, and can only be explained by means of elaborate chemical formulæ and highly technical descriptions. To imagine that a labourer or furnaceman could read such a document intelligently would be ridiculous, and, in point of fact, the witnesses who are habitually called in patent actions to speak to the sufficiency of a specification, not merely in reference to these more complicated subject matters, but even in respect of simple mechanical inventions, are persons of eminence—Fellows of the Royal Society, Presidents and ex-Presidents of the Institutions of Civil or Mechanical Engineers, of the Chemical Society, and Institution of Electrical Engineers. No doubt they are asked to say whether, in their opinion, a competent workman would understand the specification, but in answering such a question they doubtless credit the hypothetical workman, not only with a thorough practical knowledge of his craft, but also with a sufficient acquaintance with scientific literature to be able to understand its technical terms and follow its technical argument. Thus it comes to pass that in practice the law conforms to the requirements of common sense. A patentee is constrained to make a frank and full disclosure, according to the best of his knowledge and ability, of what he has patented; but he is not exposed to the risk of having his rights defeated by the mere ignorance and dulness of his neighbours. In other words, his specification will not be held to be insufficient merely because it is difficult to understand. If the difficulty is none of his making, but is inherent in his subject, it will not hurt him; but if it arises through his fault—that is to say, if he has omitted something essential to a correct statement of his meaning, or has misstated some essential point in such wise as to mislead his reader—then the specification will be held to be defective, and so defective that the patent grant is void.

There is a second reason which is given in most of the older cases for this rule that a specification must sufficiently disclose the patentee's invention—namely, that the public may know what is the prohibited ground off which they are warned. The Patent Act of 1883 has, however, made a slight difference—though but a slight one—to the rule of law in this particular. Prior to the passing of that statute it was optional with a patentee to include in his specification a distinct and formal claim, or not to do so. But now his complete specification *must* end with such a claim. It is to this that the public look when they desire to know what would be an infringement of the patentee's rights, and, as we shall be dealing later on specifically with claiming clauses, we may for the present defer the consideration of this other reason for the rule. No doubt, if a patentee intended to dispense with any formal claim, it would be necessary for him to bear in mind throughout his description that the new matter must be made sufficiently distinct from the old to afford his readers the means of telling how much of what he had described they were free to use; but if he puts in a formal claim defining his invention, it is not until that point is reached that he needs to consider its exact boundaries. For practical purposes, therefore, since all complete specifications nowadays are drafted in this way, the only object which a patentee needs to have in view in the preparation of his description is the impartation to the competent workman of what has been his own secret, and will, while the patent lasts, be his own monopoly.

In our next article we shall deal with the law relating to specifications, as apart from claiming clauses.

(To be continued.)

Books Received.

Telegraphy. By W. H. Preece, F.R.S., M.Inst.C.E., and J. Sivewright, M.A., C.M.G. Ninth edition. Revised and enlarged. London: Longmans, Green, & Co.

A Short History of Political Economy in England from Adam Smith to Arnold Toynbee. By L. L. Price, M.A. London: Methuen & Co.

The Journal of the Iron and Steel Institute. No. II. 1890. London: E. & F. N. Spon.

Journal of the American Chemical Society, March, 1891.

Scamping Tricks and Odd Knowledge Occasionally Practised upon Public Works. By John Newman, Assoc.M.Inst.C.E. London: E. & F. N. Spon.

The Corliss Engine, by John T. Henthorn, and *The Management of the Corliss Engine,* by Charles D. Thurber. Edited by Egbert P. Watson. New York: E. P. Watson & Son.

Wire: Its Manufacture and Uses. By J. Bucknall Smith, C.E. London: Office of *Engineering.*

Reviews.

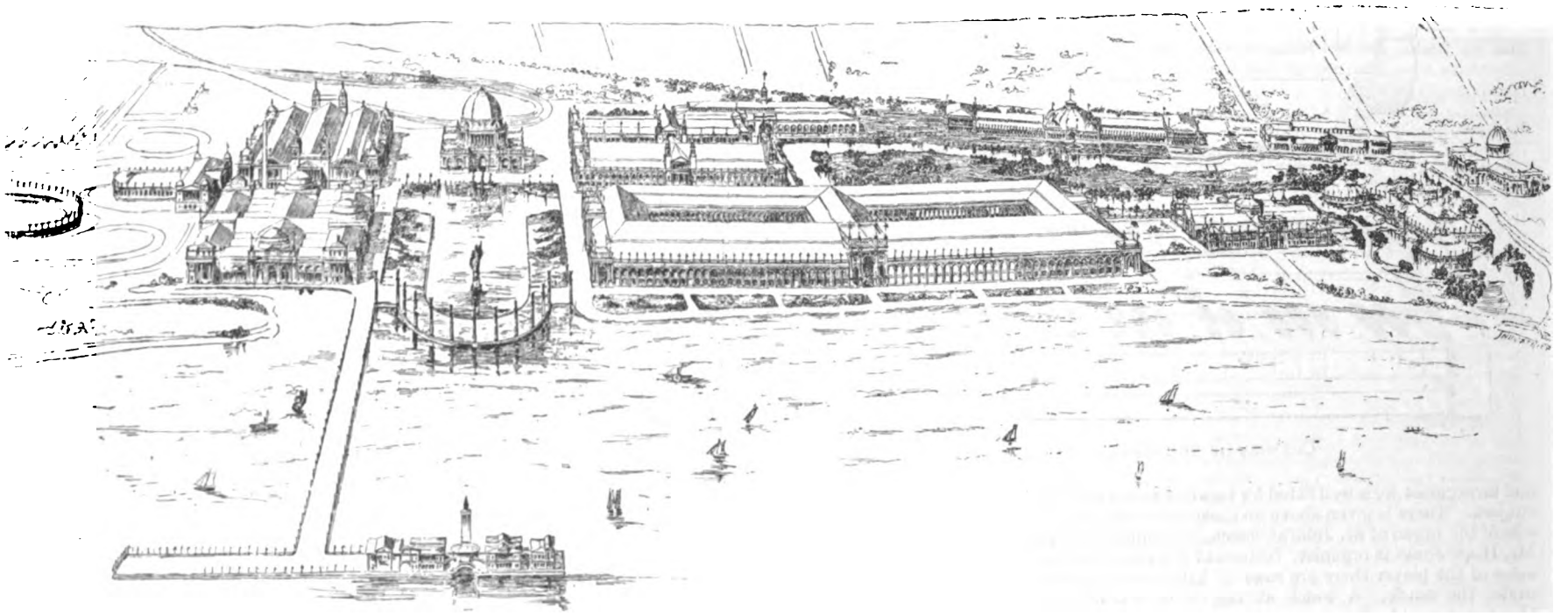
Text-Book on the Steam Engine. By T. M. Goodeve, M.A. London: Crosby Lockwood & Son. 1891.

A book which has reached its eleventh edition would usually be considered to be beyond the sphere of review, as the impression would be that that part of the public for which it was intended had so thoroughly approved of it that nothing more was to be said about it. When, however, we remember that Mr. Goodeve is not only Professor of Mechanics at the Normal School of Science and the Royal School of Mines, but also Examiner in Applied Mechanics and in Steam for the Department of Science and Art, we see at once that anything that proceeds from his pen is not to be estimated in the ordinary manner. Hundreds of teachers and thousands of students look upon the writings of a man holding such positions as worthy of the most careful attention, and in many cases they are carefully crammed, without much intelligent thought, far less criticism. It is therefore all the more necessary that scientific journals should attempt to estimate them quite impartially. During the past few years great improvements have taken place in the examinations of the Science and Art Department, but those who have carefully looked into the matter feel that the subjects for which Professor Goodeve examines have not made the same advance as the others, and that it is possible for students to pass fairly well who carefully cram from his text-books, and who have a very superficial knowledge of the subjects. We must confess that Professor Goodeve, and, in fact, all examiners who are also authors of text-books, occupy rather invidious positions, which tend to reduce teaching in their subjects to a dull routine of low uniformity, however good their books may be.

We may say at once that we do not make these remarks because we have a bad opinion of Professor Goodeve's book. Its contents, on the whole, are good, and students who are taught the subjects in an intelligent manner will find them very useful. The chief

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THE WORLD'S FAIR AT CHICAGO.



General View of the Exhibition Buildings Looking West.

fault we have to find with it is in its arrangement, or rather, we should say, its want of arrangement, for it has increased in size, not by a process of systematic growth, but by one of addition. Bits have from time to time been added on, which, however good in themselves, were not in their proper place as regards order and arrangement. Even in the first edition we can remember that this fault was very evident. The book was not so much a systematic treatise on the steam engine as a collection of notes, rather loosely thrown together, and without much connection. Some parts seemed to enter rather fully into the the theory of the subject, but they led nowhere, their bearing on the practical parts was not shown, and the students naturally asked—What is the good of all this theory unless you apply it? Even in the more practical parts there was a curious mixture of subjects, compiled from a great many sources, one of which was easily recognised as the author's well-known text-book on "Mechanism."

We need not discuss the original part of the book, but will simply suggest that, as some sections of it are rather antiquated, they might well be re-written, and supplied with more modern examples and facts, especially relating to multi-cylinder engines. The present edition has two supplements, the first being on gas engines, and the second on the theory of heat engines. The action of gas engines is explained in a very simple and, on the whole, satisfactory manner, so far as the space allowed will admit, but it would have been much better if this had been kept apart and formed into a separate book. The present arrangement looks too much as if it were intended to meet the requirements of the examinations of the Science and Art Department, rather than the wants of students or of engineers.

The part on the theory of heat engines is very good so far as it goes, and gives some elementary demonstrations of matters which are usually proved entirely by the aid of higher mathematics, but students will ask, Why is this at the end of the book? Each paragraph may no doubt be made the subject of an examination question, but the object of a text-book on the steam engine is not to turn out smart examination machines, but intelligent engineers, who are well drilled in theory, and are able to apply it to their everyday work. Now we have no hesitation in saying that students might be able to pass very good examinations in Professor Goodeve's book, and yet not have an intelligent understanding of the theory of the steam engine. We would, therefore, strongly advise Professor Goodeve to consider the advisability of re-writing the whole work and arranging it in logical order. The book contains a large number of examination questions which will be found most useful, for, although we by no means believe in getting up a subject from old examination papers, we are of opinion that students should take every opportunity of testing the progress they are making, and of putting their knowledge into a definite shape, and this can best be done by working out well-selected examples of calculation in the different departments of the subject.

THE WORLD'S FAIR AT CHICAGO.

Above we give a bird's-eye view of the buildings which have been determined upon for the World's Fair at Chicago in 1893.

The Board of Architects, which includes ten of the leading representatives of the profession in the United States, has been at work for months upon the details of the great buildings. The general design has already been decided upon, and gives promise of a grand array unequalled at any previous exposition. The structures to be erected by the Construction Department alone, not including those by individual States, industries, or foreign nations, will cover more than a hundred acres of ground space, and consist at present of the following:—Machinery Hall, 500ft. long by 850ft. wide; Agricultural Hall, 500ft. by 800ft.; Administration Building, 225ft. by 225ft.; Mines, 350ft. by 700ft.; Electricity, 350ft. by 700ft.; Transportation, 250ft. by 960ft.; Manufactures and Decorative Arts, 788ft. by 1,688ft.; Horticultural Hall, 250ft. by 1,000ft.; Woman's Building, 200ft. by 400ft.; United States Government Building, 350ft. by 420ft.; Illinois State Building, 430ft. by 160ft.; Fisheries, 150ft. by 400ft. The designs of each of these buildings are being got out by a different architect, and the contract for the construction of each will be given out to different firms, so that no time may be lost in their erection.

A large pier stretching into the lake, and enclosing a harbour available for maritime exhibits, will form one of the features of the grounds. About 1,000 men are at present at work at Jackson Park, where it has been decided to locate the Exhibition, in excavating the lagoons, grading, and preparing the foundation sites of the buildings.

ELECTRIC ORGANS.

By James Swinburne.

The idea, and to some extent the application, of electricity to the mechanism of organs is not new. Gauntlett proposed to build models of various celebrated organs at the London Exhibition of 1851, and to connect them all to one console. Barker, the inventor of the pneumatic pallet, worked out what was probably the earliest practical system of electrically controlled organs.

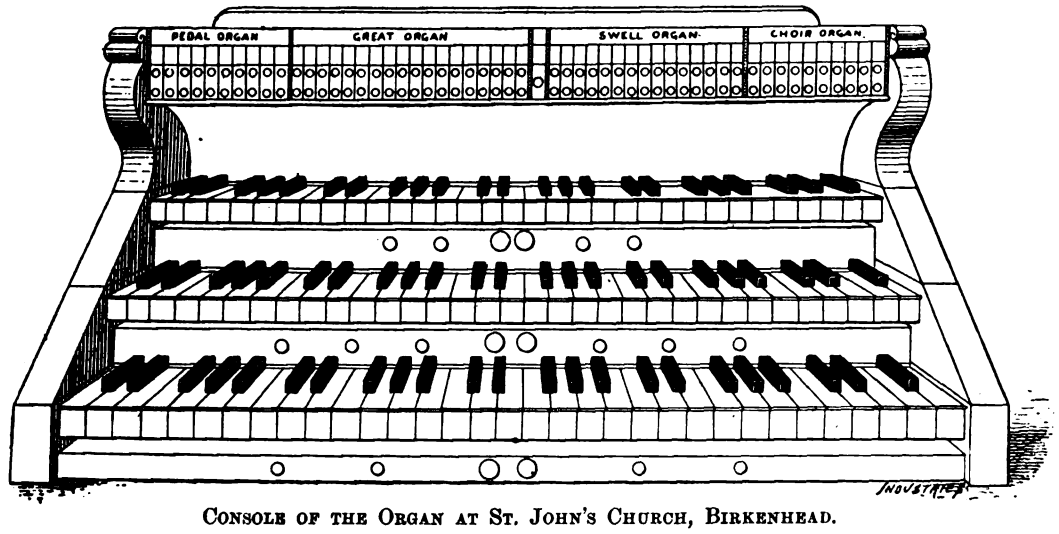
An organ consists essentially of three or four independent instruments. Each instrument is composed of sets of pipes, called stops, arranged in rows, say, crosswise, on what is known as the "soundboard," probably because it is not a soundboard. The pipes are also arranged in rows from back to front, each row corresponding to a key on the keyboard belonging to that organ. Each key commands a valve, or pallet, letting wind into a channel under all the front to back row belonging to it. Each stop has a long perforated slip or slider running under it, which can be moved so that the holes correspond or not with those leading to the pipes. These sliders are controlled by the draw-stops. A fourfold organ has one pedal and three manual keyboards, called "great," "swell," and "choir." Further mechanism is necessary to connect various keyboards, and to admit of rapid changes of the arrangement of the draw-stops. This appears very simple, but when an organ has about forty stops, and over fifty draw-stops, it becomes very complicated. The first trouble is that it soon becomes almost impossible for the fingers of the left hand to work air valves or pallets large enough to control the wind for twenty or thirty large pipes, even if equilibrium valves are used. I am, as far as possible, using engineering, and not organ-building, nomenclature. To get over this, the air relay, or pneumatic pallet, has been adopted in large organs. The finger then controls a tiny equilibrium valve, which controls an air bellows that does all the work. When this system is applied to the great organ of a small instrument, it is generally arranged to work the "choir" and "swell," too, when coupled to the "great."

There is still another difficulty. In large instruments the pneumatic pallets frequently have to be a long way off the player, and the connections are apt to alter in length and get out of adjustment. In All Saints' Church, Manchester, there is, or was, an organ played from near the reading desk, placed high up on each side of the chancel, 70ft. off. It has mechanical connections, but they are not heavy, and seem to work very well. Generally, an arrangement like that used in pneumatic bells is used, and known as the tubular pneumatic system. Barker, however, controlled his little air relay valves electrically, and realised the advantages of electrical connections in admitting of great simplicity in coupling and key mechanism, as well as ease in connecting distant organs. The electric action, as it is called, has developed especially abroad. Messrs. Bryceson have done a great deal, and many English organs have electric connection. In France there are a large number of these combined electric and air relay mechanisms. M. Carré describes several in a valuable article in *La Lumière Electrique*. Roosevelt, in America, has not only developed pneumatic actions thoroughly, but has employed electricity too. The three-manual organ at Trinity Church, Boston, has not only pneumatic action for the keys, but a pneumatic stop action which admits of an exceedingly convenient composition pedal arrangement. The pedal on being pressed and hitched down draws its corresponding set of stops, and shuts them off again when allowed to rise, without interfering with any arrangement that has already been made. There is also an electric solo organ, but it was out of order when I tried the instrument. There is a concert organ by the same makers in Boston with a set of composition pedals, each with a complete set of draw-stops, which can be arranged beforehand, and come into use when the pedal is pressed. I believe the new Riga organ is electrical.

Mr. Hope-Jones has recently paid great attention to the subject of electric actions. Being an electrical engineer

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ELECTRIC ORGANS.



CONSOLE OF THE ORGAN AT ST. JOHN'S CHURCH, BIRKENHEAD.

and an organist, he is well fitted for tackling such a difficult subject. There is given above an illustration of the console of the organ of St. John's Church, Birkenhead, where Mr. Hope-Jones is organist. Instead of draw-stops at the sides of the player there are rows of little tumblers just under the music. A touch at the top or bottom puts the stop in or out. This organ, if arranged in the ordinary way, would have about forty draw-stops. By the use of electric gear, Mr. Hope-Jones produces an organ which has the same effect as an instrument of fifty-three with the ease of manipulation of one of twenty draw-stops. In addition, it has a whole host of composition buttons, crescendo arrangements, and other accessories.

So far electricity seems to have been used to work an air relay only. The use of electricity may easily be carried very much farther than this. The difficulty has been the supply of electrical energy, and batteries have been used. Mr. Hope-Jones, who has had experience in telephone work, has probably reduced the energy needed to a minimum. It seems obvious, however, that to use electricity to work an air relay for working a valve needing a pull of a pound or two through half an inch is absurd; and our electrical readers may well study the question, as given, say, twenty watts available, the whole mechanism of the ordinary organ might be swept away, and an infinitely more convenient and much less costly instrument devised. It is easy to get the power. In England the blower, who does the whole of the work when air relays are used, works a thing like a pump handle up and down. In France he works two levers with his feet. Sometimes the blower is a water motor or a gas engine. All that is wanted is rotary motion. Even if rotary motion is provided, by means of hand cranks, water motors, or gas engines, the feeders are generally on the principle of a smith's bellows. We would suggest that such a machine as the Baker positive blower would be very much cheaper and better, giving a uniform supply without beating. The electric power can then be supplied by a very small magneto machine. This need have no commutator, it may supply alternating currents of low enough frequency to be silent. There is then nothing to get out of order, and owing to hysteresis, if closed circuit electromagnets be used, there is practically no sparking at the various contacts. Organ music is limited entirely by the mechanism of the organ and develops with it. In Germany they have only one sort of organ music, of which the works of Merkel, Rheinberger, and perhaps Mendelssohn may be taken as examples. This needs no accessory mechanism, and even modern German organs have, we believe, little as a rule. The well-known organ at Tyne Dock, by Schultze, has no composition pedals, and, if I remember aright, no couplers. In France the organ intersperses showy scraps during church service; and many of the organs are not designed for solid playing. The large organ at St. Eustache, for instance, has the pedals so arranged that the player cannot reach them without sliding along the seat. They have all sorts of arrangements for meretricious effects—tremulants, fancy reeds, and "effets d'orage." In England and the United States organ playing has got as far as it can without a change in organ construction. The average church organ spends its time in the monotonous accompaniment of hymns and chants, but the concert instrument plays German fugue music, German chorale organ music or the resulting German organ sonata; then it plays Guilmant and light French music; and then it indulges in a development which is essentially English, the organ arrangement. As much of an orchestral movement as can possibly be compressed into the region of ten fingers and two feet is crammed on three staves, and the organist has to change his stops as best he can. It is probably only in England and America that such things as the overtures to "Der Freischütz" or "A Midsummer Night's Dream" are played on organs. It is only because the mechanism does not give the right combinations quickly enough, if at all, that the overture to "Tannhaüser" does not figure on recital programmes.

It is difficult to think of all that can be done easily and cheaply by direct electric mechanism. If each key makes circuit with a set of small electric valves, one to each pipe, and if the returns to each stop are controlled by what corresponds to the draw-stop, all the ordinary mechanism of pneumatic pallets, expensive soundboards — which sometimes warp — trackers, sliders, rollers, &c., may be swept off. It may be remarked parenthetically that the abolition of pneumatic pallets is itself most desirable. Apart from expense, they tend to develop a bad style of playing. The organ cannot accent a note by playing it louder, so emphasis is given to it by clipping the note before it a little short. Phrasing thus depends on perfect instantaneousness of the action, which is not always found with the air relay. In a cathedral, organ music gets mixed up into a sort of roar which rolls down the aisles in a way poets like, and slovenly phrasing, does not matter, but in a concert room an organist accustomed to a large instrument generally bears evidences of it. With electric mechanism, any stop may be drawn on any manual, or prearranged for any manual and composition button. Any grouping may thus be adopted. In orchestral music, though there are about twenty staves in the score, the instruments fall roughly into a few groups. It should be easy to group the corresponding stops on the organ in the same way for playing orchestral music. This can be done by electricity. Again, in playing from the ordinary piano score of oratorios, there are four lines of voice parts, which demand one keyboard, and two lines of condensed accompaniment, which demand one or two keyboards, which must be coupled instantly to the voice keyboard when there are no hands available to play them. Existing organs generally meet these last requirements. Electric action admits of still another development. In a medium sized hall, one manual may be an ordinary grand piano. A piano could not be combined with an ordinary organ, because the touch is different; but if the console is detached from the organ so as to give breathing room for the piano, the addition of the contacts to the keys will not interfere with the touch of the piano at all. This suggestion will strike many as odd, some may say barbarous, but the harp may almost be considered part of the modern orchestra, and apart from concertos, the piano might also be absorbed too, especially if it were more portable, and several could be employed together.

Enough has been said to show the enormous advantages of simple organ mechanism. One great difficulty will probably be in organ builders themselves. They are often too apt to regard electric action as complicated, untrustworthy, and expensive. It must be remembered that electric work has advanced enormously within the last few years; and if electricity can sweep away the whole of the rest of the action mechanism from organs it is certainly worth consideration. The excellence of the organ at Birkenhead points to the advisability of organ builders going to electricians to get the electrical part of their actions put right, instead of designing it themselves, and then rejecting it as costly or untrustworthy.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*From our New York Correspondent.*)

THE annual meeting of this Institute took place at New York on the 19th, 20th, and 21st ult. The business meeting, at which officers were elected for the ensuing year, was held on the 19th ult. The report of Council showed a continuation of the growth in membership, which has now reached a total of 541. Professor Alexander Graham Bell was elected President.

The first paper on the 20th ult. was by Professor F. B. Crocker, on "The Perfection of the Stationary Electric Motor." He classified motors in three types—for long distance transmission, power distribution, and railway work—but directed his attention especially to the stationary motor for distribution. The base, he said, should be a solid iron casting, flat and simple in form, resting directly upon the base frame or floor, which should be preferably of wood for insulation. The base should be heavy to bring the centre of gravity low. A heavy base gives great stability and strength to the whole machine, and is highly desirable in a stationary motor. The bearings should be directly and rigidly mounted on this base, a simple fact frequently disregarded. The field magnet should be bipolar, except in machines above 10 h.p., on account of the great complications caused by a number of armature sections, commutator bars, field coils, &c., necessary in multipolar machines, and the narrowness of the neutral space on their commutators. The field should be of the single magnetic circuit rather than consequent pole type, the former being more economical in wire and current required. A single circuit requires but 70 per cent. of the weight of wire and 70 per cent. of the energy of magnetisation required by a double magnetic circuit. A triple or quadruple magnetic circuit is still more objectionable, requiring about double the wire of a single core of the same total cross-section. There is no objection to using the cast-iron base to complete the magnetic circuit, its ample weight and cross-section affording ample magnetic permeance, and it does not increase the leakage, being magnetically neutral. The field cores should be of wrought iron, because the field wire surrounds them, and if of cast iron would require almost double the cross-section, and therefore, greater length of wire. The pole pieces should also be of wrought iron to reduce their size and also magnetic leakage, they being at the highest magnetic potential of any part of the machine. Since any considerable fitting of wrought iron is difficult and costly, it is best to drop forge the core and pole piece in one part, which permits forming the armature space at the same time. In order to secure sufficient contact and strength, these cores should be set into the cast-iron base, as the ordinary butt joint limits the magnetic conductivity. The supposition that cast iron is cheaper than wrought for magnets is a fallacy. The ring armature is difficult to support mechanically, but the winding does not tend to slip out of place or pile up at the ends, and wires of greatest difference of potential come at the greatest distance apart—that is, on opposite sides of the armature—which is of the greatest importance in high voltage machines. In the case of small ring armatures, where a great number of turns of wire are used, the ring should be split in halves to facilitate winding, and put together afterwards when wound. The armature should have teeth or projections in order to secure the following advantages:—First, to reduce the reluctance of the magnetic circuit, and the weight of wire and energy of current required to magnetise it. Second, to hold the wires in place and prevent them slipping tangentially on the core. Third, the teeth protect the wires from mechanical injury, since any blow or pressure comes upon them instead of the wire. In the trapezoidal tooth armature, the teeth are considerably wider at the top than at the bottom, which, of course, makes between the teeth a slot wider at the bottom than at the top. This shape of tooth and slot has the following advantages over the ordinary form:—First, the wire is more secure, being held against centrifugal as well as tangential force; second, the wire is more perfectly protected, being almost entirely surrounded by iron; third, the armature presents an almost unbroken magnetic surface to the pole pieces, reducing to a minimum the reluctance of the air spaces in the magnetic circuit, and the magnetic leakage, and avoiding Foucault currents and loss of energy in the pole pieces. This form of slots and teeth can be still further taken advantage of by giving the slots a shape agreeing with the form of a section of the winding inside of a ring, the interior spaces for winding being divided into the necessary number of sections by radial lines. This form of slot is especially economical in winding, there being a greater number of turns in the inner layers which are shorter, and fewer turns in the outer which are longer. The teeth make it easy to support the ring

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since the bolts for carrying it may pass through the teeth without interfering with the winding. Perfect insulation of the armature core is of the utmost importance. The efficiency should be made as high as possible by reducing such elements of loss as are due to current to magnetise field, armature resistance, friction, resistance of air, Foucault currents, and hysteresis. If a machine can run two hours at full load without overheating in any part, the efficiency must be high, unless it is very large and heavy for its power, in which case the surface for conduction and radiation would be great. The following is a table of data of a 3 h.p. motor constructed in accordance with the principles laid down:—

Total weight	350	lbs.
Weight of field wire (No. 24, A.W.G.)	12	lbs.
Weight of armature wire (No. 13, A.W.G.)	11	lbs.
Resistance of field	310	ohms
Resistance of armature	·4	ohms
E.M.F. of circuit	115·	volts
Total current at full load	24·3	amps.
Current used to excite field	·37	amp.
Percentage of current used in field	·015	
Total current required to run free	1·9	amps.
Percentage of total energy to run free	·08	
Commercial efficiency	·80	
Armature speed	975·	r.p.m.
Total magnetic leakage or waste lines of force	·17	
Magnetic efficiency = Lines through armature / Total lines of force	·83	

In the discussion which followed, Professor Thomson pointed out that in order to secure a large amount of surface in a joint between cast and wrought iron, it was necessary to use a flange or something of the kind. The plan suggested in the paper secured the same result by practically taking out some of the cast iron and inserting the wrought iron.

Mr. Mailloux agreed with the author that the lamination of fields and pole pieces was not only expensive, but very unsatisfactory, mainly for mechanical reasons. He also called attention to the fact that the shape of the teeth, their number, clearance, &c., had an influence on the sparking. He believed that a motor could be made as efficient at low as at high speed if made sufficiently large. He would have been glad to have seen more attention paid to such data as would be useful to electricians, as in mechanical engineering, where everything is reduced to formula. It would have been interesting to learn the ratios of speeds to surface—the ratio of watts dissipated to surfaces on which they were dissipated. It would have been instructive to learn the percentage of heat wasted in the field in relation to the surfaces in action.

Mr. J. Martin said it was the former practice of the Edison Company to fit the surfaces of cores and yokes as accurately as possible, but now they were simply planed or turned off. The practical value of continuous and reliable running, regardless of efficiency, was important, as the users, when pressed for work, would rather pay quadruple rates for power than have the machinery stop for even a few moments.

A paper was afterwards read by Dr. E. L. Nichols, of Ithaca, entitled "A Photographic Study of the Electric Arc," based on experiments by Mr. J. C. McMynn. The alternating arc, and the continuous current arc, he said, afforded two distinct fields of investigation. The arc lamp fed by alternating currents invariably hums and sings. The note possesses a definite pitch determined by the rate of alternation of the dynamo, and is not due to the mechanism of the lamp itself. The Jablochkoff candle without mechanism sings as merrily as the lamp with a solenoid regulator. Investigation had satisfied him that the humming of the alternating arc was due to the rapid periodic extinction and re-establishment of the discharge. The paper was accompanied with reproductions of photographs, establishing the intermittent character of the alternating arc.

In the discussion Professor Elihu Thomson doubted that it could be argued absolutely that there was a cessation of the arc because the photograph appeared to show it. The current flowing might be so small as not to give actinic luminosity to the stream.

Dr. Nichols replied that the photographic results were confirmed by observations with a revolving mirror.

Mr. Carl Hering then read a paper on "A New Graphical Method of Calculating Leads for Wiring." The general principle laid down was that for any formula containing three variable quantities, one of which was the product on the quotient of the other two, the "curves" representing their relative values may always be represented by a series of straight diagonal lines drawn through the centre or zero point. Such a set of lines would therefore enable one to make any calculations graphically for that formula.

After this, Professor Edwin H. Hale, of Harvard University, gave a description of his "Thermo-Electric Method of Studying Cylinder Condensation in Steam Engines." He inserted a ¾in. plug in the cylinder wall, in which is set a plate of antimony and another of bismuth, making the best known thermo-electric pair, but, on account of the low conductivity of heat, he afterwards substituted iron and nickel. Wires are led to a galvanometer, and the variations of heat in different parts of the cylinder are determined by fluctuations in current from corresponding plugs. Although the method is not entirely perfected, it has shown sufficient merit to warrant further investigation.

A paper by Dr. F. A. C. Perrine, dealing with "The Practical Aspects of Electric Welding," was then read, and was a review of the various industrial applications of the process, and samples were exhibited by different establishments. There were steel wheels in which all the spokes are welded to the hub at one operation, parts of type-setting machines, in which brass and steel were welded together, parts of bicycles brazed by electrical heat, and fifth wheels of carriages, in which the electrical process effects a great saving of time and labour. One of the machines, used two years for jointing wire, had made 370,000 welds in that time, and by finishing off the joints with an emery wheel the writer stated that the telegraph experts found it impossible to locate them. Difficulty had been experienced in satisfactorily welding cast steel and malleable iron. In discussing the paper, Professor Thomson, the inventor of the process, said that its development had been principally in a line of work where the ordinary welding could not be utilised. There was a natural reluctance in the adoption of such a revolutionary method, and even those who favoured it were inclined to see it thoroughly tested by others before abandoning a well-tried process and incurring unusual expenses.

In the evening Mr. Nicola Tesla delivered a lecture on "Experiments with Alternating Currents of High Frequency"—of which we conclude a special abstract below. The experiments shown were very impressive, and Mr. Tesla is sanguine that they will lead to practical results in electric lighting, although he admits the difficulty of insulation.

(To be continued.)

EXPERIMENTS WITH ALTERNATING CURRENTS OF HIGH FREQUENCY.*

(Concluded from page 546.)

Mr. Tesla showed a lamp with but a single rod filament in a non-striking vacuum with no outward connection. The energy is entirely transferred by condenser action through the medium of condenser coatings in the base of the lamp. He also pointed out how the brilliancy of the lamp could be varied by simply altering the relative positions of the condenser coatings. This the lecturer followed by demonstration of the phenomena with an unexhausted globe, and a single filament mounted therein. The filament when connected to one terminal of the coil heats up to bright incandescence and spins around in the globe. He also demonstrated the heating by the use of Crookes' well-known apparatus consisting of mica vanes mounted above a platinum wire, which was brought to incandescence by connection with one terminal of the coil, and rotated the mica vanes. In order to still further verify the conclusions that the electrostatic effects are alone active, the lecturer placed a Geissler tube at right angles to the coil and at its centre. In this position the tube did not light up. When placed at the ends, however, the tube lit up brilliantly and gave sufficient light to read by. The lecturer showed both uranium and yttria tubes. He then showed how exhausted tubes could be made to glow in an electrostatic field. For this purpose two large sheets of zinc were connected to the terminals of the machine at a distance of about 15ft. apart. The tube when placed between these sheets glowed brilliantly and could be moved about freely. The lecturer remarked that, by merely creating such a field in a room, the mere suspension of the tubes in the room would afford the desired illumination.

Coming to the physiological effects, Mr. Tesla adjusted the conditions so that by touching one terminal with a brass sphere he raised the potential of the coil so enormously that a stream of light came out on the other terminal, and he estimated the difference of potential to be nearly 250,000 volts, and then performed the remarkable experiment of receiving the total discharge in his body, protecting his hands from burning by the brass balls held in his hands. He then lit up lamps by holding them in contact with one terminal or near to the coil.

The lecturer then came to another class of experiments. He stated that he had used a system of conversion from high tension to low with the enormous frequencies of the condenser discharges. Mr. Tesla then showed an interesting experiment, which consisted in passing the converted currents, produced in the manner just described, through a copper bar ⅜in. in diameter and bent into a loop. Ordinarily such a bar would constitute a short circuit, but the lecturer succeeded in bringing lamps stretched across the parallel sides of the bar to incandescence, demonstrating that the impedance in the loop connecting the two sides was so great as to practically prevent the current from passing through it and hence acting upon the lamps in the manner described. He also pointed out the existence of modes on the bar. His method consists in continuously charging and disruptively discharging a condenser into the working circuit, the charging of the condenser being effected by a coil operated either by alternating or direct currents. By this means any desired higher frequency may be obtained from any lower frequency.

The foregoing gives but the merest outline of the many beautiful and highly suggestive experiments made by Mr. Tesla. Notwithstanding the fact that Mr. Tesla excited the intensest interest of his audience for three hours, he was, nevertheless, unable, for lack of time, to bring before them many experiments, some of which, he said, were even of a more striking nature than those brought out.

* Abstract of a recent paper read by Mr. Nikola Tesla before the American Institute of Electrical Engineers. For the above abstract we are indebted to our American contemporary the *Electrical Engineer*.

CELLULOID AND ITS MANUFACTURE.

Considerable progress has recently been made in perfecting the manufacture of celluloid, and the growing demands for a cheap substitute for bone and ivory has caused several new manufactories to spring up for the production of this preparation in recent years. Since celluloid possesses the important advantage over the materials which it is intended to replace in being capable of being moulded, coloured, and worked into any desired shape, it has been adopted for many articles which previously were made of more valuable materials. Mathematical instruments are now largely made from celluloid cloth, formed by coating linen or pasteboard with this composition, and as its coefficient of expansion is very uniform instruments made of it are to be preferred to those made of even the best-seasoned box-wood. Although first manufactured by the Hyatts in America, in 1869, the manufactory established by them at Stains, near St. Denis, in 1876, was the first factory of any importance, and France since that date has possessed a number of smaller works devoted to the production of this article. In that country celluloid is made from a solution of camphor and nitro-cellulose in alcohol, whilst in Germany, in addition to the alcohol, ether is employed as a solvent.

The paste formed in this way is gently warmed, and then rolled out into thin sheets, and in this state loses the last portions of its volatile solvents. The product so ground is a brittle, transparent, horny mass, consisting of either an intimate mixture of camphor and pyroxyline or possibly of a chemical compound of these two bodies. H. Bockmann gives the following analyses of two samples of this material:—

	German.		English.
Nitro-cellulose	64·89	...	73·70
Camphor	32·86	...	22·79
Colouring matter	2·25	...	3·51
Total	100·00	...	100·00

The former of these is met with in commerce in rods, whilst the latter occurs in blocks.

The nitro-cellulose used for this manufacture is obtained by nitrating paper, cotton wool, or wood shavings. A mixture of two parts sulphuric acid and one part fuming nitric acid at a temperature not exceeding 22° C. gives the best results. In some works a mixture of 115 parts of sulphuric acid, sp. g. 1·84, and 93 parts of nitric acid is heated to 80° C., and cotton wool plunged into this bath for a few minutes, and then withdrawn and well washed. This product is entirely soluble in alcohol. Should the nitration be incomplete, a mixture of alcohol and ether will fail to completely dissolve the nitrated cellulose.

Unless the cellulose used has been previously bleached, it is absolutely necessary to perform this operation after nitrating. The nitro-cellulose is disintegrated, washed with carbonate of soda, then with water, and finally transferred to truncated bleaching tubs holding about 10 cubic metres (2,200 gallons). These vats are provided with perforated copper bottoms, through the centre of which pass agitators. The washed nitro-cellulose is added, with three times its volume of water containing 2 per cent. of potassium permanganate; it is left for about an hour, when a fresh quantity of water is added. Then, after standing for half an hour, a strong brine is added, together with some hydrochloric acid. This mixture is allowed to react on the pyroxyline for an hour; then the whole mass is thoroughly washed, first with water, and finally with sulphuric acid, to remove all foreign matters.

The pyroxyline thus prepared, when freed from acid, is carefully dried, cut into small fragments by special machinery, mixed with camphor, and reduced in a suitable mill to a fine powder, about 40 per cent. of water being added to prevent the pyroxyline taking fire. The meal obtained is compressed by a hydraulic press into cakes, which are subsequently broken into fragments and transferred to a closed vessel, where they come in contact with from 15 to 35 per cent. of alcohol of 96 per cent. In twenty-four hours a gelatinous mass is obtained, which is then generally spread out by hollow rollers heated internally by steam to keep the temperature of the exterior surface at about 60° C.; this rolling is continued between cylinders more and more closely set together until a sheet is obtained about 12 mm. thick, having the required resistance and consistency.

In order to expel air bubbles from these sheets, heat and a hydraulic press are used, and finally the celluloid is again compressed in the cold into large blocks, which

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can be easily stored. When the celluloid is sent out into commerce, these blocks are split into leaves, more or less thick, by means of special planes, or by circular saws moistened with steam. After this treatment the cut leaves are placed in ventilated drying rooms, kept at about 90°. At the end of twelve hours the material is dry enough for sale. Crude celluloid is a transparent horny substance of a pale yellowish colour, with a characteristic odour of camphor; its specific gravity varies between 1·25 and 1·45. It is softened by heat, and is then capable of receiving an impression. At 90° C. it becomes very plastic; further heat softens it, and a temperature of 140° C. decomposes it into pyroxyline and camphor aldehyde. At 195° C. the decomposition is instantaneous; the nitro-cellulose inflames and the camphor is vaporised.

Celluloid is readily inflammable and burns with a crackling flame; on blowing, the flame is easily extinguished, but the mass continues to burn, liberating thick vapours of camphor. It is not affected by concussion, and does not detonate even in contact with fulminates. Sulphuric acid decomposes it rapidly on warming; hydrochloric acid has a much slower action. Nitric acid attacks it slowly in the cold, very rapidly when warmed, and soda lye acts similarly. If it is desired to imitate either marble, ivory, or tortoiseshell in celluloid, it must be coloured uniformly or with layers of different tints. In the first case the colouring matter is incorporated with the mixture of pyroxyline and camphor, for which purpose mineral colours are generally employed. In the second case, different tinted celluloids in the gelatinous state are prepared, and then united to form the desired object having a required colour, the harmonious blending of the colours depending entirely upon the skill of the workmen.

The amount of camphor in a sample of celluloid can be estimated by the following process, due to F. Foerster, and described in the *Berichte*, XXIII., 2981-2989. A weighed quantity is heated with caustic soda, and the solution distilled with steam; the camphor volatilises, and may be taken up from the distillate by means of benzene. The rotatory power of the benzene solution affords a measure of the amount of camphor present. The process is conducted as follows:—Enough celluloid to yield 2–3 grammes camphor is weighed out into a litre flask fitted with a dropping funnel and connected to a condenser. To the condenser is fitted a special receiver to collect the distilled camphor. Sufficient 10 per cent. soda is added by the funnel to saponify the celluloid, and the flask is heated in the water-bath to 80° C. When saponification is effected, a more concentrated solution of caustic soda is run in until the solution contains 10 per cent. of soda. The mixture is then boiled and the camphor distils over. When 120 c.c. have come over (which fills the lower ball of the special receiver), the distillation is stopped, and the distillate, made up to 150 c.c., is extracted with 25 c.c. to 30 c.c. of benzene. The rotating power of this solution is then determined at 20° C. by means of a Laurent's half-shadow polariscope with a 400 mm. water-jacketed tube. The quantity of camphor in the solution is given by the following formula, deduced by Foerster from experiments made with pure recrystallised camphor:—

$$[\alpha]_D = (39{\cdot}755 + 0{\cdot}17254\,C)^0,$$

where $C = \frac{100\alpha}{l[\alpha]_D}$, in which l is the length of the tube in decimetres. Substituting the above value for $[\alpha]_D$, C (or the amount of camphor per 100 c.c.) becomes—

$$C = 115{\cdot}2052\left(-1+\sqrt{1+0{\cdot}0436683\,\frac{\alpha}{l}}\right)$$

Landolt found the value for $[\alpha]_D$ to be—

$$[\alpha]_D = (39{\cdot}185 + 0{\cdot}17084\,C)^0,$$

using camphor purified by sublimation, but Foerster states that a certain amount of decomposition takes place in this process, and that two recrystallisations from 50 per cent. alcohol yield a pure product.

The following results show the accuracy of Foerster's formula:—

Camphor Found.	Camphor calculated to Formula.	Difference.
5	5·0010	+ 0·0001
10	9·9894	− 0·0106
15	14·9982	− 0·0018
20	19·9915	− 0·0085
30	30·0037	+ 0·0037
40	39·9700	− 0·0300

Zaunschirm has also recently pointed out in the *Chemiker Zeitung* that celluloid can be conveniently analysed by dissolving ·2–·3 grammes in 5 c.c. concentrated sulphuric acid in a nitrometer, and measuring the volume of nitric oxide evolved. He assumes that commercial dinitro-cellulose is used in its manufacture, which yields 10·5 per cent. of nitrogen instead of 11·1 per cent., which is the theoretical quantity.

Notes.

LIME AND CEMENT MANUFACTURE IN ALGERIA.

An important industry which has sprung up near Bougie, in Algeria, is the manufacture of hydraulic lime and cement. There are six kilns constantly at work now, consuming from 10 to 12 tons of English coal per day, and producing 70 tons of lime and 30 tons of cement.

THE SILK INDUSTRY AT LYONS.

The year 1890 was not a very encouraging one to the silk industry at Lyons, a falling off of over 12½ per cent. in the production of the previous year having to be recorded. The year was characterised by the struggle between silk-growers, spinners, and throwers, who desired to impose a protective tariff, and the manufacturers of Lyons and St. Etienne, who viewed such a proceeding as ruinous to the trade.

ELECTRICITY METERS.

The committee appointed by the City of Paris to award the prizes in connection with the exhibition of registers of electrical energy has just made its award. The first prize, £400, has been divided between the Aron and E. Thomson meters, which are said to have given great satisfaction, and to be applicable both to continuous and to alternating currents. The apparatus of M. Frager receives the second prize—£40, as applied to continuous currents, and £40 as applied to alternating currents. The third prize, £40, has been awarded to the Marès register, as applied to the measurement of continuous currents.

THE USELESS PRODUCTION OF TENDERS.

Mr. S. F. Walker has sent us a proof of an able article, written by him for our contemporary the *Electrical Engineer*. He points out the enormous waste of money under the present system, where a number of firms are asked to tender, not only in cases where it has been already practically settled who is to have the order, but also where no order is to be given. The practice of asking for tenders when anyone wants to know the price of certain things is only too common, and, as Mr. Walker points out, the cost of preparing estimates eventually comes on the public in the long run. We are afraid, however, that Mr. Walker's proposal of charging for tenders will not come into use. In fact, contractors have often to pay for specifications.

AN ELECTRICAL ENGINEERING EXHIBITION AT TAUNTON.

An Electrical Engineering Exhibition is to be held at Taunton during the months of August, September, and October next, on the grounds adjoining the Taunton Electric Lighting Company's Central Station. The Exhibition will comprise the following:—(1) Lighting by electricity; (2) heating by electricity; (3) machines, &c., for producing electrical currents by mechanical power; (4) electric motors and their applications; (5) electric welding and brazing; (6) electric batteries—primary and secondary; (7) apparatus for electrical measurements; (8) the phonograph; (9) the telephone; (10) electric telegraphs and electric signals; (11) electricity in surgery; (12) electro-plating; (13) applications of electricity in various ways not specified above; (14) steam engines, pumps, &c.; (15) gas and oil engines; (16) models of all descriptions. Applications for space are to be sent to the Secretary of the Exhibition, Mr. Harry C. Willson, Bath Electric Light Works, Bath.

"JOSS-STICK POWDER."

Last year, amongst the exports of the Chinese port of Wuhu was an item "joss-stick powder," to the amount of more than 3½ million pounds weight. This is one of the peculiar articles of Chinese trade. It is sometimes called "native putchuck," and from it are made the small sticks of incense used largely by the Chinese in their religious ceremonies. Its production, according to a recent Consular report, in the southern portion of the province of Ganhui is very considerable, being estimated at nearly 30,000 tons annually. It varies very much in quality, the best, which is made from the bark of a species of elm, being valued at about 18s. a cwt., while the bulk of the production is most inferior, being made of refuse and twigs of all kinds, and is scarcely worth 1s. a cwt. Formerly what went out of the province was taken chiefly by native boats paying duties to the native customs, and the quantity that passed through the Imperial Maritime Customs was comparatively small, and confined to the better qualities. Last year it would seem to have occurred to some merchants in Chinkiang to effect a saving by bringing it down from the interior under the protection of transit passes. The authorities of that port, however, refused to issue these passes for "Joss-stick powder" on the ground that it is not one of the articles to which the issue of such passes is, by the rules in force in Chinkiang, restricted; and this drove the merchants into trying what effect applying for the passes at Wuhu would produce. No objection was made to the issue of the passes by the Chinese authorities there, and thus it came about that the export in 1890 rose to over 32,600 cwt.

SIMLA WATER SUPPLY.

The detailed project for pumping water into Simla during the dry months, prepared by Mr. A. Younghusband, has, states *Indian Engineering*, been approved and forwarded to the Government for sanction by the municipality. The total cost of carrying out the works is estimated at Rs.4,85,000, and the annual working expenses in a very dry year at Rs.15,614. The Government has been asked to give a free grant towards the initial cost of the work. In the event of the Government being unable to give a free grant of the amount required to carry out the work, Government is asked to lend the amount required, approximately 5 lakhs, on interest at 4 per cent. per annum. In order to cover the annual cost of working, the Committee will, if the Government approve, make proposals regarding a water rate. The maximum sum required will not exceed 2 per cent. on the assessed value of house property in Simla, including that in the bazaars.

THE PORT OF DULUTH, ON LAKE SUPERIOR.

The port of Duluth, on Lake Superior, is rapidly growing in importance. The total arrivals and clearances amounted, in 1890, to 2,534 vessels, with an aggregate tonnage of 2,740,354 tons, more than double the tonnage of five years ago. The receipts by lake, according to the Customs returns, consist chiefly of coal, cement, lime, salt, and railroad iron, and amounted to 1,000,923 tons; and the shipments, chiefly wheat, flour, other cereals, and iron ore, aggregated 1,079,131 tons; but this in some respects does not represent half the real trade of the place, as the manifests of vessels landing part of their cargo at Duluth, and then proceeding to Superior, are surrendered at the latter port, which is thus credited with much that is landed at Duluth. The same custom is followed with outward vessels, which, clearing light from Superior, are not credited in the Customs records of Duluth with the cargo taken from that port. Superior, or West Superior, still further west than Duluth, only came into existence quite lately, and is fast rising into an important shipping port.

RAILWAYS IN RUSSIA.

The statistical report of the Minister of Communications in Russia, recently published, sets forth that, although the gross receipts have slightly diminished as compared with 1888 and 1889, the net receipts were higher in 1890. The length of road in miles, with the passengers carried, and earnings, in roubles, for the past five years have been as below:—

Year.	Miles of Road.	Passengers.	Earnings. Roubles.
1886.....	16,388	34,330,683	222,087,481
1887.....	16,912	34,757,926	249,692,074
1888.....	17,422	36,773,818	279,444,317
1889.....	17,702	38,740,577	276,357,278
1890.....	18,158	39,754,241	275,830,889

The State owns 5,338 miles of road and 12,820 miles are owned by companies. The largest increase of traffic, 22 per cent., was on the Trans-Caspian Road. Extensions are said to be contemplated, amounting in all to 20,000 miles, and the matter is now under consideration. Permission has been given for the construction of a line from Riazan to Kazan by the Moscow and Riazan Railway Company. The line, which will be 300 miles in length, will be commenced as soon as practicable. It has also been decided to construct a line from Koorsk to Voronezh, which will be 200 miles long. All the railways planned for construction during the present year will be built by private companies, and not by the Government, which is sufficiently occupied with the support it is giving to the Siberian and Petrovsk Railways.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

25th May, 1891.

8813. Greening & Barringer — Automatic stop valve.
8818. Rennie, D. — Furnaces for melting metals.
8819. Bevan, W. — Annealing apparatus applied to heating furnaces.
8820. Fielding, J. — Compound duplex pumping engine.
8821. Shillito, T. R. — Igniting tubes for gas and petroleum motors (*Grob, Schultze, & Niemczik*).
8824. Zimer, F. W. — Treadle and hand-driving mechanism.
8825. Parini, G. C. — Propellers for vessels.
8826. Spencer, J. W. — Stern frames for ships.
8832. Johnson, J. — Fire-doors for locomotive boiler furnaces.
8826. The Rovello Syndicate, Ld., & Howell — Apparatus for the manufacture of wire.
8837. The Rovello Syndicate, Ld., & Howell — Apparatus for obtaining copper.
8838. Ritson, G. A. — Rotary engines.
8842. Jacobsen, A. — Bottle-filling machines.
8843. Jacobsen, A. — Apparatus for filling bottles.
8847. Gardner, H. — Machinery for sawing metals (*Hanford*).
8855. Lombard, N. — Cross-head blocks for engines.
8856. Kennedy, J. — Machinery of boom dipper dredges.
8859. Thompson, Ramsay, & Thompson — Steam and pressure gauges.
8860. Walsh, J. E. — Floating cranes and elevators.

26th May, 1891.

8875. Mead, J. J. — Lime-grinding mill.
8884. Massey & Hitchen — Number and weight indicator.
8886. Noton, W. — Scutchers for preparing cotton.
8887. Jacob, F. — Hand tools of the Archimedean drill type.
8902. Harris & Shuttlewood — Machines for making double-rib warp fabrics.
8915. Newton, P. A. — Apparatus for mounting and working ordnance (*Littlejohn*)
8933. Sternbergh, J. H. — Machines for punching, shearing, and the like.
8938. Johnston, A. — The manufacture of paper and mechanism connected therewith.
8940. May, W. de C. — Piston valves for steam engines.
8949. Thompson, W. P. — Boiler furnace grates (*Kudlicz*).
8953. Smith, J. — Regulating or controlling the flow of liquids.

27th May, 1891.

8999. Tyler & De Vesian — Apparatus for raising sunken vessels.
9000. Johnson, J. Y. — Machinery for cutting wood (*Frois*).
9004. Leaker & Bonne — Apparatus for drying grain.
9005. Stott & Stott, Jun. — Steam boilers.
9006. Boult, A. J. — Gas, petroleum, or carburetted air engines (*Lerasseur*).
9008. Hall, J. C. (of the Halton Engineering Company) — Valves.
9009. McCulloch, J. McG. — Steam boilers.
9010. Boult, A. J. — Filtering apparatus (*Wackernie*).
9016. Redwood & Redwood — Apparatus for measuring depth of water in oil tanks.

28th May, 1891.

9038. Southall, J. — Gas and oil engines.
9040. Walker, G. B. — Heading and tunnelling machines.
9045. Lucas & Yeomans — Cyclometers.
9046. Frotscher, L. — Steam press for woven fabrics.
9059. Moncrieff, R. W. — Paper-making machines.
9065. Newton, P. A. — Duplex engines (*Worthington*).
9080. Wade & Cherry — Means for use in indicating, communicating, and economising motive power, and in preventing shocks to machinery.

29th May, 1891.

9084. Murrie, J. — Apparatus for raising liquids and for feeding water into steam boilers.
9093. Wilson, W. — Steam engines.
9100. Walkerdine, A. — Apparatus for lubricating loose pulleys.
9101. Townend, W. — Jacquard looms.
9109. Ford, J. — Self-acting water feed supply to boilers.
9116. Lohr, H. — Spigot valves.
9120. Robertson & Miller — Permanent way of railways.
9124. Azzeroni, G. — Steering gear.
9125. Courlander, L. — Device for expanding or contracting rings.
9130. Pickard, A. — Apparatus for drilling square or other shaped holes.
9140. Miller, G. W. — Faucets for measuring fluids.
9146. Hunt & McKechnie — Setting out or aligning engines.

ELECTRICITY.

25th May, 1891.

8830. Kingdon, J. A. — Transformers.
8845. Haddan, R. — Galvanic batteries (*Cabanyes*).
8863. Lake, H. H. — Rheostats (*Lacombe & Co.*).

26th May, 1891.

8872. Bennett & Hides — Galvanic batteries.
8876. Hoster, A. — Recording mechanism.
8892. Adams, J. H. — Dynamos.
8896. Bolton, R. — Controlling the operation of machinery by electromotive power.
8924. Lake, H. H. — Fuse blocks (*Kaliske*).
8927. Payne-Galiwey, Rawson, & Woodhouse & Rawson United, Ld. — Electro-magnetic tools.
8929. Siemens Brothers & Co., Ld. — Ozone apparatus (*Siemens & Halske*).
8932. Lake, H. H. — Locomotives or street car motors (*Eickemeyer*).
8941. Boult, A. J. — Electrical hardening and tempering (*Ries*).
8942. Thompson, W. P. — Electrically stopping railway trains (*Deming*).
8961 Campbell, A. — Measuring currents by expansion of fluid.

27th May, 1891.

8963. Sisling, Scott, & Laurence, Scott, & Co., Ld. — Method of wiring for electric lighting and other purposes.
8991. Bishop, G. — Fire alarm.

28th May, 1891.

9029. Turbayne, W. A. — Arc lamps.
9073. Munsie, J. F. — Railways.
9079. Hoepfner, C. — Electrolytic extraction of metals.

29th May, 1891.

9103. Swinburne, J. — Dynamo-electric machines and motors.
9104. Harvey & Alldred — Electric light carbons.
9107. Barnes, G. H. — Connecting union.
9135. Ratzer & Beer — Apparatus for preventing railway accidents.
9145. Holden, Drake, & Garham — Measuring instruments.

CHEMISTRY.

25th May, 1891.

8844. Paillard, A. E. M. L. — Regenerating salts of peroxide of iron.

27th May, 1891.

9013. Clark, A. M. — Process for desilverising argentiferous lead (*The Deutsche Gold und Silber Scheide-Anstalt, vorm. Roessler*).
9023. Smith & Elmore — Production of nitrous oxide.

28th May, 1891.

9052. Thompson, W. P. — Manufacture of ammonia and tar from nitrogenous organic substances (*Kuntze*).

29th May, 1891.

9083. Scott, C. — Method of vaporising carbolic and other disinfectants.

MISCELLANEOUS.

25th May, 1891.

8823. McDougall, A. — Covering lead surfaces to protect water and other liquids from contamination with the dissolved metal.
8829. Hewitt, W. — Safety hooks for mine cages.
8831. Westphalen, R. G. — Metallised plates or fabric of asbestos for roofing purposes.
8841. Hamann, C. — Scissors or shears.
8851. Brown & Brodie — Roller for damping paper.
8853. Wise, W. L. — Phonographs (*Steiner*).

26th May, 1891.

8866. Hughes, G. — Joining ropes.
8881. Page & Anderson — Soldering aluminium.
8903. Warwick, R. — Fireproofing materials.
8904. Hardingham, G. G. M. — Treatment of ores (*Ashcroft*).
8905. Pawsey, A. — Lowering and releasing boats.
8920. Lake, H. H. — Metallic lathing (*Mosely*).
8930. Bousfield, J. E. — Regenerative gas lamps (*Mizuki*).
8943. Albers, M. — Nut locks.
8946. Eves, J. V. — Spinning yarn.

27th May, 1891.

8964. Shelley & Fitzsimons — Audible railway signalling.
8994. Kenrick, A. H. — Metallic packing.
9003. Bonne, C. R. — Cocks and taps (*Busch*).

28th May, 1891.

9027. Hunt, W. H. — Portable containers for liquids.
9050. Prince, F. O'C. — Furnace bars.
9053. Day, H. — Screws, bolts, and the like.
9060. Deisenhofer, G. — Metal packing discs.
9061. Gubbins, R. R. — Cleaning scrap iron.

29th May, 1891.

9108. Fleury, F. G. — Acid meters.
9136. Ayres & Jurby — Nut lock and washer.
9139. Boult, A. J. — Cellulose manufacture (*Rocca*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

3087. Lawrance (*Pick*).
7611. Puntis & Heal.
8434. Bayly (*McNamar*).
8605. Farmer.
8759. Von Langer.
8842. Kleczénski.
8904. Krell.
5085. Whitaker.
9176. Lake (*De la Croix*).
9457. Steven.
9687. Balfour.
9767. Newton.
9893. Swan & Leslie.
9996. Everitt.
10183. Lake (*Bergmann*).
10458. Thompson.
10678. Keane & Wilson.
10871. Touffreville.
10961. Etienne & Delhaye.
10978. Baker.
11101. Pitkin & Niblett.
11160. Jeffery & Simmonds.
11196. Bowie.
11366. Luckner.
11426. Renton.
11483. Calder.
11544. Simpson.
11567. Dronsfield.
11588. Hill & Lilley.
11613. Reade.
11649. Jepson.
11653. Heys (*Heilmann*).
11672. Gridley & Bishop.
11677. Birdsall.
11716. Hodgson & Tetley.
11738. Debie.
11760. Anderson.
11802. Scholvien & Riedel.
11823. Carroll.
11848. Toobe (*Kindermann*).
11883. Tomlinson.
11901. Dobson & Bromiley.
11909. Scott.
11914. Thomson.
11919. Legay & Legay.
11928. Edwards (*Schmid*).
11938. Hazlitt.
11945. Edwards.
11959. Davies.
11969. Conolly.
11995. Baurmann.
12049. Woodfield.
12095. Durham.
12142. De Pinto-Simonis.
12316. Cook.
12810. Boult (*Ernst*).
12825. Tangyes, Ld., & Chapman.
13666. Hague.
13705. Browne.
13784. Péthy.
13853. Faure.
14066. Popper.
14339. Ostrom.
14973. Clark (*Johnstone*).
15588. Craven.
18508. Johnson (*Langley*).
19040. Bridgeman & House.
20041. Collingwood.
5061. Rose.
8373. Walker.
8595. Granville.
8669. Weiss.
8816. Harris.
8861. Dougal.
8963. Taylor.
9160. Coventry.
9193. Messaz.
9647. Pavitt.
9762. Stuart.
9848. Watts.
9974. Rylands.
10137. Williams.
10412. Barnard, Bishop, & Barnard's, Ld., & Westacott.
10888. Dinsmore.
10963. Longworth.
11004. Timperley.
11145. Edwards.
11195. Stavely.
11204. Lomax & Cotton.
11403. Dunkley.
11482. Hudson.
11499. Wadley.
11545. Lyte & Tatters.
11587. Hogg.
11602. Bischof.
11638. Elliott.
11650. Moss & Scott.
11659. Elder.
11674. Taylor.
11700. Warrington.
11721. Woolliscroft & Todd.
11749. Grafton.
11787. Murgatroyd.
11813. Carlile.
11840. Bowling.
11882. Weldon.
11886. Webb.
11905. Adams.
11912. Bennett & Collison.
11918. Huelser (*Silbermann*).
11922. Callister.
11931. Fayod.
11942. Argles.
11957. McKenny.
11963. Carver.
11988. Isaacs.
12014. Sloper.
12094. Morris.
12117. Weir.
12224. Lake (*Boynton*).
12576. Sutcliffe & Greenwood.
13469. Westray.
13585. Walker.
13696. Southwell & Head.
13768. Peasgood.
13852. Viollet.
13935. Pett.
14263. Day.
14470. Close.
15324. Hinton.
16942. Simson & Cox.
18546. Molesworth.
19120. Wheeler.
21068. Salenius.

1891.

27. Turner & Wearing.
705. Smith.
2159. Soetje & Kahl.
2237. Edler (*Hoppe, partly*).
2774. Pancoast.
2861. Poll & Bennett.
2945. Withington.
3012. Booth.
3424. Douse.
3470. Redgate.
3818. Hargrave.
3991. Taylor.
4276. Eppler.
5126. Winfield.
5458. Dunmore.
5560. Boult (*Andrews*).
5900. Schapiro.
6082 Heikel.
6189. Zwerintzeff.
6392. Lunkenheimer.
579. Saville.
1480. Thompson (*Branson*).
2236. Edler (*Hoppe, partly*).
2629. Shelley, Fitzsimons, & Shelley.
2867. Pike.
2973. Young.
3337. Lake (*Berrenberg & Nickerson*).
3689. Degremont. (16th August, 1890.)
4258. Poulin.
4295. Boult (*Friede & Friede*).
5435. Lichtenstadt & Lichtenstadt. (8th December, 1890).
5966. Lake (*Reynolds & Reynolds*).
6196. Taylor.
6411. Baumotte.

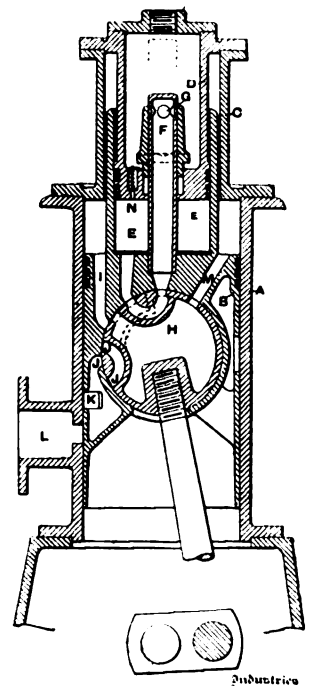
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6865. Crawford.
6912. Gillham.
7024. Foster.
7119. Grieg & Grieg.
7159. Walter.
7198. Johnson (*De Latouche*).
7206. Caley & Parker.
7234. Riéunier.
7239. Krafft & Krafft.
7246. Schaefer.
7254. Brand.
7276. Kennedy.
7279. Withington.
7298. Gerdom & Reynolds.
7318. Spies.
7325. Fell (*Whitney*).
7330. Shelly & Shelly.
7362. Kellner.
7450. Cuttler, Cuttler, & Cook.
7484. Lagarde.
7486. De Long.
6892. Hatfield.
6930. Gullan.
7081. Williams & Gregory.
7140. Mason.
7168. Webster.
7205. The Gaseous and Liquid Fuel Supply Company, Ld., & Thwaite.
7247. Klein.
7271. Boult (*Still & More*).
7277. Gilfillan & Harper.
7284. Cruikshank (*Bergeon*).
7307. Newton (*Worthington*).
7321. Garnier.
7328. Bernstein.
7335. Thompson (*Lauhoff*).
7423. Malen.
7480. Hirsch.
7481. Carmont.
7485. Warry.
7514. Bohm.
7521. Preston & Nelson.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Steam Engines.—*W. T. Lord, London.*—The fluid pressure engines constructed according to this specification are fitted with trunk pistons containing a cylindrical or other oscillating valve having the necessary ports and passages, and adapted to receive and distribute the working fluid. Upon the trunk piston is fitted a tubular extension, for the purpose of conveying steam from the steam chest to the oscillating valve for distribution. The example illustrated below in sectional elevation is that of a single-



acting compound engine, in which A is the low-pressure cylinder containing the trunk piston B. The upper portion C of the engine casing carries a cylindrical chamber D constituting a steam-chest, and being fitted at its lower end with packing in order to make a steam-tight joint with a second trunk carried by the main trunk piston B, the chamber E within the second trunk forming the high-pressure cylinder. In the lower end of the steam chest D is an opening fitted with a gland, through which the inner steam supply tube F works. Steam from D passes through the openings G in the tube F, and through the passages in the oscillating valve H into the high-pressure cylinder, and, the engine being thus set in motion, the valve H is oscillated and presently allows steam to exhaust from the high-pressure cylinder into the interior of the valve H, during which latter operation the low-pressure cylinder is open to exhaust by the passages I, J, K, and L. A further movement of the valve allows the steam from the interior of H to pass by the passage M into the low-pressure cylinder. A relief valve N is placed in the wall between the valve chest and the high-pressure cylinder, to relieve any excessive back pressure in the latter. Several modifications of detail are described, but the principle and mode of operation of the engine is sufficiently made clear in the foregoing. Claims: A trunk piston having one or more tubes attached thereto as steam passages, and containing an oscillating valve; a trunk piston containing an oscillating valve which also forms a steam reservoir; the combination of a relief valve with arrangement of pistons and valve chest described; the arrangement as a whole.—No. 10488. July 7th, 1890. 6*d.*

Injectors.—*R. G. Brooke, Blackpool.*—This invention relates to an improved injector which, when applied in position for use on a boiler, has the combining nozzle, or the delivery nozzle, or a portion of each, or both, within the boiler shell. The improvements also relate to injectors in which the steam nozzle is so arranged that it can be longitudinally moved to control the supply of the water or steam. The accompanying illustration shows in Fig. 1 a longitudinal section, and in Fig. 2 a transverse section, of an injector so constructed that the delivery nozzle and a part of the combining nozzle are within the boiler. A shows the casing which by means of the flange B is secured to the boiler shell, C is the steam inlet branch, D the steam nozzle, E is the water inlet branch, and F the overflow outlet leading from the overflow passage G. On the inside of the boiler shell is the ordinary combining nozzle H and the delivery nozzle I connected to a tubular

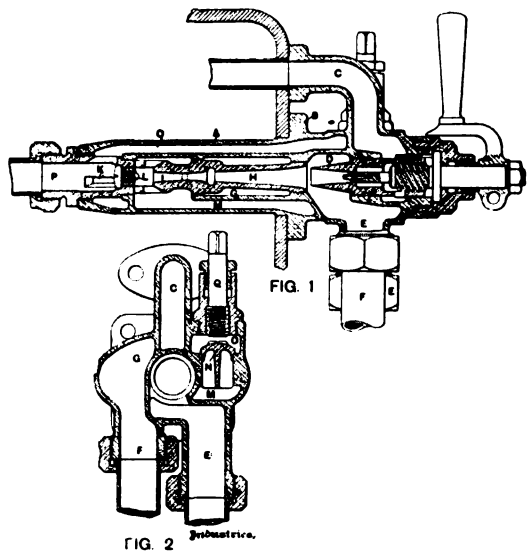


FIG. 1

FIG. 2

bush having two sets of openings J and K, and a diaphragm L between them, closing the direct passage through the delivery nozzle. One set of the openings J lead by the passage M through a non-return valve N, and along the passage O into the other openings K, and thence through the open delivery P into the boiler. The valve N can be held closed by a screw spindle Q. The specification shows other modifications and applications of this invention, among which is one of the type known as an "automatic self-starting injector." Claims: Attaching an injector to a boiler shell in such a manner that a portion of its casing projects into the boiler, and in which the discharge passes through a non-return valve, thence by a passage to the end of the injector casing located within the boiler.—No. 10164. July 1st, 1890. 11*d.*

Making Tubes.—*F. J. Jones, Bedford, Herts.*—This invention relates to a method of making tubes or cylinders of any desired length and diameter, of copper, its alloys, or of aluminium, without a longitudinal seam. The process consists in simultaneously winding a flat strip of metal in spiral convolutions, and welding or soldering together the abutting edges of the convolutions by electricity, the heated edges being pressed towards each other. In making bent pipes the strip would be of varying width, its edges being of sinuous form, according to the position each part of the strip will occupy in the circumference of the pipe, so as to produce a bend of uniform thickness of metal at all points. By substituting a spiral seam for a longitudinal one, the resistance of the joint to rupture is greatly increased. Fig. 1 is an end elevation partly in section, and Fig. 2 a plan, of an apparatus for making straight tubes in which the winding of the metal strip is effected by a mandrel A carrying a collar B of unglazed porcelain or other material upon which the strip is wound, the mandrel being driven by suitable gear, the standard at the far end being removable to allow of the tube being taken off the mandrel. A second collar C of metal of same diameter as B is fitted with a feather connection so as to rotate with and be free to slide on the mandrel A. It is furnished with clamps D by which the leading end of the strip E is made fast for the purpose of winding it by the rotation of the mandrel A. F is a helical guide for the strip, having a pitch corresponding

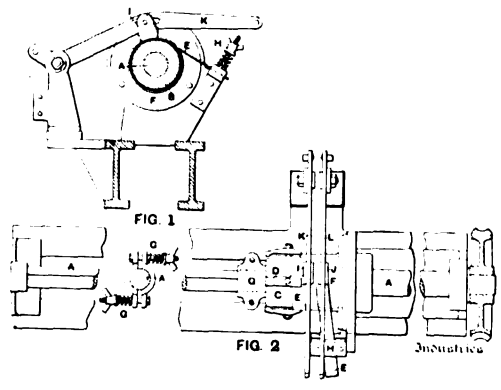


FIG. 1

FIG. 2

to the effective width of the strip when welded. This guide F acts as a fence whereby the strip is guided on to the mandrel. This spiral fence or guide is formed of a short cylinder surrounding the mandrel and fixed to the headstock, but insulated therefrom. G is an adjustable spring clip embracing the mandrel and opposing by its friction sufficient resistance to the motion of the clip head C to cause the edges at the point of welding to be pressed together with the necessary force, as the strip is fed on against the helical fence guide F. H is an adjustable spring clip embracing the strip whereby the laying-on tension of the strip is regulated. I J are electrical contact pieces attached to adjustably loaded levers K L, pivoted side by side. The contacts I J bear respectively upon the convolution already wound on the mandrel, and on the strip being laid on, one at either side of the abutting edges at the point where the weld is to be effected. The levers K L are insulated from each other and respectively connected at any suitable points with the leads from the transformer. The porcelain collar B is secured by a screw-nut on the mandrel A and the collar B, clip head C, contact blocks I J, and guide fence F are removable for the purpose of being replaced by others corresponding to the diameter of the tube to be made. Instead of welding the edges together, they may, as above mentioned, be united by brazing, for which purpose a wire of suitable alloy is fed in along with the strip and between the edges of the convolutions so as to be fused between and unite the adjacent heated edges. The apparatus for making pipe bends is similar in construction and operation to that above described, except that the porcelain collar is curved to the arc of the intended bend, the welded pipe, as it is forced off, being received by a radial arm suitably centred. Claims: Spirally formed and electrically welded or brazed tubes, straight or curved, of copper, its alloys, and of aluminium; the machinery for making the same, as described.—No. 2901. February 22nd, 1890. 8*d.*

Pumping Engines.—*L. d'Auria & H. Robert, Philadelphia, U.S.A.*—This invention relates to the class of non-rotative direct-acting steam pumps, in which, particularly where steam is used expansively, the propelling force of the engine is, in the earlier part of the stroke somewhat greater, and in the latter part of the stroke somewhat less, than the total pressure exerted by the liquid column upon the pump plunger, and it is stated that the compensating devices generally employed in such cases practically nullify the accelerative work resulting from excess of steam pressure above the pressure of the water; this specification describes means whereby these engines may use steam expansively without the loss of this accelerative work, a kind of balance weight being provided, whose useful effect relatively to the moving parts of the pump is increased by giving it a proportionately greater speed, as will presently be seen. The vibrating arms usually employed to operate the steam valves are considerably extended, and are loaded at the end of their longer arms with weights, for the purpose of increasing the accelerated mean weight. The position of the weights upon the arms can be shifted, and as this shifting affects the value of the accelerated mean weight, it will affect also the piston speed, other things remaining the same. The arrangement is considered to be a controlling, as distinct from a compensating, device, and is claimed accordingly, and as described.—No. 2883. February 17th, 1891. 8*d.*

Governor and Safety Apparatus.—*W. M. Musgrave, Bolton.*—This invention is arranged to operate the valve-gear to shut off steam to prevent excessive speed, and, in the event of any derangement, to stop the engines. One modification of the apparatus is illustrated in the accompanying illustrations, Fig. 1 being a side elevation and Fig. 2 an end view. A spindle A mounted in bear-

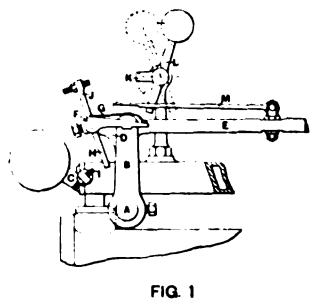


FIG. 1

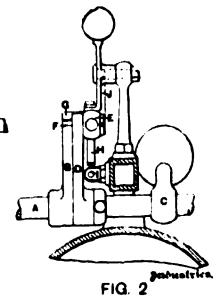


FIG. 2

ings on the cylinder or valve chest is connected by suitable means to the valve-gear, and has secured upon it two levers B and C, and loosely mounted upon it a lever D. This lever D is operated by a rod E (which is connected in the usual manner to the governor), and carries a catch piece F kept in position by a spring G which engages with a lever B. Should the speed of the engine cause the governor to rise to its highest position, the rod E causes the catch piece F to be disengaged by means of an arm H being brought into contact with the screw I, and the spindle A will be turned by the action of the falling weight on lever C, and so actuate the valve gear and stop the engine. If accident should cause the governor to reach its lowest position, the arm J makes contact with projection on lever L, and the catch piece F is disengaged and the engine stopped as before described. The lever L may be moved into the dotted position by the attendant to prevent the apparatus acting when engine is stopped in the usual way, but the lever L is returned by notched rod M upon restarting engine. Several other arrangements are described for carrying out this invention, and in one of them a spring is substituted for the lever L. Claims: The method of preventing excessive speed in motive power engines, and means for stopping same, consisting of a catch released from a lever or spindle working the valve-gear by levers or the like attached to said catch, and coming into contact with stops through the extreme rising or falling of the governor, together with automatic means for operating spindle and valve gear; also claims the various modifications described.—No. 2605. February 13th, 1891. 6*d.*

Drilling Machines.—*J. Claridge & R. Middleton, London.*—This invention relates to improvements in the Tyler and Ellis square hole drilling machine. In these improvements, instead of keeping the roller on the drilling spindle or its sleeve by means of two spiral springs, a second cam or template is substituted, struck to such dimensions that a line drawn through the centre of the spindle from the face of one cam or template to the face of the other shall always be of the same length; thus, a roller placed on the opposite side of the spindle to the point of contact of that used in the Tyler and Ellis machine will always remain in contact with the second cam or template, and maintain the contact of the first roller with its cam or template. The contact of the second roller, and through it of the first roller, is maintained in order to meet any small irregularities of the cams or templates. The arm which carries the second roller may be moved free from its template or cam when it is desired to bring the drill spindle vertical for drilling round holes. Another improvement consists in the employment of a sliding bracket for carrying the ball bearing of the spindle, which bearing, when moved by screw upon

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the main head, varies the size of hole to be drilled. A solid spindle, with altered form of tool socket, is employed. The driving gear is placed at the ball bearing, so that the machine is driven at the nearest possible point to the work. An arrangement of index is described, operated by the adjusting mechanism of the tool, to indicate the dimensions of the hole about to be drilled. Claims: The use of the whole of the improvements described, which, to be properly appreciated, require that reference be made to the quoted patent of Messrs. Tyler and Ellis, No. 3850, A.D. 1890.—No. 20716. December 19th, 1890. 8*d*.

Gas Engines.—*H. T. Dawson, Salcombe, Devon.*—The engine described is a four-cycle motor in which the piston performs the operations which, in other engines, are regulated by a valve, this engine having a piston which, besides reciprocating, revolves once for each stroke of the engine. In the accompanying illustrations of the engine Fig. 1 is a side elevation, Fig. 2 a

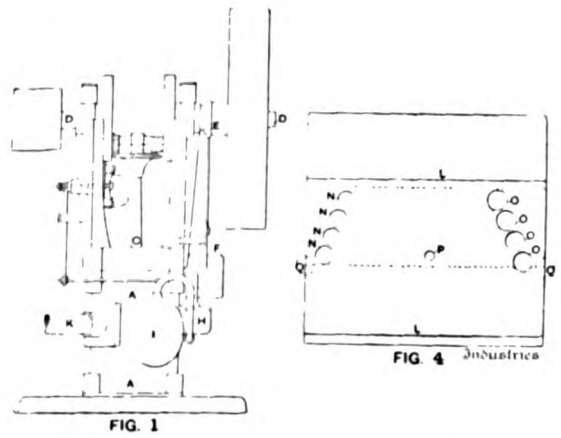


FIG. 1

FIG. 4

vertical section of the cylinder and piston, showing the connecting rod, crank pin, and some other parts, Fig. 3 is a horizontal section, and Fig. 4 will be referred to later. In these figures A is the cylinder, water-jacketed, and containing a piston B, which by a connecting rod C drives a crank on a shaft D; an eccentric E on this shaft actuates an air pump F, whose object is hereinafter explained, and an elastic bag receives the air from the pump. H is a casing containing a governor valve which opens for the admission of air and gas to the cylinder. An elastic bag I serves to maintain a uniform gas pressure. J is the ignition apparatus, and K the exhaust or outlet from the cylinder. The piston is tubular and about twice the length of the stroke, the piston tube L being closed by a diaphragm M situate at about a fourth of its length. The cylinder is about thrice as long as the stroke, and has long ports at about its centre part, which extend spirally in the cylinder walls for rather less than the length of the stroke. Fig. 4 shows, to a larger scale, the interior of the cylinder developed. The full circles show the ports or passages formed in it. The ports N in this figure serve for the admission of air and gas, and they all communicate with a passage formed partly in the walls of the cylinder and partly in the port cover, and form or run into one long port. They also communicate with the governor valve. The exhaust ports O are similarly arranged. P is the firing port. One modification of the arrangements for rotating the piston while it reciprocates may be readily understood from the illustrations. The piston has a port through its tubular part at about the centre of its length serving for all the purposes of admission, ignition, and exhaust. The relative position of this aperture is indicated by dotted lines in Fig. 4, and is marked Q; it is carried by the movement of the piston successively over the ports of the cylinder. In some cases the governor valve is so constructed as still to admit air when the gas passage is closed. This partially destroys the vacuum in the cylinder, which would otherwise be excessive, and arrangements are made whereby, although the governor may vary the quantity of the charge, its proportions of air and gas remain approximately

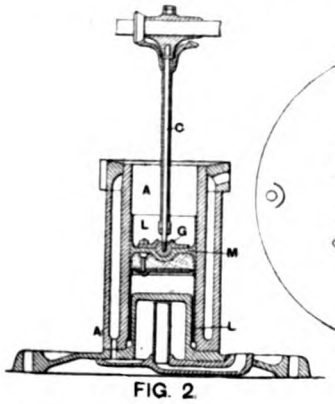


FIG. 2

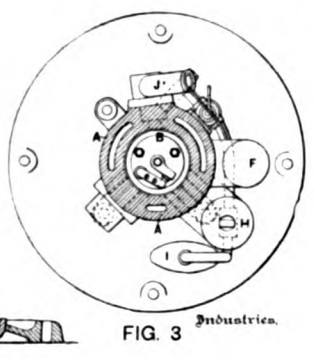


FIG. 3

constant. The ignition apparatus, in one of its forms, consists of a tube or capsule of metal or of porcelain contained in a furnace chamber to which a current of mixed gas and heated air is supplied, the air being forced in by the air pump F before referred to. The tube is gradually brought to and and kept at a state of high incandescence, and rapid ignition of the charge is said to result in consequence. The extra stages are sometimes adopted, by which a clearing charge of air is drawn in and expelled between the quadruple series of operations at first referred to. Claims: A four or six-cycle engine in which a reciprocating and rotating piston operates as a valve in the manner described; the governor and valve details varying the quantity of the charge, while the proportions of gas and air therein remain constant; the various modifications of ignition apparatus; also the various modes of imparting rotation to the reciprocating piston. Claims also the gas engine as a whole.—No. 6407. April 26th, 1890. 1*s*. 1*d*.

Apparatus for Burning Hydrocarbon Fuel.—*J. P. Swift, Woods Holl, Mass., U.S.A.*—This invention relates to apparatus for burning hydrocarbon oil, especially crude petroleum, as a fuel to supply heat for making steam, and for like purposes. Outside the steam generator, for example, is an initial combustion or ignition chamber, the bottom of which is preferably formed of a pan covered with asbestos, mineral wool, or similar substance. Oil is fed into this chamber by any suitable feed, and is ignited therein by any well-known means. Air to support combustion is admitted by an air opening provided with a damper for regulating purposes. The oil ignited and burning in this chamber gives off vapour or gas, which passes through an outlet of annular form on its way to the point where heating is required, and, to complete the combustion of the vapour or gas in the ignition chamber, an air pipe leads air from the exterior of the apparatus to the centre of the annulus, and beyond the outlet a second pipe is provided in which the vapours and air finally mix, and by which they are delivered to the furnace of the boiler or the like. The arrangement thus far described is defective in that there is a tendency to the formation of soot around the edges of the outlet pipe and along its walls. Its formation around the outlet edges is obviated by leading an additional air supply into the apparatus to mingle with the vapours at the beginning of the outlet pipe, and a third air supply may be led into the outlet pipe at some point along its length, for a similar purpose. Claims: The apparatus substantially as described in the first portion of the description, and the apparatus in detail, with the additional pipes for air supply arranged as described.—No. 6502. April 28th, 1690. 8*d*.

Guillotine Paper Cutters.—*H. Harrild, Jun., & J. F. Buckland, both of London.*—In the machines constructed according to this invention the improvements comprise a novel arrangement of the parts by which the up-and-down motion is given to the knife frame and to the clamping beam, with the object of doing away with the counterbalance weights hitherto employed in this class of machine to prevent the knife frame and beam descending of their own weight when the machine is disconnected from the driving power or the brake is applied. These improvements are embodied in the machine shown below, in which Fig. 1 is half of

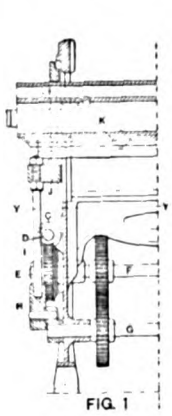


FIG. 1

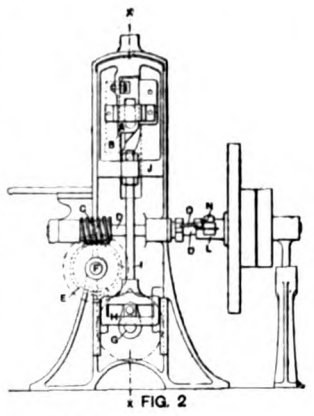


FIG. 2

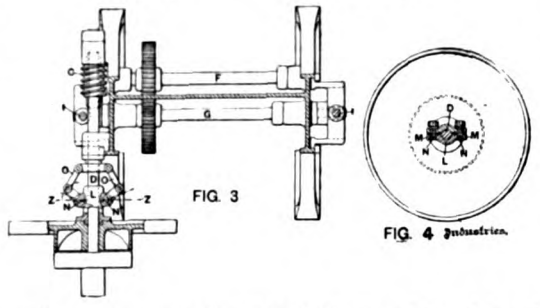


FIG. 3

FIG. 4

a vertical section on the line X X of Fig. 2, and Fig. 2 is a side elevation, Fig. 3 a horizontal section on the line Y Y of Fig. 1, and Fig. 4 a section on the line Z Z of Fig. 3. A is the knife frame and B the clamping beam. The up-and-down motion is given to the knife frame by the following means:—A worm C on the first motion shaft D drives a worm-wheel E carried by the shaft F, which, by spur gearing, rotates the crank-shaft G, the cranks of which, as the shaft revolves, give up-and-down motion to the slide blocks H, which move in vertical guides in the side frames of the machine. These slide blocks H are connected by rods I to upper slides J, which carry the knife frame A and the presser beam B, so that these receive the requisite up-and-down motion. The presser beam B moves in vertical guides, and the knife frame moves during the lower part of its travel in inclined guides K in the presser beam, so that by its slanting or oblique movement it acts upon the paper with a draw cut. The motion being communicated by worm gearing, the knife framing is prevented from descending by its own weight, and the usual counterbalance weights may be dispensed with. The arrangement of clutch mechanism consists of a split clutch L mounted on the fly-wheel shaft D, and having dowels or analogous devices to enter corresponding holes in the wheel so that the clutch and wheel shall rotate together. The clutch has flanges or lugs M, tapped to receive screw bolts N, which when given a slight turn bring the flanges towards each other, and thereby cause the clutch to grip the shaft D. When the shaft is thus gripped it turns the fly-wheel and clutch; when, on the other hand, the clutch is slacked, the fly-wheel and clutch turn loosely on the shaft. The screw bolts N are turned by toggle levers O, connecting them with a grooved sleeve on the shaft, which is operated as is customary. Claims: The paper cutting machine, and also the clutch mechanism, substantially as described.—No. 10253. July 2nd, 1890. 8*d*.

Compensating Mechanism for Signals.—*J. P. Annett, Southampton.*—This is an improved arrangement of mechanism for actuating signal wires in such a manner as to allow the wire to expand or contract according to variations of temperature, and the essence of the invention is that the wire is free to move according as it is acted upon by the temperature and is not in absolute connection with the lever until the lever is worked for the purpose of operating the signal. In the example given, a vertical rod is operated by the signal lever, and at the lower end of that rod is a pulley wheel. At about the normal level of this wheel and in line therewith is a second wheel centered in a fixed frame; secured to this frame, above the last-mentioned wheel, is a pawl pivoted at its centre and having a grooved portion bearing upon the single wire where it leaves the upper side of this pulley and passes below the pulley upon the vertical rod, going thence under another pulley closely adjoining, from which it passes to the signal. At the signal box end the wire terminates in a weight, which rises or falls with variations in the length of the wire, and keeps it at uniform tension, but which, of course, is insufficient alone to operate the signal. Upon the signalman wishing to operate the signal, he works his lever, which pulls the vertical rod and its wheel upwards; the wire being also pulled upwards, tilts the pawl, and one end thereof being thus raised the opposite end grips the wire and holds it stationary between the fixed pawl and the pulley; further motion of the vertical rod must therefore haul in the wire and cause its opposite end to work the signal. Upon the vertical rod being lowered, the wire is first slacked out, placing the signal at danger, and the pawl is next released, leaving the wire free, as at first. Claims: The compensator as described.—No. 8697. June 5th, 1890. 6*d*.

Resistance Governors.—*G. P. Spooner, Portmadoc, North Wales.*—The idea of the inventor is to use a spring clutch to connect the driving and driven shafts, and to arrange it so that when the power is being utilised the springs are compressed and

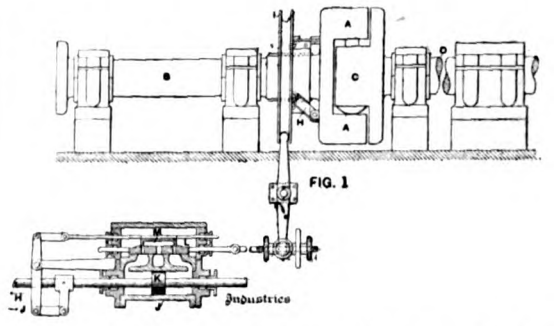


FIG. 1

steam is admitted to the cylinders without throttling. When the work is suddenly reduced or thrown off—for example, when in a marine engine the propeller rises out of the sea—a lever acts on the throttle-valve to govern the distribution of steam. The arrangement is illustrated in side elevation Fig. 1 as applied to a marine engine, Figs. 2 and 3 being views of details. A is a disc fast on the driving shaft B, and C is another disc fast on the propeller shaft D. Three studs E pass through the disc A, and three similar studs F pass through the disc C. These studs E and F terminate inside the discs in sockets, and have placed between each pair helical springs, Fig. 3. Attached to the studs E are levers H connected to a grooved pulley I, which is capable of longitudinal movement upon the shaft. While the resistance is normal the springs are compressed, but should any change take place in the resistance the wheel I is moved along the shaft, and so can operate any suitable governing device. The inventor describes an apparatus shown in Fig. 1, for governing the engine. A steam cylinder J is fitted with a piston K attached to a piston rod communicating with the throttle-valve. Two valves L and M are arranged as shown, one of which L is connected by means of a rod to a lever retained by the grooved pulley I, the other valve M being connected by means of a lever and rods to the piston rod, as may clearly be seen. The action is as follows:—When the wheel I is drawn along the shaft by the reduction of resistance the valve L is moved so that steam passes to one side of the piston K. This moves the piston K to operate the throttle-valve, and by this movement of the piston rod the valve M is moved and cuts off the steam from the cylinder J. Another modification is described for actuating the

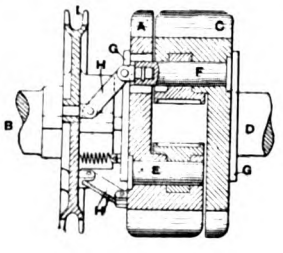


FIG. 2.

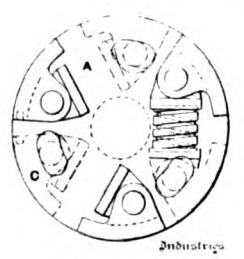


FIG 3.

grooved pulley by means of bell-cranked levers. The last arrangement described is where the grooved pulley is mounted on the propeller shaft, and the propeller shaft is capable of sliding longitudinally in its bearings. Helical springs are placed between the driving and propeller shafts. Claims: In apparatus for governing steam engines the utilisation of the variations in the load by means of springs to operate the throttle-valve; and the various arrangement described in the specification, including attaching pulley to propeller shaft.—No. 19852. December 5th, 1890. 8*d*.

Slide Valves.—*T. Townson, Stoke-on-Trent.*—The object of this invention is to obtain very short and direct steam and exhaust ports, and thus to diminish clearance. This is effected by forming the cylinder covers as a valve chest or casing, and adapting a slide valve to work across port faces at right angles to the axis of the cylinder. The cylinder covers are furnished with valve covers to allow the working faces to be planed and scraped, and to permit of the valves being placed in position. The valve stems are carried through the side of the covers, and are actuated by a secondary shaft, which is driven from the main shaft by suitable toothed gearing. It is preferred to make

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the steam and exhaust passages separate from one another to avoid the cooling action of the exhaust steam. Expansion slides on the back of the main slides may be employed if desired. In one construction of slide valve the valve has two faces, one being the face controlling the admission and exhaust of the steam, and the other face, at right angles therewith, forming a surface which moves in contact with a bearing surface arranged to support the weight of the valve, which is kept up to its work by steam pressure. A port in one face communicates with the cylinder, and a port in the other face with the exhaust. The exhaust port is placed so as to be as near as possible to the exhaust outlet, the length of both steam and exhaust ports being determined by the thickness of the metal of the cylinder ends. At the stuffing-box end of the cylinder the valve is partially divided, so as to pass the exterior of the piston-rod stuffing-box. Claims: Arranging the valves to work on the cylinder ends; the valve with faces at right angles as described; the whole of the arrangements described and illustrated in the specification.—No. 8209. May 27th, 1890. 8*d*.

Steam Boilers.—*P. Kosinski & V. Kisielnicki, Warschau, Russia.*—This apparatus for the generation of high-pressure steam consists of two concentric cylinders, the bottoms of which are made hemispherical in form, the cylinders being let one into the other, leaving an annular space between the two. Between the two cylinders a flat helix is placed, so as to form a helical channel in which the water lies, and around them is an annular cylindrical casing containing at its lower part the grate. The products of combustion are led from a grate below the outer cylinder, around the cylinder passing over its upper edge and down an annular passage adjacent to the inner wall of the inner cylinder, finally ascending to the exit by a central flue. Water is periodically injected into the lower portion of the water space, and ascending the helix is converted into very high pressure steam, highly superheated, which by suitable connections may be withdrawn from the upper part of the steam space. Claims: The boiler for generating steam of exceptional pressure, arranged as described.—No. 4461. March 12th, 1891. 6*d*.

Hot Air for Furnaces.—*N. S. Hawks, Forest Gate, Essex.*—The leading principle of this invention is that air should be forced into easily removable chambers in the uptake or smoke-box of a boiler, that it should be heated in those chambers, and led afterwards into closed ashpits to support combustion. The heating chambers, in one modification adapted for marine use, consist of casings, one to each furnace, placed in the uptake over the ends of the tubes and fitted with short tubes passing through the chambers from front to back and forming extensions to the main boiler tubes, the chambers being either hinged to the boiler by horizontal or by vertical hinges, or being fitted to travel on rollers running upon horizontal guides, so that the ordinary boiler tubes may easily be got at. The air is forced into the chambers by a centrifugal fan, and is circulated between the short tubes by guide or baffle plates, being afterwards led to the ashpits or elsewhere as desired. Where the chambers are caused to travel horizontally, pins upon their sides "take" into inclined slots made in vertical angle irons secured to the tube-plate; this ensures that the chambers shall take a good bearing against the tube plates. They are lifted out of engagement with the slots by screw shackles, borne by the rollers upon which the chambers are supported. In lieu of the heating chambers of the type described, a smoke chamber may be arranged so that its hollow walls fitted upon the tube plate surround the ends of a group of boiler tubes; one side, or the front, of this chamber has a perforated plate, which impedes the exit of gases from the boiler tubes, and this perforated plate can at any time be turned upon hinges for purposes of regulation or to enable the tube ends to be got at. There are no special heating tubes in this modification, the air to be heated being led around within the hollow walls of the chamber, which may be corrugated or provided with internal and external gills, to baffle the air being heated and to add to the heating surface. This last example is shown as fitted to a locomotive, the air inlet pipe being trumpet-mouthed, to receive the indraught resulting from the motion of the locomotive. Claims: The heating chambers as described, hinged; the same, arranged to travel on rollers; and the chamber with perforated front to retain, normally, a considerable proportion of the gases, and being otherwise constructed as described.—No. 6647. April 30th, 1890. 11*d*.

Travelling Cranes.—*J. Platt, Royton, Lancaster.*—The improvements described are applicable either to hand or power cranes, and their object is that the three motions of hoisting, lowering, and traversing may be accomplished by one operating rope or chain, if the crane be worked from below, or by one and the same handle shaft if worked overhead. The rope pulley for hoisting is arranged as is usual, and a small pinion sliding on a shaft can be put into or out of gear with the hoisting pulley, and when put into gear causes a pair of drums, one at each end of the traveller, to rotate at equal speeds. The load hangs in the bight of a chain whose opposite ends are connected to the two drums, and when these two drums are operated as aforesaid at equal speeds, the load is neither hoisted nor lowered, but is traversed transversely to the right or left in accordance with the direction of motion of the hoisting shaft by which the two drums are thus operated. But the pinion referred to above may be drawn out of gear with the hoisting pulley, and brought against a fixed stop, which prevents it and one of the drums from revolving, whereupon, if the hoisting pulley be operated, the load will not be traversed, but will be raised or lowered as the case may be. Separate transverse travelling gear is avoided, longitudinal traverse being obtained as is customary, the operations of raising, lowering, and transverse traversing being governed by one rope. Claims: Substantially, the arrangement described, and operating as in the last paragraph.—No. 9480. June 19th, 1890. 6*d*.

ELECTRICITY.

Electric Batteries.—*H. H. Lake, London.* (*W. Dowse, Boston, Mass., U.S.A.*)—In this battery, by the peculiar arrangement of the solutions with reference to the elements of the battery, local action is said to be entirely obviated, and, there being no chemical action except when circuit is closed, it becomes unnecessary to amalgamate the zincs employed. The example shown is a quadruple cell, there being four porous cups within an outer vessel. These cups contain the zinc elements, preferably made cruciform to expose considerable surface to the liquid within the cup, and the elements are connected together by a ring secured to the tops thereof. The copper element is bent around the porous cups, the ends of the plate not meeting. In the bath for the positive elements chromic acid is employed, or any solution of a chromate or bichromate. The copper plate has for a bath sulphate of copper. A mixture of sal ammoniac, chromic acid, bisulphate of mercury, and chromic acid is preferred for the zinc bath. A solution of copper sulphate is poured directly into the outer vessel, a perforated feed cup containing copper crystals being immersed therein. Claims: The chromate, bichromate, or chromic acid bath for one element, in combination with a sulphate of copper bath for the opposite element; also the variations thereof, and the form and arrangement of battery described.—No. 3589. February 27th, 1891. 6*d*.

Electric Railways.—*A. M. Clark, London.* (*The Waddell-Entz Electric Co., Brooklyn, N.Y., U.S.A.*)—This is claimed to be a new system of electric transportation, consisting mainly in the employment in such a system of a continuous armature, which armature is stationary, and extends from end to end of the track to be traversed by the vehicle. This armature exercises its force upon a field magnet, which is carried by the vehicle to be propelled, with the aid of brushes or analogous contact devices that travel with the vehicle and convey the current from mains or conductors to that portion of the armature which is under the influence of the field magnet. One advantage claimed for this system is that the power applied is in the nature of a direct pull, and does not depend upon the weight of the car for its tractive force. Another advantage claimed is that the armature winding can be regulated to suit the traffic as regards speed and power required along different portions of the route. Thus, on an ascent, the windings may be closer than on a level. All conductors carrying dangerous currents are completely sealed in conduits which admit of no mechanical or electrical communication between the said conductors and the street or vehicle, and which prevents leakage, due to moisture or otherwise, and permits of the use of higher potentials than would otherwise be possible and consequently induces higher efficiency. Referring now to one form in which this invention may be employed, which is represented in Figs. 1 and 2 of the illustrations, A shows the armature placed in a conduit B below the level of the street C. The armature is a continuous coil extending from end to end of the track. D is the field magnet suspended within the conduit

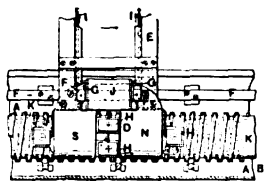


FIG. 1.

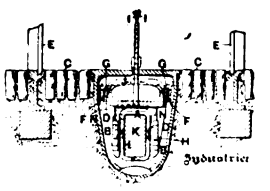


FIG. 2.

B from the vehicle E, and which embraces the armature A. F F are the mains or conductors, which are secured within the conduit B, and extend from end to end of the road. G G are contact pieces carried by the magnet D, and bearing against the mains or conductors F F. H H are the brushes which are carried by the field magnet D, and bear upon the outside of the coiled armature A. The magnet D is excited with the aid of conductors I I that lead from the car or vehicle E to and around the spool J of the magnet D. The winding of the armature A is that of a continuous coil upon an iron core, and corresponds to a Gramme ring armature cut at one place and laid out straight. In another modification the parts as represented in Figs. 1 and 2 are substantially duplicated, with the exception that instead of the continous core K a travelling core is represented, this travelling core being only about as long as the field magnet D, and, in fact, of sufficient length only to complete the magnetic circuit between the two magnet poles. Claims: Various modifications of the apparatus described in the specification, and consisting substantially of a stationary armature in combination with a movable magnet, the latter carried by the vehicle, together with the various accessories necessary to enable the magnet on the vehicle to be influenced by the current in the armature windings, and so effect the movement of the vehicle.—No. 4758. March 17th, 1891. 8*d*.

CHEMISTRY.

Bicarbonate of Soda.—*J. Vivian, St. Bees, Cumberland, & G. Bell, Wavertree, Lancaster.*—This invention refers to apparatus used in the manufacture of bicarbonate of soda. The apparatus comprises two or more carbonators arranged one above the other, and each provided with a perforated valve adapted to act as a gas and blow-off cock, the said carbonators having formed around them a jacket or jackets, within which brine on its upward course, preparatory to its treatment in the carbonators, is caused to circulate for the purpose of cooling the contents of the said carbonators and of receiving any ammonia that may leak therefrom. Between the carbonators is a cooling apparatus in which carbonic acid is cooled as it flows from one carbonator to another. An arrangement of apparatus according to this invention with three carbonators is shown in the accompanying illustrations, in which Fig. 1 is a vertical section of the upper portion of the apparatus, and Fig. 2 is a vertical section of the lower portion, these two portions when in use being arranged one above the other. The apparatus and the mode of operating the same may be described as follows:—A B and C are the carbonators which are charged from the saturator (which comprises an outer cylindrical casing D with an inner cylindrical vessel E) with brine saturated with ammonia gas. Carbonic acid gas is then forced by an engine through the pipe F and perforated valve G, and into the carbonator A, rising through the liquor therein. The carbonic acid gas arriving in the upper end of this carbonator flows through pipe H into a lower cooling apparatus, passing upward through the tubes I thereof, and downwards through the tubes J. It then flows through the pipe K and perforated valve L into the carbonator B, rising through the liquor therein to the top thereof, whence it passes through pipe M into the upper cooling apparatus, flowing through the tubes I and J thereof and the pipe N to the

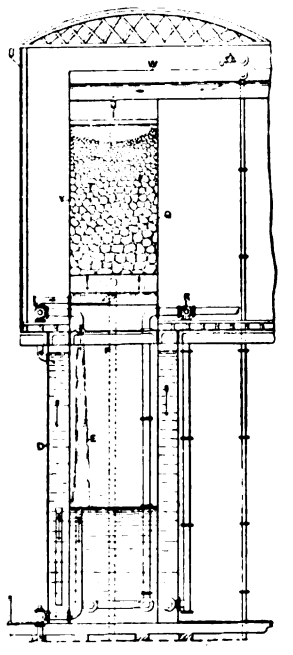


FIG. 1

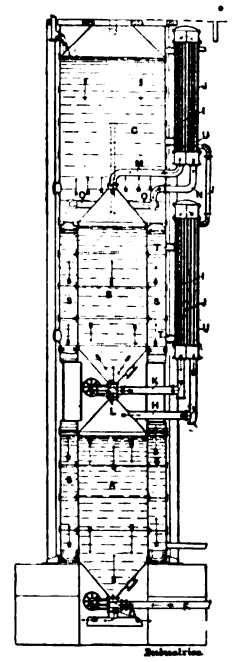


FIG. 2.

perforated pipe O by which it is distributed through the liquor in the carbonator C. The gas not absorbed in this carbonator passes through pipe P into the tower Q, through which it rises, meeting the descending brine, which absorbs any ammonia that may be present in the escaping gas. Any gas not absorbed escapes by the outlet R, and may be further dealt with if necessary. Whilst carbonic acid is passing through the carbonators in the direction of the arrows shown in full lines, and converting the saturated brine therein into bicarbonate of soda, brine is forced into the annular space S between the carbonators A B and the outer casing, circulating upward through the said space and cooling the contents of the two carbonators. The brine then flows through the two branches T into the casing U of the lower cooler, and through pipe V into the casing of the upper one, whence it passes to the brine cistern W. From this cistern it descends into and percolates through coke X with which the tower is packed, going thence to the saturator, where it is treated with ammonia gas supplied from any suitable still. After the brine has been sufficiently treated in the saturator it is taken in succession through the carbonators C B and A, its conversion being completed in the latter. By cooling the contents of the carbonators the yield is increased. Claims: In apparatus for the manufacture of bicarbonate of soda by the ammonia soda process, the arrangement of two carbonators one above another, and each provided with hollow perforated valves such as G and L adapted to act alternately as gas and blow-off cocks, so that gas can be distributed to the contents of the carbonator above them, and the contents of said carbonator can be run off when desired; cooling the carbonators, and the general combination for the purpose described.—No. 7527. May 14th, 1890. 8*d*.

MISCELLANEOUS.

Stockless Anchor.—*F. J. Sinnette, Southampton.*—The improved stockless anchor described in this specification is composed of two principal parts, specially proportioned and arranged so as to transmit the stresses from the arms to the shank without depending upon the strength of the bolt connection as is usual. The shank passes into the tripping head, which is slotted to receive it, the portion of the shank just above the tripping head being enlarged, and the tripping head being provided with projections on its upper side, on each side of the slot and in line with the shank of the anchor. The tripping head and arms or flukes constitute one member of the anchor, and the shank the other, the two being connected by a bolt, which, however, works in an elongated hole and acts merely as a connecting link to keep the parts in proper relative position. When the anchor takes the ground the arms and tripping head oscillate over to one side, and the projections on the tripping head thrust against the enlargement of the shank and the stress is directly transmitted from one part to the other by contact, and the bolt connection has no tendency to shear as is commonly the case. Claims: A stockless anchor with tripping head which surrounds the lower end of the shank, both shank and tripping head being provided with enlargements forming bearing surfaces for the purpose described.—No. 8194. May 27th, 1890. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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THE GARRUCHA AERIAL ROPEWAY.

In our issue of the 30th January last we gave extracts from the Foreign Office Report on the iron ore mines in the district of Garrucha, in the South of Spain. Reference is there made to an aerial ropeway employed for conveying the ore from the mines near the village of Serena to the shore of the Mediterranean, for shipment at Garrucha. As this ropeway is, we believe, the most important aerial line that has yet been constructed, a description of it will no doubt be of interest to our readers, and by the courtesy of Messrs. Commans & Co., of 52, Gracechurch Street, London, E.C., who are the representatives for this system of ropeway in this country, we are now enabled to give full particulars of this interesting line.

The chief feature of this—the Otto—system of rope transport is the employment of *two fixed carrying ropes*, along which the buckets are hauled by a light endless running rope. The advantages of using fixed ropes are, that it is possible to carry heavy loads, cross large spans, and surmount the steepest gradients with safety. Without this system of transport these rich mines would

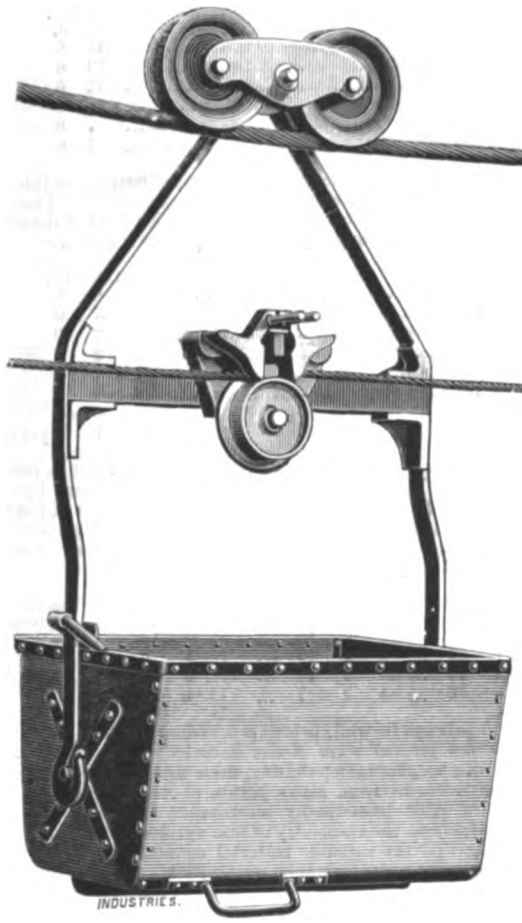


Fig. 1.

probably not have been opened out, as the cost of an ordinary railway would have been very great, and more than absorbed all prospective profit on the sale of the ore.

The standards for these lines are made either of wood or iron, and, according to their height and the strain they have to withstand, are either two or four legged. Figs. 2 and 3 show the design of a four-legged wooden support seen in perspective in the view (Fig. 6, on page 578) of the line, and which is 85ft. in height. Fig. 6 also shows a perspective view of the largest span on the line (918ft.), situated near the Villa Reforma. At this point no less than six empty and six full buckets are suspended at one time between the supports. One of the standards on this line has a total height of 118ft. The two-legged supports are held in position with guy rods. Figs. 1 shows clearly the relative positions of the fixed and hauling ropes, and Fig. 2 shows how the carriers pass the supports.

These carriers consist mainly of four parts—a truck or runner, a triangular-shaped hanger, the bucket or skip, and the grip for attaching the carrier to the hauling rope. The form of buckets depends largely on the nature of the material to be transported; for ore, coal, &c., a bucket arranged to be tipped by hand is usually employed, as illustrated in Fig. 1. The buckets used on the Garrucha Line are of this form, and have a capacity of 7 cwt.

A most important detail, to ensure regular and uninterrupted working of a line, is the form of grip that is adopted for attaching the buckets to the hauling rope.

THE GARRUCHA AERIAL ROPEWAY.

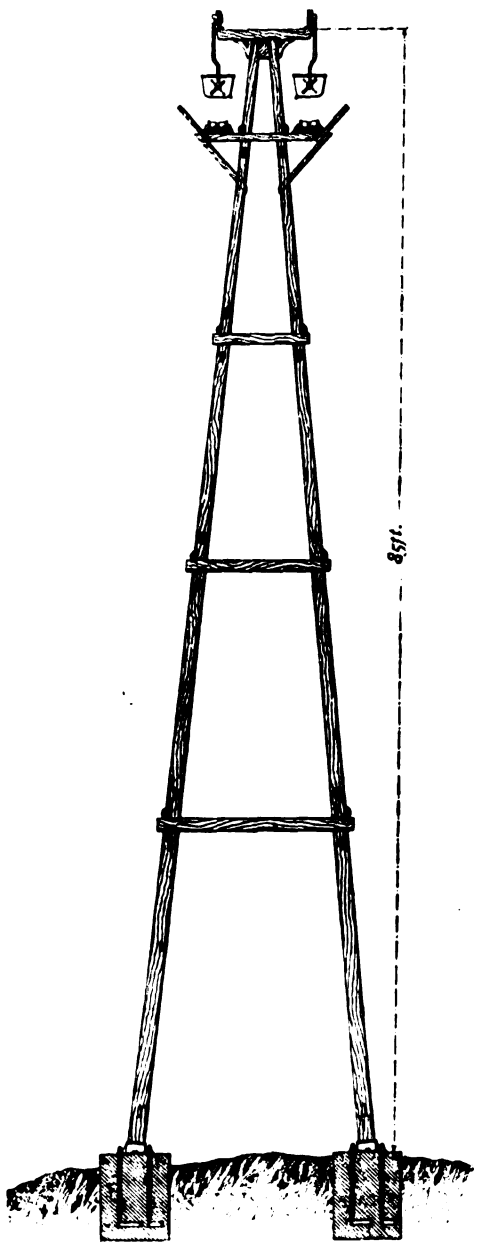


Fig. 2.

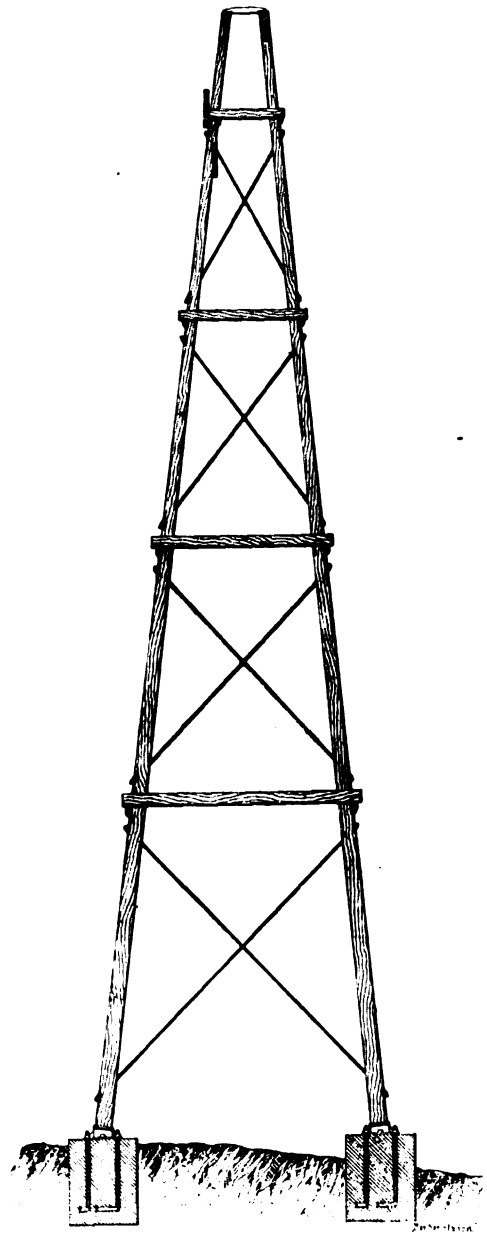


Fig. 3.

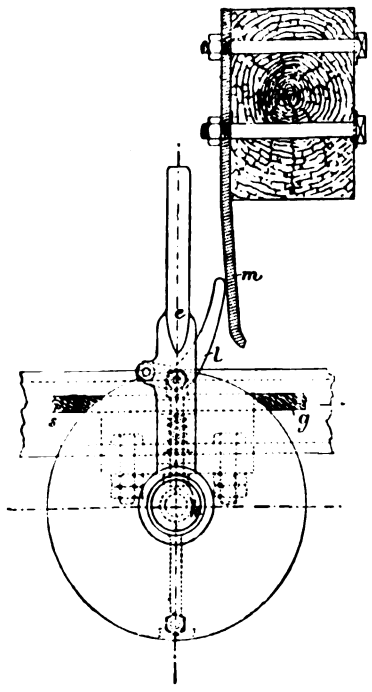


Fig. 4.

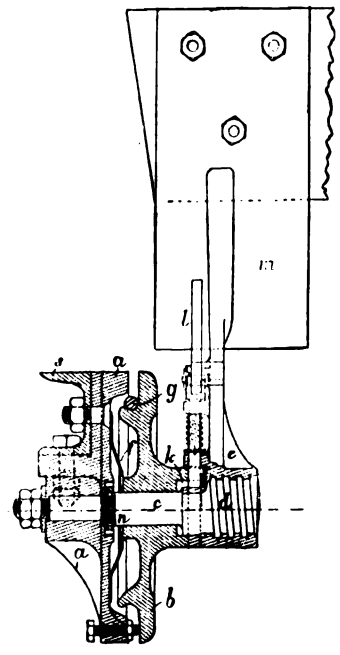


Fig. 5.

For lines with easy gradients friction grips are employed; these are of two kinds—the first, used for gradients up to 1 in 6, is shown in elevation and section in Figs. 4 and 5, and consists of two smooth-faced discs *a* and *b*, one rigidly attached to the cross-bar of the hanger, the other being free when out of action to revolve and act as a guide and supporting roller for the hauling rope. The spindle carrying the movable disc has a square thread on its outer end, and carries a lever, the boss of which forms the nut. If the lever is

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THE GARRUCHA AERIAL ROPEWAY.

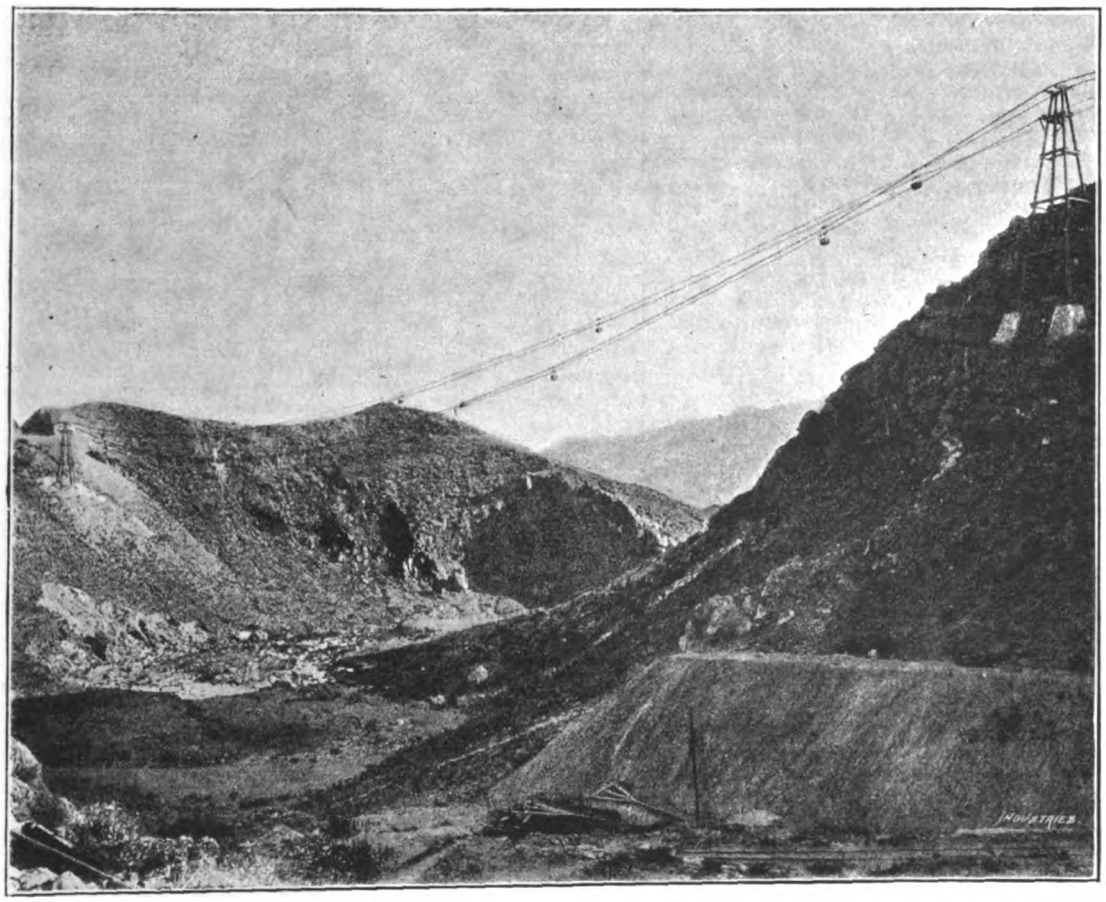


Fig. 6.—918ft. Span near Villa Reforma.

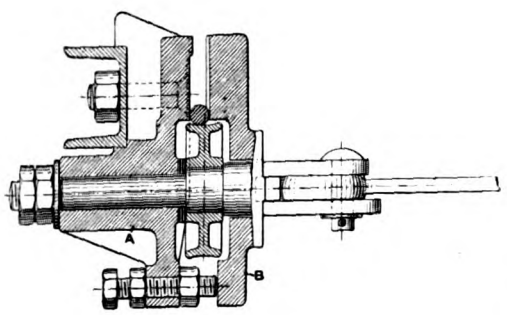


Fig. 7.

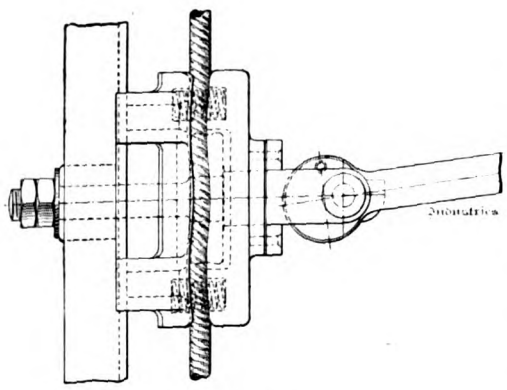


Fig. 8.

hanging down the discs do not grip the rope, and are kept apart by a spring. On raising the lever, however, through an angle of 180° the discs are made to approach each other, and the hauling rope is tightly gripped between them. The lever is prevented from falling in transit by a small spring trigger. For gradients from 1 in 6 up to 1 in 3 a friction grip with corrugated jaws A B (Figs. 7 and 8) has recently been employed, which differs from the disc friction grip above described, in that the movable plate or jaw B is corrugated and does not revolve, the pressure being obtained by means of a lever and eccentric, as clearly shown in the illustration. Both forms of grip work exceedingly well, and permit of the buckets being attached at any point of the hauling rope.

As on the Garrucha Line there are gradients of 1 in 2½, a friction grip would not be sufficiently reliable; it is necessary, therefore, to employ the "pawl" grip, shown in Figs. 9, 10, and 11, on page 579, representing a front elevation, end sectional elevation, and general plan respectively. This consists of two symmetrically placed pawls C C, free to move in a vertical plane, with forked ends, which drop down on either side of the knots attached at intervals to the hauling rope. The hauling rope itself is carried on a roller D slightly below the pawls. To throw the pawls in and out of gear pins are attached to their upper ends, and these at the stations come in contact with guide rails, which raise the pawls, automatically releasing the hauling rope and permitting of the carrier being switched off on to the shunt rails at the station. A large number of these grips, we are informed, are now at work, and in no instance have they been known to fail.

The latest and best form of knot, shown in Figs. 12 and 13, has a star section, and has an outside diameter slightly in excess of that of the hauling rope. The strands of the hauling rope lie in the helical grooves as shown, the ribs forming the star projecting sufficiently above these to form a shoulder to press against the pawls of the carrier coupling. The knot is made fast to a steel wire strand E about 6ft. long, which takes the place of the hempen core in the hauling rope; by this means it is rigidly held, and any strain distributed, the strand forming the core being tightly gripped throughout its length by the strands of the hauling rope itself. The advantages of this form of knot are that it can be quickly attached to, and—when worn—removed from, the hauling rope without cutting the same; for fixing it is not necessary to employ white metal, which was found to very much impair the strength of the rope; moreover, the hauling rope does not lose its flexibility at the point of attachment, and any breakage of single wires is at once visible and easily repaired.

(To be continued.)

ECONOMICAL PUDDLING AND PUDDLING CINDER.*

(Concluded from page 556.)

I do not propose to do more than incidentally touch upon the composition of the finished metal, and the rest of this paper will, therefore, be devoted to a brief consideration of the character and composition of the fettling used and the cinder produced. It may, perhaps, in this connection, be of interest to some members to have on record a few details illustrating the practice of one of the oldest and best known firms in the South Staffordshire iron trade. For these figures I am indebted to the kindness of Mr. A. E. Barrows, who for some time past has worked in the Metallurgical Laboratory of the Mason College, and who is connected with the firm of William Barrows & Sons, of Bloomfield, Tipton. It will be remembered that it was at these works that the modern or "boiling" process of puddling was first introduced, more than half a century ago, by the late Joseph Hall, one of the early members of the firm, and the excellence of the iron made by this firm has been referred to by several metallurgical writers, including the late Dr. Percy, while their brand of B. B. H. is of world-wide reputation. The iron used will, of course, vary with the class of work in hand, but consists of a mixture of about four brands of all-mine pig iron; such a mixture would contain about 0·55 per cent. of phosphorus. The weight charged is 4 cwt. 1 qr. 18lb. The varieties of fettling used, together with the prices delivered at the works in March last, are as follows:—

	Per Ton. s.	d.
Best tap	17	6
Ore (purple)	13	6
Bull-dog	12	6
Do. ground	15	0
Roll scale	7	0
Hammer slag	1	0

Calcined pottery mine is also an important fettling in this district, but so far as I am aware hematite is not used. The consumption of fettling, as calculated over a week's work of the above iron, was, per ton, averaging 25 cwt. 2 qrs., as follows:—

	Cwt.	Qrs.	Lb.
Best tap	3	0	0
Ore	0	3	0
Bull-dog	2	2	0
Do. ground	1	2	0
Scale	1	1	0
Hammer slag	4	0	0
	13	0	0 per turn.

Or nearly 10¼ cwt. of fettling per ton of pig. It must be remembered that this is for best iron, and is more than is used by ordinary makers. The following figures give the weight of pig iron charged, the puddled bar obtained, and the cinder produced in three ordinary heats as above, the weights being taken for me for experimental purposes:—

Weight Charged. Cwt.	Qrs.	Lb.	Yield. Cwt.	Qrs.	Lb.	Tap Cinder Boilings. Cwt.	Qrs.	Lb.	Tap Cinder Tappings. Cwt.	Qrs.	Lb.
4	1	18	4	2	14	1	1	0	1	1	0
4	1	18	4	2	14	1	0	0	1	1	12
4	1	18	4	2	7	1	0	20	1	2	0

It will perhaps be well, before proceeding further, to indicate what is the present state of our knowledge in relation to the removal of phosphorus in puddling, since this is probably the most important element from many points of view. So far as I am aware, the most trustworthy information is contained in Mr. Stead's papers on the chemistry of iron purification, and to me it is surprising that the valuable material contained in these papers has not met with greater public recognition. The correctness of Mr. Stead's conclusions has since been practically confirmed by Messrs. Harbord and Tucker. Briefly stated, the facts are as follow:—Under ordinary conditions of puddling, with a sufficiency of cinder and a fairly high temperature, a large proportion of the phosphorus is oxidised during the melting down of the pig iron, so that the melted metal frequently contains less than half of the phosphorus originally present. Phosphorus is further eliminated during the quiet period which precedes the boil, so that at the beginning of the boil the metal frequently retains not above one-fourth of the original amount of phosphorus. When the metal once becomes granular, or comes to nature, phosphorus elimination almost entirely ceases. The presence of silicon in excess retards phosphorus elimination; manganese acts in the same way when present in excess, but when part of the manganese has been removed, and the two elements are present in about equal proportions, they are rapidly removed together, and yield a very pure product. Oxide of manganese added to the slag does not appear to act like manganese in the pig, but the presence of an impure cinder at the latter part of the process may cause phosphorus to be once more reduced, and to pass back again into the iron. In short, the reactions in the puddling furnace closely resemble those of the basic Siemens process, which, of course, is what might be expected, since the fettling used is basic, and in each case the iron is melted in the furnace itself. Prior to Mr. Stead's researches, it was apparently the custom to regard the puddling and Bessemer processes as closely related, and that this erroneous view in part survives is shown by references I have given in the earlier portion of this paper. In the Bessemer process the metal is melted in a separate furnace, and the result is that the reactions of the acid and basic-lined converters not only differ from each other, but also differ from those of the puddling furnace. In the basic Siemens furnace, on the other hand, melting is performed in the furnace itself, and during the melting down, in a bath of rich cinder, it is quite possible, as Mr. Harbord has shown, to almost entirely remove the phosphorus originally present in the pig. It is also possible in the puddling furnace, with pigs which do not contain too much silicon or manganese, and with suitable fettling, to remove almost the whole of the phosphorus during the melting-down

* Paper read by Mr. Thomas Turner, Lecturer on Metallurgy, Mason College, Birmingham, before the Iron and Steel Institute, on the 7th ult.

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stage. In the puddling process, since the removal of phosphorus almost ceases when the iron is no longer fluid, a high temperature during the boil, and particularly in the early part of the boil before the damper is put down, assists in the complete purification of the iron, by keeping the metal longer in the fluid condition, and promoting the action of the cinder.

As it is necessary, before discussing the relative economy of various kinds of fettling and cinder, to have some definite view as to the constitution of puddling cinder itself, I will here venture to put forth my own views on this matter. In the earlier portion of this paper I have referred to the unsatisfactory manner in which fettling is often referred to as oxide of iron, while, as a matter of fact, ferric oxide (Fe_2O_3) alone is not a satisfactory fettling on account of its infusibility. In skilful puddling, the cinder plays a most important part, not only during the middle and end of the operation, but also during the melting-down stage itself; and it is a bad workman who, during the earlier part of his heat, has to make cinder either by the oxidation of his iron or by melting down his side or bottom fettling. In other words, there should be a sufficiency of fluid cinder present in the furnace to cover, and thus to clear, the iron as it melts. Having thus a bath of fluid cinder to begin with, the workman has then to rely upon his less fusible fettling, and partly upon atmospheric oxidation, to supply the ferric oxide he needs during the process.

Magnetic oxide of iron is produced when iron burns in air or oxygen, and is usually represented by the formula Fe_3O_4 (or FeO, Fe_2O_3), though there are considerable differences in the proportion of ferrous and ferric oxide found in various samples of native magnetite and in the artificial "best tap." This magnetic oxide is fusible, as is evidenced by the fluid cinder on an "oxide bottom," sometimes used in reheating furnaces when "best tap" is made. But though magnetic oxide is fusible, it does not melt nearly so readily as ordinary puddling cinder. Ferrous silicates, such as FeO, SiO_2, or $2FeO,SiO_2$, are readily fusible, but have little oxidising power, and the iron they contain is not easily reduced by the action of carbon or other reducing agents. Good tap cinder, if carefully crushed and freed by a moderately powerful magnet from any shots or globules of iron, is found to be almost wholly attracted by a powerful magnet, thus showing the presence of a considerable proportion of magnetic oxide of iron. In connection with some experiments of this kind, it struck me that as a small part of the crushed cinder is not attracted by a magnet, it might be possible in this way to separate the phosphorus or other impurities, and to obtain a fertiliser on the one hand and best tap on the other from puddling cinder. I therefore repeatedly treated a sample of such cinder with a powerful magnet, until a portion was obtained which was not attracted, while the whole of the rest, about 85 per cent. of the original, was attracted. On analysis the following results were obtained:—

	Original Sample.		Portion not Attracted.
Silica (SiO_2)	17·12	...	18·06
Phosphoric anhydride (P_2O_5)..	7·62	...	7·22

From this I conclude that no further separation of the sort I had in view was possible, and that the part attracted was merely richer in magnetic oxide of iron, while the part not attracted was richer in ferrous silicate.

These and similar considerations lead me to put forward the following suggestions. Puddling cinder may be regarded as being essentially composed of two substances—ferrous silicate and magnetic oxide of iron. The first of these is readily fusible, comparatively neutral so far as its influence on the constituents of the iron is concerned, and cheap. It can be obtained at an almost nominal cost in the form of hammer-slag, which still retains in addition a very appreciable and useful quantity of magnetic oxide. Magnetic oxide itself, on the other hand, is less fusible, and with much ferric oxide is extremely refractory. It is an active oxidising agent, and is the chief constituent of the best tap, bull-dog, &c.; for it is erroneous to suppose that these materials consist of ferric oxide alone. During the puddling process, the more readily fusible silicate melts first, and then dissolves the magnetic oxide, or the still more refractory ferric oxide, which when dissolved forms magnetic oxide; and thus puddling cinder may be regarded as a solution of magnetic oxide, that is, of ferrous and ferric oxides, in ferrous silicate. Or, to put it in another way, just as the galvaniser uses hydrochloric acid dissolved in water to clean his sheets before coating them with zinc, so the puddler uses magnetic oxide of iron dissolved in a nearly neutral cinder to remove the impurities of his crude iron.

If the explanation thus given be the true one for puddling cinder, it is doubtless to a large degree applicable to other processes where oxides of iron are used as oxidising agents, such, for instance, as the old-fashioned refinery, the American bloomery, the Swedish and Styrian processes for producing iron or steel in an open-hearth, and the "washing" processes introduced by Bell and Krupp. In all of these cases the slag obtained is silicious and fusible, and contains a variable amount of dissolved magnetic (or ferric) oxide. Further, it would appear that since, in modern puddling, the greater part of the oxidation which takes place is due to the action of the cinder, this question of the amount of the dissolved oxide is of the highest economic importance. The ferrous silicate melts easily, and can be used in a form which costs next to nothing, and obviously it must be economical to have the highest proportion of this material present which is consistent with good working.* On the other hand, ferric oxide (which is an essential constituent, and often the source of magnetic oxide) is necessary, but dear. Too large a proportion of magnetic oxide, therefore, means preventible loss of fettling, while too small a proportion will involve the use of more time, a larger total weight of cinder, and consequent waste of fuel.

For these reasons I contend that a knowledge of the weight and composition of the cinder produced in puddling is of the highest practical value in enabling us to judge of the success of the process. It will, of course, be understood that in these and the subsequent remarks, I am merely endeavouring to elucidate the main principles which underlie the puddling process, and not to dogmatise or to lay down any hard and fast lines of procedure which it is obviously impossible to do in a case like the present, where the operation is conducted on small quantities at a time,

* Though ferrous silicate itself has comparatively little oxidising power in the puddling furnace, it doubtless acts as a carrier of atmospheric oxygen from the furnace gases, and thus contributes to the oxidation of the impurities present.

THE GARRUCHA AERIAL ROPEWAY.

(*For description see page 577.*)

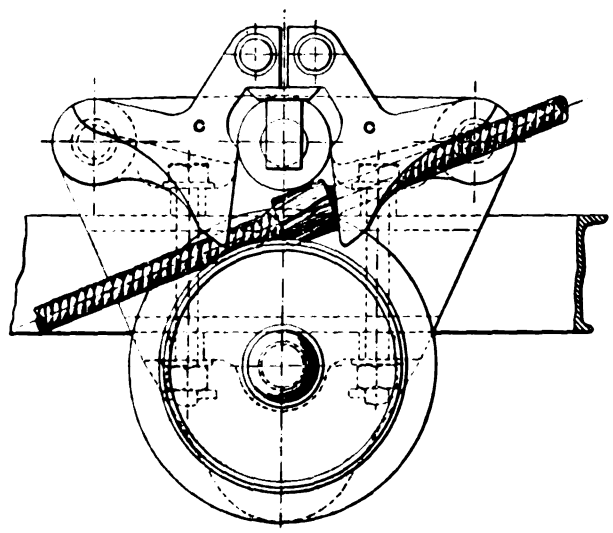


FIG. 9.

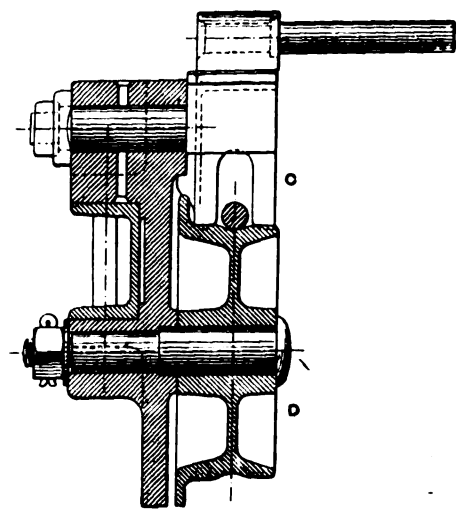


FIG. 10.

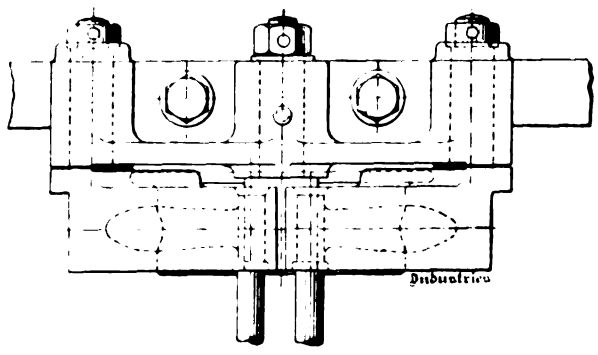


FIG. 11.



FIG. 12.

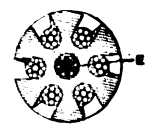


FIG. 13.

on nearly all varieties of pig iron, and with many kinds of fettling, and when success or failure is so often dependent upon the skill and attention of the workman.

In the ordinary process of puddling there are two distinct varieties of cinder produced, and the difference between the two is generally overlooked, though I think this difference is of great importance. The first variety of cinder is usually known as "boilings," from the fact that it boils over the foreplate during the heat, and is collected in the tapping-waggon. The second kind is known as "tappings" and is tapped out at the end of the process. The "boilings" are usually more or less honeycombed in structure, and are more easily fractured than the tappings, which are, on the other hand, more compact and dense. The tappings are free from metallic iron, while the boilings always contain some shots or globules of metal, which are carried over by the turbulence of the boil, and in some specimens recently examined I found as much as 16 per cent. of metal in the form of small globules, which were separated by a moderately powerful magnet from the crushed cinder. These globules of iron still retain carbon, and, being in contact with an oxidising slag, they produce carbonic oxide, which burns in jets at the surface of the molten cinder. The tappings, on the contrary, usually evolve little or no combustible gas. I think it may be considered, as a general rule, if the tappings are very lively in the waggon while hot, and very honeycombed and brittle when cold, that the process is not so satisfactory as when the boilings are more quiet and compact. Now it is somewhat remarkable to find how differently experienced men work these two varieties of cinder. Thus, while Mr. Harrison, a manager of many years' experience in South Staffordshire, advocates the production of practically no boilings, but retaining the whole of the cinder in the furnace till the end of the process, the figures given by Mr. Barrows earlier in this paper show that at one of the best works in the district they produce about an equal weight of tappings and of boilings. And yet another manager, who would prefer to have his name unmentioned, but to whose experience and practical knowledge I attach the very highest importance, recommends that so far as possible all the cinder should be boiled out, and only so much allowed to remain as can be carried to the hammer with the balls. But all will, I think, agree that the balls should, when taken to the hammer, retain a considerable quantity of tolerably thick cinder, which should so adhere to the iron as not to leave a trail behind on the way to be shingled, and yet which, when under the hammer, should cover and almost bathe the metal in slag.

For the purpose of my experiments, by the kindness of gentlemen who are or have been students in the Metallurgical Laboratory at Mason College, I obtained three sets of samples from different works—namely, samples of three heats from Mr. T. Ashton, of Netherton, one heat from Mr. Tolley, of Darlaston, and three heats from Mr. Barrows, of Bloomfield. The samples, therefore, represented seven heats worked under ordinary conditions, and in each of which satisfactory iron was produced; they were collected from different works using various kinds of iron and varieties of fettling. In this way it was hoped to obtain a mean result, which would as fairly represent the general practice as is possible under the circumstances. The samples were first crushed and treated with a magnet to extract any metallic iron that was present. In each case the boilings contained shots of iron, while the tappings were free from such metal. The mean composition, as deduced from the seven heats, was as follows:—

	Boilings.		Tappings.
Ferric oxide (Fe_2O_3)	6·94	...	12·90
Ferrous oxide (FeO)	62·61	...	64·62
Silica (SiO_2).....	19·45	...	15·47
Phosphoric anhydride (P_2O_5) ...	6·82	...	3·91
Not estimated (MnO, S, CaO, &c.)	4·68	...	3·10
	100·00		100·00
Total iron	53·55	...	59·29

I have not ventured to calculate how much of the ferrous oxide was combined with silica and phosphoric anhydride and how much oxide of iron was free, on account of the uncertainty as to the exact composition of the silicates and phosphates of iron that occur in tap cinder. The above figures, however, show a marked difference in the composition of the two kinds of cinder, the boilings being richer in silica and phosphoric anhydride, while the tappings contain more ferrous and ferric oxide, and consequently more iron. I know that blast furnace managers who use puddling cinder have a decided preference for tappings, and this is only what would be expected from the above analysis. This difference in composition is connected with the fact previously noticed, that the greater part of the silicon and phosphorus are oxidised during the earlier part of the process. Now, it is obviously necessary that these impurities should be oxidised and pass into the slag if a good product is to be obtained; but experience also shows that in order to produce a good iron it is necessary to have a fairly pure tapping cinder, as otherwise the impurities are either not wholly removed, or, if removed, they may actually pass back into the metal again. But if we wish to have economical working, the consumption of fettling must be reduced as much as possible; while, if we desire a pure product, the cinder must be rich and pure. How, then, are these two apparently opposite conditions to be obtained?

The purification of iron by oxide has been referred to as a "washing" process, and in an earlier part of this paper I have compared it to a "pickling" process. Certainly the final separation of slag from the granules of iron is not unlike the washing of a precipitate in the laboratory. If, for the sake of illustration, we consider the case of a quantity of oxide of iron contaminated with a soluble salt, and assume that the material will in the moist state retain one volume of the washing water. If then the oxide of iron be agitated with 100 volumes of water and filtered, the amount of remaining impurity will be only $\frac{1}{100}$ of the original quantity. But if the oxide were agitated with 10 volumes of water, and filtered, the impurity would be reduced to $\frac{1}{10}$; and if it were again treated in the same manner with 10 volumes of

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water, the impurity would now amount to only $\frac{1}{100}$ of that originally present. Thus, by twice washing with 10 volumes of water, we obtain the same result as by the use of 100 volumes with a single washing. Now it seems to me that this principle is applicable to puddling cinder, especially when very impure pigs are to be used. Enough fusible cinder should be used to produce a bath sufficient to cover the metal as it melts, and this cinder need not be of an expensive character, since hammer-slag and similar materials are cheap. The character and proportion of ferric oxide in this cinder must, of course, be varied according to the pig to be treated, the object in each case being to remove the greatest possible amount of silicon and phosphorus at the beginning of the process. Having thus transferred the impurities from the pig iron to the cinder, and as far as possible *saturated the cinder with impurities* (which is, I believe, the key to economy at this stage), this cinder should be removed from the furnace, and this is most easily done, not by tapping at this stage, as was formerly the custom at some places, but by regulating the damper so as to produce a good boil, and thus boiling out the impure cinder into the tapping-waggon. Care must, however, be taken to avoid undue loss of metal in the form of globules at this stage, and the boiling cinder should be tested occasionally by crushing in a mortar, sieving, and treating with a moderately powerful magnet.

It must also be borne in mind that it is easy to spoil the iron by having either too little cinder or a too fluid cinder during balling, as this leaves the finely divided metal exposed to oxidising gases at a critical stage of the process. In puddling unusually pure iron, or metal that is more apt to produce a deficiency than an excess of cinder, obviously the foregoing reasoning with regard to the boilings does not apply, and it may in such a case be best to produce little or no boiling cinder. The general practice of the present day is to use much more impure pig iron than was the case forty years ago, and hence the importance of a correct knowledge of the composition of cinder at different stages of the process becomes more necessary. It is perfectly certain that it is possible, by the use of a sufficiency of cinder, by thoroughly boiling the iron, and by boiling out a good deal of the first cinder, to produce a splendid bar iron from very impure materials, and the quality of the finished iron often depends more upon the details of manipulation than upon the chemical composition of the original pig iron.

The average composition of the three samples of tappings and boilings previously mentioned is given in the following table, from which it will be seen that the amount of ferric oxide in the boilings is fairly uniform, and does not vary over a wide range in the tappings, while the other constituents show considerable differences, though in each case the same fact is noticed—namely

	Boilings.			Tappings.		
	1. Three Heats.	2. One Heat.	3. Three Heats.	1. Three Heats.	2. One Heat.	3. Three Heats.
Ferric oxide (Fe_2O_3)	6·28	7·53	7·40	13·24	11·61	14·00
Ferrous oxide (FeO)	59·91	63·96	64·86	59·83	67·46	68·46
Silica (SiO_4)	19·31	17·12	20·38	18·12	11·02	14·29
Phosphoric anhydride (P_2O_5)	7·68	7·62	4·52	4·90	5·06	2·53
Not estimated.....	6·82	3·77	2·84	4·91	4·83	0·72
	100·00	100·00	100·00	100·00	100·00	100·00
Total iron.....	51·00	54·91	55·63	55·10	60·60	63·05

that the boilings contain more phosphorus and silicon, and less oxides of iron, than the tappings. But when it is found that, in slags from different works conducting the same process, variations exist which amount to more than 50 per cent. of the silica present (viz., 11·02 and 18·12 per cent.), and to just over 100 per cent. in the amount of phosphorus (2·53 and 5·08 per cent. respectively), the question naturally arises whether these slags are equally economical, and whether it is possible in any simple manner to determine the relative economy of various samples of puddling cinder.

To do this it is necessary to have some standard of comparison, and to obtain a satisfactory standard is not easy, while it would probably be impossible to get any one standard which would be of general application. Thus I can only hope to suggest an approximation to the truth. But it is fully settled, I think, that a puddling cinder may be an efficient purifier and yet contain as much as 20 per cent. of silica and 8 per cent. of phosphoric anhydride. Possibly even more impurities than this might be permitted, and with a reduction of silica more phosphorus could be allowed, and *vice versâ*. Still experience shows that such a cinder is efficient, and we may, for purposes of comparison, regard this as a saturated boiling cinder. But the above table shows that we have usually about 5 per cent. of other constituents which were not separately estimated, while the ferric oxide is very fairly constant at about 7 per cent. Hence, as the composition of a boiling cinder for comparison, we may take—

Ferric oxide (Fe_2O_3)	7
Ferrous oxide (FeO)	60
Silica (SiO_2)	20
Phosphoric anhydride (P_2O_5)	8
Other constituents.....	5
	100

Such a slag as that above given contains scarcely any FeO in addition to that necessary to neutralise the SiO_2 and P_2O_5 on the assumption that the compounds $2FeO,SiO_2$, and $3FeO,P_2O_5$ are formed. On examining the table of analysis, it will be found that sample No. 1 agrees almost exactly with the suggested composition, while sample No. 2 is lower in silica, and No. 3 considerably lower in phosphoric anhydride than the standard. These are, therefore, unsaturated cinders, and are, for that reason, less economical, since either rather less fettling, or a cheaper kind of fettling, or a more impure iron, could have been used without interfering with the purification so far as the boiling stage is concerned.

If it is difficult to suggest a standard of comparison for boiling cinder, it is more difficult still to lay down any definite rule in the case of tapping cinder, on account of the variety in the quality of the iron to be produced, the weight of the tappings, and other causes. The following would, however, be tolerably economical and sufficiently pure for most purposes:—

Ferric oxide (Fe_2O_3)	12
Ferrous oxide (FeO).....	60
Silica (SiO_2)	18
Phosphoric anhydride (P_2O_5)	5
Other constituents.....	5
	100

On comparing the table of analysis, it will be noticed that sample No. 1 is again very nearly of the character suggested, while No. 2 is low in silica, and No. 3 rather lower in silica, and considerably lower in phosphorus. It must of course be remembered that this sample is from very best iron, and the apparent extravagance may be to some extent necessary.

To appreciate the importance of this question, it is only necessary to calculate the effect of such difference of composition as is here noticed on the annual cost at a large works. Thus, No. 3 sample of tappings contained 10·45 per cent. of Fe_2O_3 and FeO together in excess of what is necessary, if it is possible to work with the composition I have given. The oxide so calculated is pure, and equal to best tap at 17s. 6d. per ton. The tappings are, in round figures, 1 cwt. per heat, or 6 cwt. per turn, or about 50 cwt. per week per furnace; 10 per cent. of this gives 2½ tons, which, at 17s. 6d. per ton, would cost £2 3s. 9d. per furnace per week, which, in an ironworks of the largest size, with, say, fifty puddling furnaces, would mean £5,000 per annum.

Before closing this paper, I should like to say a few words as to the probable nature of the changes which take place during the oxidation of the impurities of the pig iron during the puddling process. I have previously referred to the fact that a number of actions are possible, some of which involve the use of much more fettling than others, some of which yield much iron, and others none. Now, any explanation which may be suggested must be in harmony with the observed facts, such as:—That oxidation is carried on by oxide of iron, which is partly produced from the pig iron itself, but chiefly supplied in the form of fettling. Ferric oxide alone is too infusible to play an important part in the process, but acts when dissolved in cinder. Puddling cinder consists largely of ferrous silicate, which is readily fusible, but not easily reducible, and which amounts to two-thirds of the whole slag in the early part of the process. Puddling cinder contains magnetic oxide of iron, which is present in greatest proportion in the tappings. The amount of ferric oxide present is usually pretty constant at the same stage of the process in different heats, and increases as the purification of the metal progresses. Impure pig irons do not necessarily give the smallest yield of puddled bar per unit weight of pig iron used, the contrary being particularly noticed with very common irons. The weight of puddled bar obtained may exceed the weight of pig iron used, especially if plenty of suitable fettling has been used, and the metal well boiled, so as to give a pure product.

Now, so far as I can at present see, these conditions involve the reduction of both ferric and ferrous oxides together according to an equation of the following type:—

$$xFe_2O_3 + yFeO - zO = 2XFeO + yFe,$$

in which, starting with ferric and ferrous oxides, by the removal of oxygen, ferrous oxide and iron are obtained. If we consider ordinary magnetic oxide (Fe_3O_4), this equation would become

$$FeO,Fe_2O_3 - O_2 = Fe + 2FeO,$$

and such an equation probably represents a close approximation to what actually takes place in many cases, since we know that both FeO and metallic iron are produced. The relative amount of each will doubtless depend upon the conditions which exist in any case under consideration, and more particularly upon the proportion which exists between the oxidising power of the slag, and the kind and amount of impurities which have to be removed.

A consideration of the thermal aspects of this question supports the view that ferrous oxide or ferrous silicate take but little part in the oxidation under ordinary conditions. The heat developed by the combination of 1 gramme of iron with oxygen in different proportions is approximately as follows:—

1 gramme of iron oxidised to		Fe_2O_3	yields	1,725	calories.
1	,,	,,	Fe_3O_4	,, 1,600	,,
1	,,	,,	FeO	,, 1,350	,,

By calculating from these numbers the amount of heat required to liberate the same quantity of oxygen for each of the three oxides, we obtain the following values:—

To liberate a unit weight of oxygen and produce metallic iron from	FeO	absorbs	1,350	calories.
,, ,, ,, ,,	Fe_3O_4	,,	1,200	,,
,, ,, ,, ,,	Fe_2O_3	,,	1,150	,,

Now, since more heat is required to obtain an equal weight of oxygen from FeO than from either Fe_3O_4 or from Fe_2O_3, obviously but little FeO will be reduced so long as higher oxides are present; but in tap cinder much, at least, of the FeO is already combined with either SiO_2 or P_2O_5, and this would render the reduction of the iron still more difficult. Of the remaining two oxides, Fe_2O_3 is somewhat more readily reduced than Fe_3O_4, but much more infusible, and, as we have seen, oxidation is carried on in the puddling furnace chiefly by the fluid cinder which contains magnetic oxide. Hence it is not unreasonable to suppose that the infusibility of ferric oxide would counteract the slight advantage it possesses in reducibility, and that the main reaction is of the type above given.

Further support of this view is afforded by the results of some of my own experiments performed six years ago (*Jour. Chem. Soc.*, 1885, p. 474), in which it was observed that, on fusing silicon pig in a crucible with ferrous silicate, the proportion of silicon and manganese was but very slightly reduced, while these elements were rapidly oxidised by slags containing ferric oxide, or by the action of atmospheric air. I then concluded that ferrous silicate, apart from atmospheric oxidation, has very little influence on silicon or manganese in pig iron, and stated that:—"From the fact that manganese is more readily oxidisable than iron, it might have appeared that ferrous silicate would itself probably act as an oxidising agent in removing manganese from pig iron. But these experiments appear to show that the real action of ferrous silicate is rather that of a carrier of oxygen than of a true oxidising agent. Ferric oxide is first formed, and this is reduced by the bath of metal present."

On the other hand, an experiment performed by Mr. Stead (*Cleveland Engineers*, 1877, p. 153), in which a small quantity of pig iron was fused with an excess of oxide of iron, chiefly in the form of ferrous oxide, appears to prove that phosphorus is oxidised by ferrous oxide, and that, at the same time, it reduces an equivalent amount of iron from the slag. This experiment is scarcely conclusive, as no account was taken of other elements present in the pig; but if ferrous oxide removes phosphorus and reduces an equivalent amount of iron, while silicon and manganese are oxidised by ferric oxide and reduce no iron from the slag, this would explain some of the apparently anomalous yields obtained with certain common irons, to which I have before referred. Too much importance must not be attached to crucible experiments, however, as the conditions are not the same as those which obtain in the puddling furnace, and additional experimental evidence is required in order to further elucidate some of these points.

It may, in conclusion, be necessary for me to again remind you that my paper is intended to partake more of the character of a contribution to the discussion of a subject which is of interest to many members of this Institute than as a dogmatic assertion of fixed and unalterable views; and if what I have said should be of use in assisting to clear up some points which are obscure, and in causing others with wider opportunities for practical observation to investigate the matter more fully, I shall feel that the object I had in view when this paper was commenced has been fully realised.

THE ROYAL NAVAL EXHIBITION.

ELECTRIC LIGHTING PLANT.

The necessary arrangements for the electric lighting of this Exhibition having been entrusted by the executive to Messrs. Siemens Brothers & Co., it was decided by this firm to carry out the same on the lines of a small central station, and for this purpose an engine and dynamo room 68ft. long and 29ft. wide was provided, but, after deducting from these dimensions the space apportioned to visitors, there remained a floor area of only 48ft. by 21ft. whereon to erect six sets of engines and dynamos, aggregating collectively over 1,100 h.p. In addition to this building, a boiler-house measuring 60ft. by 29ft., and containing seven steel boilers constructed by Messrs. Davey, Paxman, & Co., was also provided.

Briefly, the general lighting may be said to be effected by some 200 1,000 (approximate) c.p. arc lamps and upwards of 2,000 Edison-Swan 16 c.p. incandescent lamps, suitably dispersed about the various galleries, grounds, kiosks, &c. The arc lamps, of Siemens' new pattern—similar to those in use at the British Museum—are run two in series, and work with a current of 9 amperes each, those employed for illuminating the galleries being suspended from the ribs of the roofs, while those used in the grounds are hung in groups of six, on 40ft. lattice iron masts. To supply the current required for these 2,200 arc and incandescent lamps, also numerous motors (used for working models in various parts of the buildings), and the lighthouse lamps, Messrs. Siemens Brothers have installed five of their continuous current dynamos and one separately excited alternator, the leads from all of which are taken to a switch-board (of the firm's central station engine-room type), provided with all necessary controlling, regulating, and measuring instruments, magnetic, and other cut-outs. From the switch-board the current is led by means of Siemens' lead-cased and iron-sheathed underground feeding mains to the network of distributing conductors placed throughout the buildings and grounds.

As the continuous current dynamos used are substantially the same as the makers' latest type, recently described by us (see *Industries*, Vol. X., page 401), we need not again refer to details of construction, nor does the alternator, being of the well-known type, need description here. It will therefore suffice for descriptive purposes to consider the plant as divided into two groups, the first consisting of three of the makers' shunt-wound dynamos (type H.B. 24/36), each capable of giving an output of 1,500 amperes at a pressure of 120 volts whilst absorbing 260 h.p. Driving power is supplied by three of Willans' central-valve engines, each indicating about 300 h.p., with steam at 120lb. boiler pressure, and when running at the required speed of 350 revolutions per minute. Each of these units occupies a base area of 108·5 square feet (*i.e.*, 15ft. 6in. long by 7ft. wide), and stands 9ft. high, the combined efficiency of engine and dynamo at full load being given as about 86 per cent. It is claimed that, with one exception, these are the largest direct-coupled high-speed engines and dynamos in existence, and that they, in themselves, are a sufficient generating plant for a fair-sized lighting station, as they are capable, if worked together, of supplying current for upwards of 8,000 16 c.p. lamps.

The second group is made up of three units, the first consisting of one H.B. 15/19 dynamo coupled direct to a Willans vertical open type engine. The bed-plate on which these are mounted is 8ft. 6in. by 3ft. 3in., and the whole would stand with a headroom of 5ft. 3in. This dynamo, when running at 320 revolutions per minute, is equal to an output of 200 amperes at a pressure of 120

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THE ROYAL NAVAL EXHIBITION.

Electric Lighting Plant.

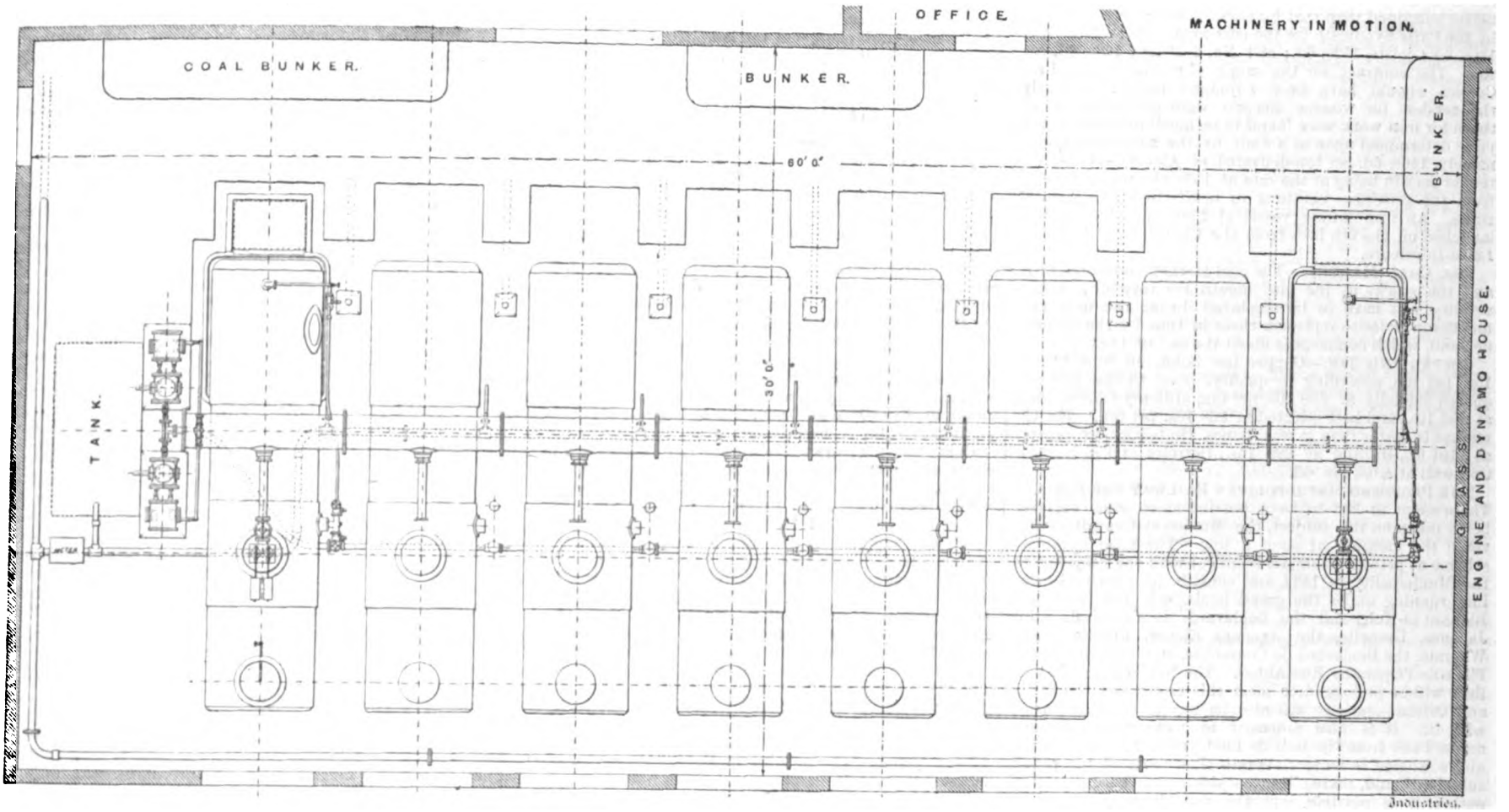


Fig. 1.—Plan of Boiler House.

volts. The second unit of this group, occupying a space of 8ft. 6in. by 4ft. and standing 6ft. high, is made up of one H.B. 16/19 dynamo coupled direct to a Willans engine, and gives an output of 400 amperes, under 120 volts pressure, when running at 475 revolutions per minute; while the remaining unit, devoted to maintaining the arc lamp of the lighthouse, yields, by means of a Siemens W_{20} separately excited alternator, running at 420 revolutions per minute, an output of 40 kilowatts (*i.e.*, 500 amperes 80 volts). This is also driven by a Willans engine, the over-all dimensions being 5ft. 3in. by 9ft. 6in. by 6ft. 9in. The following are brief particulars of the engines above mentioned:—

The large engines are of the double-expansion compound non-condensing type, having three pairs of tandem cylinders, mounted, high-pressure uppermost, over a three-throw crank shaft (120 degrees between each throw), the high and low pressure pistons being 14in. and 20in. in diameter respectively, and 9in. stroke. These engines, standing on a base 7ft. 8in. by 3ft., indicate, as before stated, 300 h.p., and when doing so consume about 20lb. of steam at 120lb. pressure per indicated horse-power per hour, but similar engines fitted for condensing and working with steam of 160lb. pressure have been proved to require only 14lb. of steam per indicated horse-power per hour. We purpose illustrating and describing this engine in an early issue.

The G.G. type engines are compound non-condensing four-cylinder engines, having 8in. high-pressure and 14in. low-pressure pistons and 6in. stroke. These engines, numbers of which have been supplied to the Navy, stand on a base of 3ft. 8in. by 2ft. 4in., and are 5ft. high. With steam of 120lb. pressure they indicate 80 h.p. when running at 475 revolutions per minute. The open-type engine differs from those above described in that it has steam-jacketed low-pressure cylinders, and, as its name implies, all below these, such as piston and connecting rods, guides, cranks, &c., are open, as in the ordinary type of inverted cylinder engine. The steam to the high and low pressure cylinders is controlled by piston valves placed outside these cylinders and driven by eccentrics in the ordinary way. This engine, when running at 350 revolutions per minute, indicates 60 h.p.

Steam is supplied to the several engines mentioned by a battery of seven steel locomotive-type boilers constructed by Messrs Davey, Paxman, & Co., of Colchester,

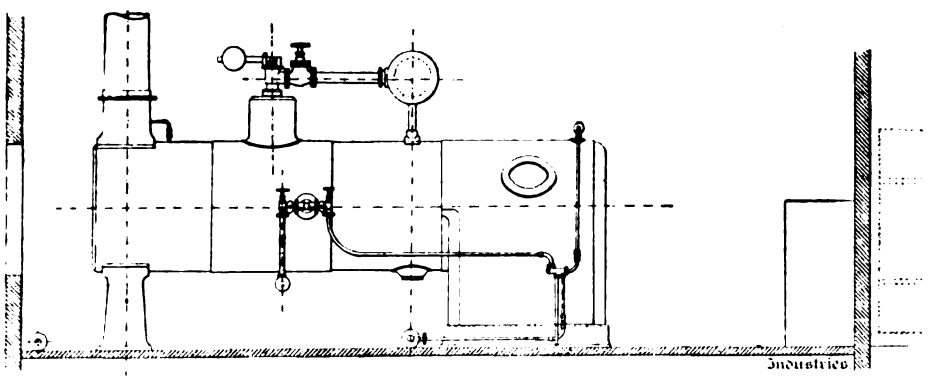


Fig. 2.—Part Sectional Elevation

and shown in plan and elevation in Figs. 1 and 2, the boiler-house in which they are placed measuring 60ft. by 29ft. In addition to these the same makers have supplied two other boilers, or nine in all, of exactly the same construction, and which latter are placed contiguous to the Camperdown Gallery for driving the various machinery therein. Each of the boilers has a grate area of 16½ square feet and 710 square feet of heating surface. They were constructed for a working pressure of 140lb., and each has been carefully tested, hydraulically, to 250lb. per square inch. The inside fire-boxes were made from Messrs. Davey, Paxman, & Co.'s special mild steel, all flanging being done by special hydraulic machinery, and, as an additional precaution, every plate was most carefully annealed after passing through the various machines. All the plates, planed or turned on their edges, had the rivet holes drilled in position, and closed by special quality steel rivets. A steel receiver, made up of 6ft. 6in. lengths, the flanges whereof are welded on, runs across the entire battery, and into this each boiler discharges its steam, provision being made, by means of suitable stop valves, to allow of the opening or shutting off of any of the boilers. The feed-water for the electric light boilers, each of which evaporates over 3,000lb. of water per hour, is supplied by two of Mumford & Anthony's "Duplex" steam pumps, and, in addition, each is fitted with a Gresham & Craven injector.

In closing this necessarily cursory description of the electric lighting plant at the Exhibition, we may congratulate the executive upon the successful termination of the excellent and efficient arrangements made by each of the firms interested, and upon the satisfactory working of the whole installation.

RAILWAYS IN ILLINOIS, U.S.A.

Illinois has the greatest railway mileage of any State in the Union, having 10,163 miles of main line, 926 of second, third, and fourth tracks, and 2,928 miles of sidings. The total capital stock, funded debts, and current liabilities of the railway companies in Illinois for all mileage operated in 1890 amounted to £403,236,785, or £10,833 per mile, and the net income on 41 railways was £6,591,582, while 21 railways showed a net deficit of £285,391. The total earnings from operation in Illinois in 1890 amounted in the passenger department to £3,600,805, in the freight department to £9,924,453, and from miscellaneous sources to £390,266, making the total earnings £13,915,524, and showing a slight increase in the passenger traffic and about 10 per cent. increase in freight returns over the preceding year. The operating expenses in 1890 were £2,646,438 chargeable to passenger traffic, and £5,612,917 to the freight department, total £8,259,355, an increase of under 2 per cent. on the year 1889.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 16th June, 1891.

The Iron Market.—There is no change in the state of the iron market. The demand for joists continues to be better sustained than that for bars. The prices established by the Paris Syndicate for the past week were:—Best bars, 140s. 6d.; joists, 152s. 6d.; and No. 2 sheets, 168s. 8d. per ton. The contract for the supply of railway material for Corsica should have been adjudged to-day, but only the tenders for wooden sleepers were accepted, as all those for iron work were found to be much in excess of the price determined upon as a limit by the administration—namely, 146s. 6d. per ton delivered at Ajaccio—the lowest tender sent in being at the rate of 153s. the ton. Reports from the provinces continue to testify to a fair state of trade. An iron sailing vessel of 2,000 tons burden was launched on the 6th inst. from the Chantiers de la Loire, Loire-Inférieure.

The Coal Market.—The coal market continues firm, and the stocks at the pits' mouth are very low. Great activity will have to be displayed during the next two months in order to replenish these in time for the autumn demand, which commences about the end of August.

Copper and Tin.—Copper has fallen off from 12s. to 15s. per ton, according to quality. Best Chilian bars are quoted officially at £58 10s. per ton, ordinary Chilian bars at £56 10s., and best selected at £60 10s. per ton. The tin market is better than it was, Banca tin being now quoted at £101 9s., Billiton at £99 16s., Detroits at £98 9s., and Cornwall at £103 17s. 6d.

The Proposed Metropolitan Railway for Paris.—There seems at last to be a possibility of some decision being taken on this subject, the Municipal Council having voted the creation of such a line. The most approved scheme at present is almost identical with one proposed to the Municipality in 1883, and consists in a main circular line running under the grand boulevards, the Boulevard Richard-le-Noir, and the Boulevards de l'Hôpital, Saint Jacques, Grenelle, the Avenues Kléber, Friedland and Wagram, the Boulevard de Courcelles, and returning to the Place de l'Opéra by Rue Auber. The Northern and Sceaux lines will be prolonged to meet this circle, and the Lyons and Orleans stations will also be put in communication with it. It is also proposed to make a line running across Paris from the Bois de Boulogne to Vincennes. The above scheme is more elaborate than most of the others submitted, and, taking into consideration the question of outlay, it is possible that the committee appointed to examine into the question may reject it.

The Panama Canal.—M. Charles de Lesseps has published a letter in the Parisian journal, *Le Jour*, which says that his father and himself will shortly be able to make a statement with reference to their administration of the affairs of the Panama Canal Company, and to explain the motives of their past action.

BERLIN, 15th June, 1891.

The Iron Market.—The demand for rails on the part of the Breslau State Railway management has generally amounted during the first half of each year to 4,000 tons, but this year the demand is considerably greater. An order for 15,330 tons of steel rails has already been placed with the Royal Laura Works and the Upper Silesian Supply Company. The rolling mills will, therefore, be well supplied with work for some time. The price offered by both works for steel rails was £6 4s. 4d. per ton.

The Coal Market.—Tenders for patent fuel, nut coals, furnace, and foundry coal were recently invited by the management of the Right Bank Rhenish Railway. No offer was made for 20,000 tons of patent fuel; the lowest offer for 4,500 tons of foundry coal was made by the Gelsenkirchen Mines, which offered coal at 10s. 2d. per ton, delivered at the Germania Pit.—A seam of coal has been bored into at Welsberg, near Schattenstein, in Oberfranken, and a company is being formed for the purpose of working it.

Woollen and Cloth Trades.—The condition of the cloth market has been unfavourable in some important respects. Notwithstanding the severity of last winter, business in the poorer and moderate sorts of wool was confined within narrow limits, and was less than that of previous years. For better and superfine sorts the market was satisfactory. The lessened sale of the poorer wools is shown by the diminished earnings caused by the strikes. Wool merchants are despondent about forward orders for next winter, especially since the spring business did not develop in consequence of the continuance of severe weather. Business in light woollens did not become active till the beginning of May. The regular demand for raw material has decreased very little, and prices have been well maintained, so that manufacturers frequently find business unremunerative.

Regenerative Petroleum Lamp.—Mr. Julius Schnelke, of Berlin, has recently constructed a petroleum lamp which is similar in working to the Wenham and Clarke gas lamps. The petroleum is evaporated in a chamber, and after having passed through a ring of small tubes is burnt as a gas without a wick, and produces an inverted flame. The products of combustion serve for the heating of a system of baffle plates, by means of which the air necessary for combustion is well heated before reaching the burner. The flame is perfectly white, and the regulation of the oil, which flows from a reservoir above, is easily effected by a needle valve, which at the same time secures the entrance of a clean oil into the lamp. The heating of the evaporating chamber is effected by a small flame, which is fed either by petroleum or by spirit, and which is automatically extinguished as soon as the evaporation of the oil has commenced, and the lamp is in working order. Photometric trials show that the lamp has a high illuminating value per unit of oil consumed.

VIENNA, 15th June, 1891.

The Iron Market.—The general condition of the iron market has not changed during the past week, and prices remain stationary. Notwithstanding the brisk demand for all sorts of iron, it is impossible for manufacturers to raise the prices, as foreign markets would then be able to compete successfully with our own market. The price of pig iron only has increased, and shows a firm tendency, whilst a good business is being done in rolled iron. Bohemian firms are very well represented in the Jubilee Exhibition at Prague, and it is evident that the Bohemian machine works are the most important works in Austria. The total value of the engines which are constructed in Bohemia annually amounts from £1,350,000 to £1,950,000. The capital invested in these works is nearly £2,000,000. From 7,000 to 10,000 workmen are employed, and the wages paid amount annually to £480,000 to £500,000. The production of Bohemian pig iron amounts to 200,000 tons.

Electrical Engineering.—On the 11th inst. a large electrical central station at Carlsbad, in Bohemia, was started. The installation consists of five Babcock-Willcox boilers, each with 1,310 square feet of heating surface. Four steam engines of 125 h.p. each and 360 revolutions have been supplied by the Brunn Machine Works. The engines are directly coupled with the alternating current dynamos, and also drive the exciters. The dynamos are of the A. 6 type, constructed by Messrs. Ganz & Co. in Budapest, and have an output of 80,000 watts at a pressure of 2,000 volts. The central station is situated at a distance of about 1¼ miles from the town, to which the current is carried by a conductor above ground of 8mm. diameter. The current is distributed through the town by an underground cable, of which about 12½ miles have been laid, and the secondary conductors also are carried underground. The public transformers are on the Zipernowsky-Déri-Blathy system. The lighting of the streets is effected by 90 arc lamps at 12 amperes and about 180 incandescent lamps of 16 c.p., which, however, do not work simultaneously. Private establishments in the town have been anxious to adopt electric lighting, and nearly the whole of the output of the present installation has been applied for. At Prague an electrical railway has nearly been completed. A mountain railway is being constructed by Herr Krizik to the Belvedere, and thence an electric railway of about 2½ miles is being made to the Exhibition ground in the Baumgarten. Austrian firms continue to take a prominent part in the Frankfort Electrical Exhibition. Professor A. von Waltenhofen, director of the Electrical Institute in Vienna, has been elected a member of the committee of awards.

BRUSSELS, 16th June, 1891.

The Iron Market.—The market has again become slack owing to the lowering of the price of pig iron in England. There is, however, some hope of a rise in consequence of the favourable state of the French market. Constructive works are well supplied with orders. Some large contracts for fish plates have just been awarded, as well as for a supply of metal frames and supports for the repair of works at Maestricht. The Liége works are constructing some mechanical separators for the coal mines at Werister.—On comparing the exports of the first four months of this year with those of the corresponding period of last year, it is found that the exports of steel have considerably decreased. Steel rails show a decrease of 11,000 tons; miscellaneous steel work, 10,000 tons; manufactured steel, 1,000 tons; miscellaneous rolled iron, 4,500 tons; manufactured iron, 2,000 tons; cast iron, 7,000 tons; rolling stock, 5,000 tons; machines, 6,300 tons—making a total of 46,800 tons. The imports have been maintained, with the exception of rough cast iron, which has decreased from 87,000 tons in 1890 to 30,000 tons in 1891.

The Coal Market.—The award of contracts, which is fixed to take place to-day, is awaited with some impatience. Supplies are decreasing in the Liége and Charleroi districts, and the price would possibly rise, if it were not for the import of French coal, which is of good quality. There is a large demand for coke, which is likely to rise in price again. Coke is now quoted at 14s. 10d.; screened coal, at 9s. 7d. to 10s. 5d.; lump coal, for furnaces, at 11s. 2d. to 12s.; household sorts, at 12s. 10d. to 16s. On the 17th inst. the Naval Department will award contracts for 12,000 tons of coal or patent fuel.

Electric Lighting.—The Julien Company has erected an installation of incandescent lamps of 20 c.p. in the large market of Ixelles, which are lighted by means of two batteries of Julien accumulators. Some installations have recently been carried out at Charleroi, in consequence of the success attending the central station erected by M. Dulait. At Antwerp the prospect of an arrangement with the gas company causes the former projects for the lighting of the town to be revived.

Linens and Textile Fabrics.—Linens and yarns imported from Russia have been offered at a low price, but little business has been done. For home made linens and yarns the market is very small. Linen threads show some activity, but manufacturers are well supplied with orders, and prices are very firm. Bruges has produced a larger supply of linen than usual, and there is a slight rise in price of the better qualities.

The Port of Brussels.—M. Van Mierlo, chief engineer of the public works in Brussels, M. de Paepe, chief engineer of the railway administration, M. Maillet, chief engineer of roads and bridges, and M. Dustin, have gone to Brême in order to visit the port, and will afterwards visit the port of Dunkirk.

DÜSSELDORF, 16th June, 1891.

The Iron and Steel Market.—The better tone which was recently apparent in this market has given way, and business in the pig iron market has again become inactive. For manufactured goods there is a good demand, and business shows a tendency to increase. The award of contracts for railway material continues, and on the 19th inst. a supply of 5,000 tons to 6,000 tons is to be placed by the Baden State Railways at Karlsruhe. The Dortmund Union has received from the State Railway management at Cologne an order for iron to be used in the construction of the railway station there at a cost of £78,300. The owners of the blast furnaces of the Rhenish-Westphalian Union, which produce Thomas iron, and the owners of the Luxembourg blast furnaces have arranged a common place of sale in Düsseldorf for phosphorised iron, which is used in the manufacture of steel and iron flux. The Bochum-Steuer trial has attracted much attention in industrial and other circles. Political relations in Bochum have been strained for some years past, and the Ultramontane, the Liberal, and Social Democratic parties have been bitterly opposed to one another. The leaders of the various parties have shown a bitter personal hatred. The journals which represent the Ultramontane party have published such insulting statements that the other party, with Mr. Baare, the general director of the Bochum Union, at their head, have felt compelled to institute an action for libel against the editor of an Ultramontane journal. The latter has replied by bringing an accusation against the Bochum Union before the Government authorities that false marks have been placed on the rails and axles for sale with the knowledge of Mr. Baare. The inquiry which has been instituted does not, so far, give much foundation for this accusation. It is unfortunate that accusations, which have been made against the Bochum Union without full proof, and probably from personal motives, should reflect on the iron industry throughout Germany.

The Coal Market.—The coal market remains firm, and prices are well maintained. In consequence of continued rain the Rhine has risen considerably, and shipments at Duisburg have in consequence been much decreased. The shipments, however, of Westphalian coal amounted to 110,000 tons.

Electric *versus* Gas Lighting.—A controversy is at present going on between Mr. Hegener, the former manager of the Cologne Gas and Water Works, and Mr. Riemer, an engineer of this town, as to whether the electrical central stations, which are now in course of construction in the larger number of the important towns of Germany, are likely to be profitable. Mr. Hegener is decidedly of opinion that they will not earn a profit, while Mr. Riemer, relying on the practical experience of Mr. Haniel and Mr. Lueg, regards the prospect of these installations as favourable.

AMSTERDAM, 15th June, 1891.

The Stearine Candle Factory at Gouda.—In 1883, when this company had been in existence for fifty years, a pension fund for the employés was started by the board of directors, who set aside £4,166 from the reserve fund for that purpose, and engaged themselves to pay into the pension fund an annual percentage of the profits for the benefit of the participating members. It appears from a recent report, that the pension fund has benefited to the extent of £16,312 from 1883 to 1890. Last year £1,660 was available for distribution, being equal to 21 per cent. of the total of the wages paid.

The Western Sugar Refining Company at Amsterdam.—In 1890 this undertaking made a clear profit of £36,976. After writing off £16,635, there remained a balance sufficient to pay a dividend of £9 3s. upon each share of £83. 43,500 tons of raw sugar were treated in 1890, against 32,500 tons in 1889.

Cinchona Culture in Java.—The official report of the Government cinchona plantation in Java states that the crop of 1890 amounts to 534,562lb., 142,396lb. being Cinchona succirubra, 6,447lb. Cinchona Josephiana, 342,271lb. Cinchona Ledgeriana, and 43,448lb. Cinchona officinalis. 100,000lb. of bark were collected in the first quarter of 1891. The bark sold at Amsterdam out of the crop of 1890 fetched 1½d. per unit for common kinds. The Cinchona Ledgeriana fetched good prices, and even better ones were realised by the bark of the Cinchona succirubra—viz., up to 2s. 4d. a pound. The "Melattie" Company's cinchona plantations in Java have done well in 1890, and the shareholders receive a dividend of 11 per cent., after placing £250 to reserve, and writing off £166.

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DUTCH GUIANA.—At the opening of the States in Paramaribo, on the 12th ult., a report was read concerning the economical progress of the colony in 1890. It appears that Dutch Guiana produced last year 1,963 tons of Muscovados sugar, 6,149 tons of vacuum pan sugar, 1,168,962 litres of molasses, 532,239 litres of rum, 2,169 tons of cocoa, 572,113 bunches of bananas, 7 tons of coffee, 9 tons of rice, and 241 tons of corn. 1,380 immigrants arrived in the colony during 1890, among them the first Javanese labourers imported into the colony.

STOCKHOLM, 13TH JUNE, 1891.

THE GOTHENBURG EXHIBITION.—As the completion of the buildings in connection with this Exhibition advances, it becomes evident that it will be both extensive and interesting. The principal building is 336ft. long and 134ft. broad, but its accommodation is insufficient, and many auxiliary buildings have been erected in consequence. The exhibitors number about 1,000, and a great many of them intend to show machinery in motion driven by electricity. The whole of the buildings will be lighted by electricity.

DREDGERS.—The Munktell engineering firm has recently delivered several large dredgers. One has been supplied for Ystod, 85½ft. long and 22ft. broad, with a compound engine of 50 h.p., in addition to which there are two smaller engines of 5 h.p. each. The greatest dredging depth is 26ft., and capacity about 3,000 cubic feet per hour. A somewhat larger dredger has just been completed for Kalmar, but the largest will be the one just ordered for the town of Hango, in Finland.

NEW STEAMER.—The new steamer "Göteborg," built by the Bergsund Engineering Co., for the Bohnslön Steamer Co., had a satisfactory trial trip about a fortnight ago. The steamer is 160ft. long and 35½ft. broad, and is fitted with triple-expansion engines of 700 i.h.p.

CHRISTIANIA, 13TH JUNE, 1891.

THE NEW RAILWAYS.—The construction of the Nestun-Os Railway was commenced a few weeks ago. The period required for the completion of the lines, recently sanctioned by Parliament, will extend over six years. The annual grants were estimated to be about £166,000. The first lines to be completed will be the Kongsvinger-Flisen Railway, the Hamar-Lillehammer Railway, and the Lillehammer-Losna section of the Lillehammer-Sel line. The Söterdale Railway and the Losna-Sel section would be delayed until the second half of the term of six years. In accordance with this plan the Kongsvinger-Flisen line could probably be opened in the autumn of 1893, and the Hamar-Losna Railway a year later.

STATE GRANTS TO ENGINEERS.—The Norwegian Government having voted a sum to be distributed among engineers who do not hold State appointments, so as to enable them to complete their studies, this money has now been distributed. Among those who have obtained such assistance are men who are engaged in milling, telephony, the stone industry, and paper manufacture. The grants are for studies abroad, and the recipients have to send in to the authorities, within a year after their return, a full report of their work.

COPENHAGEN, 13TH JUNE, 1891.

THE RAILWAY WORKS AT SLAGELSE.—The large railway works at Slagelse, Sealand, are now rapidly progressing, the number of workmen having been recently increased. The digging machine, probably the first used in Denmark, has of late been worked both night and day. The larger bridges are well advanced, and some of the viaducts are already completed. The new railway station is also approaching completion.

LIFE SAVING APPLIANCES.—An exhibition of various life saving appliances took place at the new harbour, Copenhagen, on the 9th inst. A lifeboat of the most approved construction, capable of carrying thirty-five men, was first shown. Some instructive experiments with rocket firing were then made. Mr. O. Larsen, who has made a specialty of life saving appliances, had arranged an exhibition of his various manufactures, comprising patent oil distributors, life buoys, life saving garments and mattresses, and the Klickbüll life saving appliances. Messrs. Koefoed & Boge also showed their patent oil bag.

MEETING OF TELEPHONE DELEGATES.—A meeting of delegates and engineers from all the Jutland telephone companies is to be held at Aarhus to-morrow. In connection with this meeting several Danish and foreign firms have arranged an exhibition of telephonic appliances.

MADRID, 15TH JUNE, 1891.

HARVEST PROSPECTS.—It is feared that the barley and wheat crops will be much below the average of the past few years. Particular districts may, however, show some exception to this rule. Straw is likely to be even more scarce than grain. The profits of the Madrid tramway companies will be seriously diminished this year in consequence of the high price of barley. If a similar state of affairs were to continue for two years it is probable that the companies would substitute electrical for horse traction Up to the present time none of the four large companies has taken any steps to effect this improvement, although proposals are continually being made. One of the four companies is English, another Belgian, and the other two are Spanish. One of the Spanish companies, named "Estaciones y Mercados," seems rather disposed to adopt electrical traction.

IMPROVEMENTS AT BARCELONA.—On the 8th inst. tenders were to have been received for making the projected extensive improvements at Barcelona. No tender, however, was submitted, and the concession will be granted to the original applicant, Señor Baixeras. The project is likely to meet with much opposition from the shopkeepers whose houses are to be pulled down. According to the present law the contractor will be obliged to pay the estimated value of such buildings as are made use of for the proposed improvement, but compensation is to be made to traders for losses incurred through the removal of their business. It is, however, generally recognised that the present law is imperfect in this respect. It is rumoured that Señor Baixeras is supported by an English syndicate.

TELEPHONE SYSTEM IN VISCAY.—The provincial authorities of Viscay have decided to establish a complete system of telephones throughout the province, and to have a telephone station at each of the 122 municipalities which are situated in that energetic and prosperous district of the country.

PHOSPHATE MINES AT PEÑAFLOR.—A company has been formed in Belgium with a capital of £109,200 to work the phosphate mines of Peñaflor. No serious attempt has yet been made to work the mines, but a sanguine report has been accepted by the company, which states that there are 1,400,000 tons of phosphates in the mines. It is expected that 100,000 tons of phosphates will be obtained annually, out of which 26,400 tons will be of 75 per cent. quality. These mines are favourably situated for shipping purposes, as they are only 53 miles from Seville, and there is a railway through the whole distance with the exception of six miles.

ROME, 15TH JUNE, 1891.

ITALIAN LIGNITE.—Some experiments were recently made on the railroad from Rome to Frascati, in which lignite, distilled according to the process of Mr. Sapori, was used instead of coal. The experiments were made on a very heavy gradient, and only one engine was employed for the trip instead of two as usual, although there was a larger number of waggons and a considerable number of passengers. There was no unpleasant smell, and the consumption of lignite was less than coal, the boiler pressure being kept constantly at nine atmospheres. The trial has been considered very satisfactory, and it is hoped that the use of lignite instead of coal for the various industries will be advantageous from an economical as well as from a social point of view. The great importance attached to this subject by Italian manufacturers may be easily understood from the fact that Italy produces no coals, whilst it imports about 5,000,000 tons of coals per annum from abroad, of the value of over £5,000,000. After the experiments made in Germany many Italian engineers and manufacturers devoted their attention to lignite, and tried to find out the best method for adapting this fuel for industrial as well as for household purposes. Many works in Italy are now using lignite only, by means of the Siemens gas producers, among the most important being the Terni steel works and the iron mills of San Giovanni di Val d'Elsa, of Volbarno. There are various kinds of lignite to be found in Italy, the two principal ones being "lignite xiloide" and "lignite picea" (pitchy), or "schistosa." This latter kind is the purer, as it contains a smaller proportion of earthy substances and is drier.

ZÜRICH, 16TH JUNE, 1891.

AN EIFFEL TOWER FOR MOUNT PILATUS.—A scheme has been proposed for the erection of an Eiffel Tower on the summit of Mount Pilatus. The proposed tower is to have a height of 918ft., so that a splendid view of the Alps may be obtained. The tower is to be of steel, and be composed of two open-work cylinders.

SWISS RAILWAYS.—The Railway Department of the Swiss Government has issued a circular letter to the various branches of the Swiss Railway Union, directing attention to the growing importance of standard methods and appliances in the railway service, and to the good results which have already been achieved by their partial adoption. In the circular prominence is given to the desirability of uniformity in practice among the different railways, and the officials are requested to take the matter under consideration, and to determine upon proper resolutions with this end in view.

ELECTRIC LAUNCH ON THE LAKE OF ZÜRICH.—The first electric boat built on the Continent was launched last month on the Lake of Zürich. It has been built by Messrs. Esscher & Wyss and the Oërlikon Maschinenfabrik. It attains a speed of six miles per hour, and can run five or six hours with one charge of the fifty-six secondary cells carried.

NEW YORK, 6TH JUNE, 1891.

FUEL GAS FOR DOMESTIC USE.—The manufacture of fuel gas for domestic use in Terre Haute, Ind., is said to be a commercial success, the cost to consumers being about one-half the cost of hard coal. The gas is made from crude oil, and the company owning the plant is preparing to largely extend its mains.

NATURAL HOT WATER SUPPLY.—The Water Company at Boise City, Idaho, has two artesian wells each about 400ft. deep, discharging over 1,000,000 gallons of water per day. The water is reported to have a temperature of 180° Fahr. It is proposed to bore another well, so that the water may be used for bathing purposes.

LARGE MACHINE TOOLS.—The Universal Radial Drill Company has recently completed a pipe facing machine built for the Addyston Pipe Works, which is of 60in. swing, double-headed, and will take in between the heads a length of pipe 17ft. long, which is held stationary as in cylinder boring, while the heads carry swinging arms provided with sliding tool rests to do the facing.—Messrs. Robinson, Rea, & Co., of Pittsburgh, have completed two casings for rolling machines to be used at the Carnegie Armour Plate Mills, at Homestead, Pa. Each casing is in one piece, and weighs 90,000lb. One of the Pennsylvania gun trucks, with a carrying capacity of 100,000lb., was used in the transportation of the mammoth piece of iron. These trucks have 16 wheels, and are used exclusively for this kind of work. The largest crane at the foundry had only a capacity of 25,000lb., but by lifting one end at a time the big casting was placed in position on the car.

AWARD.—Mr. Henry M. Howe, of Boston, Mass., has been awarded a prize of £100 by the Société d'Encouragement pour l'Industrie Nationale, of Paris, for his treatise on "The Metallurgy of Steel," which was noticed in *Industries*, Vol X., page 112.

LARGE MARBLE COLUMNS.—The Vermont Marble Company, of Rutland, Vt., has recently made six marble columns 19ft. 7in. long, and 2ft. 10in. in diameter. They are each made from one solid piece of marble, turned in a lathe, and are said to be the largest ever turned out in the United States. They are for use in the construction of Whig Hall, Princeton College.

STEEL WIRE.—It is reported that the Washburn and Moen Works, of Worcester, have after many experiments brought out a process whereby steel wire can be made so that its ductility is equal to that of copper wire.

PHILADELPHIA, 5TH JUNE, 1891.

CRUISER "No. 13."—Tenders have been opened by the Navy Department for the construction of the protected cruiser "No 13," for which provision was made by the last Congress. The vessel is to be similar to cruiser "No. 12," and equipped with one 8in., two 6in., and a number of smaller rapid-firing and machine guns. She is designed to make, in an emergency, a speed of 22 knots, so as to enable her to capture or to escape from the pursuit of any vessel now afloat. The vessel is to be fitted with three triple-expansion engines, each driving a separate screw propeller. The tenders received were as follow:—Messrs. Wm. Cramp & Sons, of Philadelphia, £549,000; Bath Iron Works, of Bath, Maine, £538,000; Union Iron Works, of San Francisco, £558,600. The limit of cost fixed for the cruiser by Congress is £550,000, and a bounty of £10,000 for every ¼ knot in excess of 21 knots per hour developed by the cruiser on her trial trip.

IRON AND STEEL WORKERS.—The annual convention of the Amalgamated Association of Iron and Steel Workers has been opened at Pittsburgh. The wage committee has decided to fix the rates for puddling, heating, and rolling, and for catching in bar mills, at the same amount as during the past year—viz., £1 2s. and 2s. 11d. per ton, and five-eighths the product respectively. The outlook for the year is not particularly good, but it is believed that the manufacturers will not attempt a reduction.

RESUMPTION OF WORK AT COLLIERIES.—After being idle for six months the Exeter Colliery, of the Lehigh Valley Coal Company, will resume operations, giving employment to several hundred workmen. The Exeter Colliery is situated at West Pittson, and is one of the largest in the anthracite coal fields. It is thought probable that more of the collieries of this company which are now idle may resume work shortly.

ANOTHER "STANDARD OIL" PURCHASE.—It is announced from Newark, N.J., that the McKirgan Oil Company's property has been transferred to the Standard Oil Company. The property was valued at £40,000.

REDUCTION IN THE PRICE OF ALUMINIUM.—A reduction in the price of aluminium to 2s. 0½d. per pound is announced from Cincinnati. The reduction is on metal produced in unlimited quantities by a Newport aluminium company.

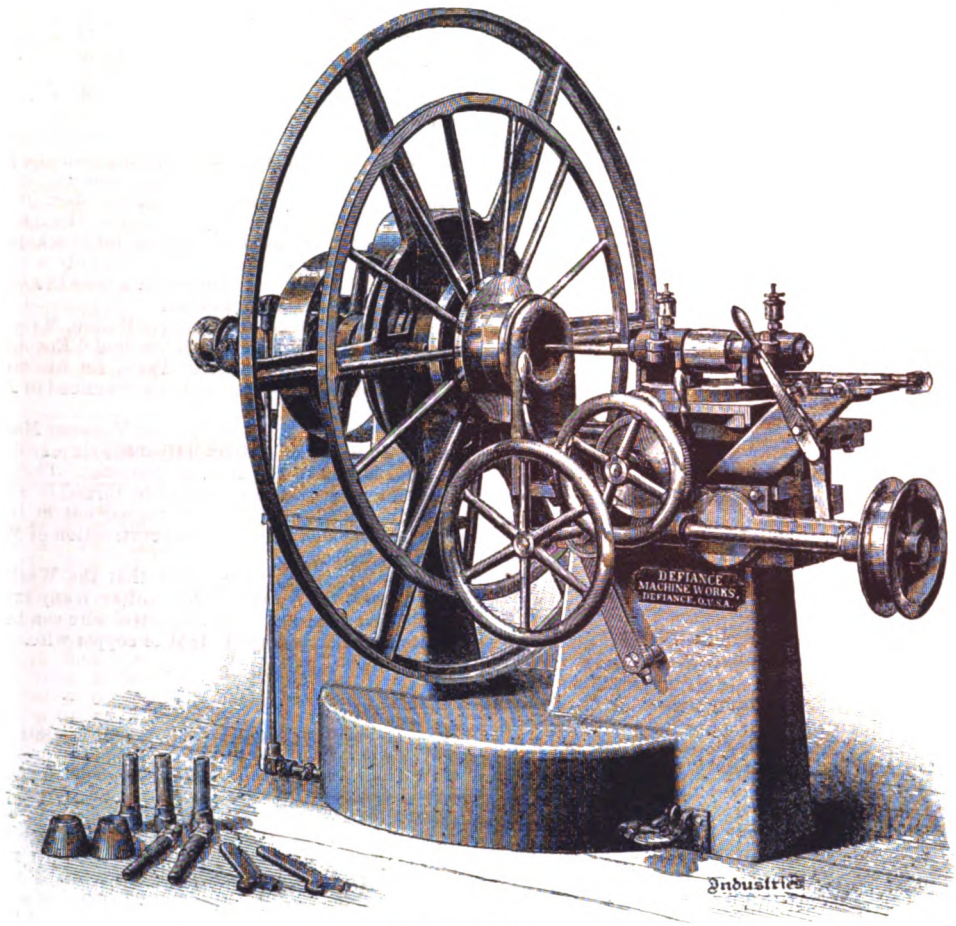
THE GUNS OF THE "VESUVIUS."—From the official report of the test of the guns on the dynamite cruiser "Vesuvius," it appears that these guns were not as unsatisfactory as was at first stated. The report states that the accuracy of fire of the starboard gun was good, and that the middle and port guns could not be criticised, since the valves were not in good working order. The Navy Department has ordered that the Board shall meet and prepare a programme of such further tests as they shall recommend.

PEARL BUTTON MANUFACTORY.—Another new industry which has come into existence here since the passage of the McKinley Act is the manufacture of pearl buttons. Since the decision that pearl blanks are subject to duty as manufactured buttons, there has been a vigorous movement to erect a large button factory in the vicinity of this city. The company proposes to employ about 2,000 hands, and has decided to employ American workmen only.

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AUTOMATIC WHEEL BOXING MACHINE.

CONSTRUCTED BY THE DEFIANCE MACHINE WORKS, DEFIANCE, OHIO, U.S.A.



GENERAL VIEW.

AUTOMATIC WHEEL BOXING MACHINE.

THE accompanying illustration, which is reproduced from our contemporary, the *American Machinist*, represents a new machine made by the Defiance Machine Works, Defiance, Ohio, U.S.A., for the purpose of boring out wooden hubs of wheels for the reception of the sleeve, commonly called the "box." The wheel is centred by a plunger, which is forced forward by a spring, this plunger being hollow and of a conical form internally, so that, as it comes against the end of the hub, the wheel is centred. The felloe is, at the same time, trued sidewise by coming against the radial arms shown, and the wheel is driven by the two revolving padded discs, which bear upon the spokes near the hub, the outer one of these being held in place by pressure brought upon it by a lever, and which runs upon a bearing composed of forty §in. steel balls, to reduce friction. The time occupied in thus chucking the wheel is not over five seconds, and upon the machine being set in motion the wheel is revolved at 200 revolutions a minute, while the cutter, which makes 5,000 revolutions, is automatically fed through the hub on a line which conforms exactly to the outline of the box which is to be fitted. This is secured by the use of a former, which is placed at the back of the slide, by which the cross slide is moved at the proper rate, as the tool advances, to make it follow the desired outline. The feed is automatically thrown out at the completion of the boring. The machine is carefully designed and built, and provided with liberal bearing surfaces, and constitutes, we believe, a new departure in the manner of doing this work, and one which will conduce very much to greater accuracy and rapidity of work, as the appliance is capable of turning out 600 wheels per day. Provision is also made for cupping both ends of the hub at the same time to any size and shape.

NOTES ON PATENT LAW.

VI.

(*Continued from page* 568.)

WE are now in a position to summarise the law as to specifications apart from claiming clauses, and perhaps cannot do so better than by taking a supposititious case and applying the principles already laid down to the preparation of sample specifications (Provisional and Complete).

A sufficiently apt illustration lies ready to hand in James Watt's great invention of the steam engine condenser, which was the subject of much argument and an elaborate judicial decision in the year 1795. One of the judges who gave judgment in that case drew up what he conceived to be a sufficient specification of that invention in the following terms:—"Now the specification of such a discovery seems to consist in nothing more than saying to the constructor of a 'fire engine,' 'for the future condense your steam out of the body of the cylinder, instead of condensing it within it, put something round the cylinder to protect it from the external air and to preserve the heat within it, and keep your piston air tight without water.'" Throwing this substance into the modern and official form, we should obtain something like the following documents:—

PROVISIONAL SPECIFICATION.

Title. Improvements in Steam Engines.

Name and Description of Patentee. I, James Watt, of Glasgow, in the County of Lanark, Engineer, do hereby declare the nature of this invention to be as follows—that is to say, it

Description of the Nature of the Invention. consists in causing the steam which is used in the cylinder for the purpose of propelling the piston to be condensed in a separate vessel, and in preventing as nearly as possible any condensation of such steam from taking place within the cylinder by protecting the outside of the cylinder from contact with the external air or other cold bodies, and putting round it a suitable vessel or covering with this object, and also with the object of reducing the amount of radiation and consequent loss of heat to a minimum, and furthermore, in using as a packing for making the piston steam tight within the cylinder some suitable substance less absorbent of heat than cool water.

JAMES WATT.

Dated this 19th June, 1891.

It will be observed that we have here departed in several particulars from the sketch given by Chief Justice Eyre in his judgment. In the first place, instead of casting the specification into the form of injunctions addressed to a workman, we have thrown it into the literary form of a description of the invention. This the Patent Office prescribes. Then the specification commences with a title which serves to indicate the class of "manufactures" to which the invention relates. This also is a statutory requirement, and it is important that the title should be correct, although it will be observed that it may be expressed in the most comprehensive terms. Pursuing the text, we remark in the next place that the patentee does not here strictly explain the *object* of his improvements. It is very common practice to open with such an explanation—for instance, "The object of my improvements is to economise the fuel consumed in steam engines" would have been a perfectly proper commencement of the above specification; but it is more strictly in accordance with the official form not to do so, and, as we have already remarked, danger lurks in every supernumerary word of a provisional specification. When, however, the invention is an application of well-known principles, and consists in some comparatively small modification of existing mechanism, it is often by no means a supernumerary statement which sets out the purpose of the improvements with some precision. If there is likely to be any difficulty in disentangling the new matter from the old, a statement of that sort may materially assist the interpretation of the claims. But in the present case the improvement was a revolutionary one, and no difficulty in defining the novelty could possibly be apprehended. It is therefore safe, and consequently best, to follow the strict form, and go straight to the nature of the invention without any preliminary discussion of its objects.

The description itself is expressed, it will be observed, in the widest possible terms. The principle of separate condensation is clearly enunciated, and its consequences are followed out to the point of indicating, as by means of a verbal diagram, the nature of the several alterations that will have to be made in the mechanism for the purpose of giving effect to the principle. But there the description stops. Not a word is used that could limit the patentee to any particular mode of effecting these changes, and according to our existing law—which has grown up since James Watt's time—the patentee is entitled during his nine months of provisional protection to work out the details of his invention as so sketched out, and to get the benefit as a patented improvement of any novelty which he may thereafter disclose in his complete specification provided only that it is covered—not necessarily indicated—by the comprehensive language of the provisional specification.

We pass now to the complete specification which may be supposed to be founded on the foregoing provisional. It would be entituled in the same way, and the title would be followed, as in the provisional, by the full name, address, and description of the *applicant*—for by the name applicant the future patentee is known at this stage in the proceedings; the meaning, of course, is applicant for letters patent. These, therefore, need not be set out again, and we shall merely indicate them in the following specimen:—

COMPLETE SPECIFICATION.

Title (*as in provisional*).

I, James Watt (*&c., as in provisional*) do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement—that is to say, it consists (*&c., repeating the provisional specification*). . . . .

The better to make my meaning clear, and by way of illustration, I will proceed to describe a steam engine constructed and worked according to my improvements by the aid of the accompanying drawings, of which

Fig. I. is a front elevation.

Fig. II. is a section through the line 1——1 of Fig. I.

Fig. III. is &c., &c.

(*Here follows a precise description of the drawings*).

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is,

1.

2. &c. (*Claims to be discussed hereafter*).

JAMES WATT.

Dated this day of 1891.

It will be observed that the introductory passage here differs materially from that in the provisional specification, inasmuch as it adds to the undertaking to declare the nature of the invention a further undertaking to describe it particularly and ascertain it, and also to describe in like manner and ascertain "in what manner the same is to be performed." Still the nature of the invention has to be declared, and if the terms of the provisional specification amount to a sufficient declaration of its nature, it is well to incorporate them here. All necessary particularity will be supplied by the description of the drawings, and, therefore, the generality of the language of the provisional specification does not unfit it for this place.

In the description which follows care should, of course, be taken *to exhibit every feature* of the invention. Sometimes it is necessary for this purpose to show two or more modifications of the thing described in general terms. But it is idle to multiply figures and augment the description for the mere purpose of exhibiting *the same feature* under various *forms*. For example, in the supposed case the condenser might be constructed either as a still-worm or as a chamber occupied by baffle plates

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or probably in any one of half a dozen other forms. But nothing would be gained by elaborating the specification in this way. One form of condenser, if effective for the purpose, would exhibit this feature of the invention as well as a hundred; therefore, the other ninety-nine would be mere surplusage. But, on the other hand, the draftsman should be careful to omit no single feature from his detailed description. It matters nothing to what dimensions this principle expands the specification. All necessary drawings and all necessary description must be given to exhibit everything essential to the effective working of the improved parts, and every detail on which the inventor means to rest a claim. Thus, in the given case, not only should the separate condenser be shown, but also the necessary details for working it; not only the steam jacket, but also the mode of keeping it supplied with steam; not only the improved packing for the piston, but also the way of applying it. Of course, these subordinate parts need not necessarily be described with any minuteness. If no claim is to be made to them, and no difficulty is presented in their construction or by their adaptation to the engine, they may be dismissed with a word, but the danger of describing new parts without including in the description old connections would be that of describing inadvertently new parts that could not work. This, if it happened, would destroy the patent irremediably, since no amendment of the specification could be permitted which would have the effect of so materially altering its subject matter.

These hints will probably enable the reader to form a better impression of what is required by way of description than an exemplification would, and, as that could not possibly be of use in any case arising at the present time, it has been omitted here. We pass now to the claims—a subject which must be reserved for our next article.

(To be continued.)

THE SILK ASSOCIATION OF GREAT BRITAIN AND IRELAND.

The third annual dinner of the above Association was held at the Freemasons' Tavern, Great Queen Street, London, W.C., on Wednesday, the 17th inst., and was presided over by Lord Mashamshire (Mr. S. Cunliffe Lister, of Manningham), who has recently been raised to the peerage. There were also present:—Mr. Woodall, M.P.; Sir Philip Cunliffe Owen; Mr. Thomas Wardle, F.C.S., F.G.S., the President; Mr. Piggott, Secretary of the Association, and Mr. Reynolds, Secretary of the Manchester Technical School. The Chairman, in response to the toast of the Houses of Parliament, gave an account of the progress of the silk industry since his connection with it. He explained that after a struggle of several years he managed to produce a machine for combing silk waste, which had hitherto been a practically useless product of the silk industry. This waste he once bought at 8d. per pound, and, after being treated by his machine, it was retailed at the handsome price of 24s. per pound. Mr. Woodall urged that Free Trade principles, which at present appeared to handicap the silk industry of this country, would at length prove beneficial to it. Mr. Reynolds urged very forcibly the claims of technical education, and recommended that all students of spinning and weaving should also take up the study of art. He referred to the efforts made by the German nation as regards technical education, and stated that during a recent visit to a weaving school in Rhenish Prussia he discovered several students from Manchester, who were paying four times the fees paid by the German students for the privilege of studying there.

SHIPBUILDING NOTES.

The last of the three steam hopper barges constructed by Messrs. Wm. Simons & Co., Renfrew, for the Corporation of Preston has been tried on the Clyde with very satisfactory results. The measured mile was run at Skelmorlie, the mean speed obtained being about 10 miles per hour, which is in excess of that contracted for.

On the 6th inst. the Tyne Iron Shipbuilding Company, Ld., of Willington Quay-on-Tyne, launched the steel screw steamer "Cape Comino," which has been built to the order of a local firm. The vessel is of the following dimensions, viz.:—Length, 300ft.; breadth, 38ft. 8in.; depth, 23ft. 2in.; and is to class 100 A1 at Lloyd's. This vessel has water ballast fitted right fore and aft on the cellular system. The engines, which are to be supplied by Messrs. Wigham Richardson & Co., are of the triple-expansion type, having cylinders 23in., 37in., and 62in., by 42in. stroke, and working at a pressure of 160lb.

On the 6th inst. the steamer "Ibex," which has been built by Messrs. Laird for the Great Western Railway Company, was launched from the Birkenhead Ironworks. The vessel is intended to take part with the "Lynx," "Antelope," and "Gazelle," in the service between Weymouth and the Channel Islands. The "Ibex" is a steel twin-screw steamer of 270ft. in length, 32ft. 6in. beam, and 15ft. 6in. depth, and is about 1,380 tons B.M. The machinery, which is being constructed by Messrs. Laird, will consist of two sets of engines of the triple-expansion type, driving twin screws, and designed to propel the vessel at a speed of about 19 knots per hour.

On the 6th inst. the Naval Construction and Armaments Company, Barrow, launched from their shipbuilding yard the steel screw steamer "Indianapolis," for Messrs. James Little & Co., shipowners, Glasgow. Her dimensions are:—Length, 278ft.; breadth, 42ft.; depth, moulded, 21ft.; with a displacement of about 4,800 tons on a loaded draught of 19ft. 3in. She will class 100 A1 at Lloyd's. Water ballast is carried in a cellular double bottom, and the hull is divided into four water-tight compartments. Messrs. Westray, Copeland, & Co., Barrow, will fit the vessel with a set of triple-expansion engines.

On the 8th inst. Sir Raylton Dixon & Co., Middlesbrough, launched from the Cleveland Dockyard the large steel screw steamer "Dictator," which has been built for Messrs. Thos. and Jas. Harrison, Liverpool, of the following dimensions:—Length, over all, 378ft. 6in.; breadth, 45ft.; depth, moulded, 31ft. 3in., with a deadweight capacity of about 6,000 tons. The engines will be fitted by Messrs. T. Richardson & Sons, Hartlepool, with cylinders 24in., 40in., and 61in., by 51in. stroke.

Notices of Meetings.

NEXT WEEK.

Royal Institute of British Architects.—Monday, June 22nd, at 8 p.m. Presentation of the Royal Gold Medal.

Society of Architects.—Tuesday, June 23rd, at 7.30 p.m. Annual general meeting.

Chemical Society.—Thursday, June 25th, at 8 p.m. Extraordinary general meeting.

PRICES CURRENT, 17th June, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
" Angles	5 10 0	.....	6 0 0	"
" Plates	5 12 6	.....	6 2 6	"
Staffordshire Bars	6 10 0	.....	7 0 0	London.
" Angles	6 12 6	.....	7 2 6	"
Crown Sheets	7 0 0	.....	7 10 0	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			7 5 0	"
" Ship and Girder			6 10 0	"

PIG IRON.

Middlesbro' Warrants, No. 3.		41/9	Cash.
Scotch Warrants, m/n		47/9	"
Hematite Warrants, m/n		50/-	"
Stocks in Stores. Scotch	514,969—Dec. for week	867	Tons.
Middlesbro'	132,344—Inc. "	8,920	"
Hematite	137,981—Dec. "	2,165	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	62/-	.....	57/-	f.o.b. Glasgow.
Gartsherrie	58/6	.....	55/-	" "
Langloan	61/-	.....	56/6	" "
Summerlee	58/6	.....	55/-	" "
Glengarnock	60/-	.....	58/-	" "
G.M.B. ex store	48/3	.....	48/3	" "

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/6	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£	s.	d.		£	s.	d.
Spelter:	Ordinary	24	10	0	to	24	15	0
Copper:	British Cakes and Ingots	58	10	0	"	59	10	0
"	Chili Bars, G.O.B.'s	55	15	0	"	56	5	0
"	Other sorts, G.M.B.'s (equal to Chili Bars)	55	15	0	"	56	5	0
"	Manufactured (strong)	66	0	0	"	67	0	0
Lead:	Common Pig	13	7	6	"	13	10	0
"	English Sheet	14	2	6	"	14	5	0
Tin:	Straits	93	5	0	"	93	15	0
"	Australian	94	10	0		.....		
"	English Ingots	97	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues firm. Chili bars have steadily advanced in value during the last few days, current quotations being 12s. 6d. to 15s. higher than in our last report. To-day's prices are £55 15s. to £56 5s. cash, with firm market. Manufactured firm at £66 to £67, "strong."

Tin: Changeable. To-day's market reported firmer.

Lead: Steady, with small business; values unchanged.

Spelter has advanced considerably, owing to improved demand on the Continent. Stocks are very small, and the producers have sold their make for some months, so that prices are likely to advance further.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals lb.	0	0	5¼	to	0	0	6¼
"	" Liquid gal.	0	1	0	—	.....		
"	Citric lb.	0	1	7½	—	.....		
"	Oxalic "	0	0	3½	—	.....		
"	Sulphuric ton	1	15	0	—	.....		
"	Tartaric lb.	0	1	3	—	.....		
Alum:	Lump (powder 10/- ex.) ton	5	12	6	—	.....		
Ammonia:	Carbonate lb.	0	0	3½	—	.....		
"	Muriate (Grey) ton	23	0	0	—	.....		
"	" (White) "	30	0	0	—	.....		
"	Sulphate "	11	0	0	—	11	2	6
"	Liquor lb.	0	0	3	—	.....		
Antimony	ton	75	0	0	—	.....		
Bleaching Powder	"	6	12	6	—	.....		
Bisulphide of Carbon	"	13	0	0	—	.....		
Borax	"	29	0	0	—	.....		
Benzole (90 %)	gal.	0	3	9	—	.....		
" (50/90 %)	"	0	2	9	—	.....		
Copper Sulphate	ton	15	10	0	—	.....		
Copperas	"	2	0	0	—	.....		
Kieserit	"	.....			—	.....		
Lead: Nitrate	"	21	0	0	—	.....		
"	White Sugar "	26	0	0	—	.....		
"	Brown "	19	10	0	—	.....		
Potash:	Bichromate lb.	0	0	3¾	—	.....		
"	Caustic ton	21	10	0	—	.....		
"	Carbonate "	20	0	0	—	.....		
"	Chlorate lb.	0	0	5½	—	.....		
"	Prussiate (Yellow) "	0	0	10½	—	.....		
"	Sulphate (Basis 90 %) ton	4	0	0	—	.....		
Precipitate:	Red lb.	0	3	4	—	.....		
"	White "	0	3	0	—	.....		
Salts:	Epsom Bags ton	3	0	0	—	.....		
	Epsom Casks "	3	15	0	—	.....		
"	Glauber "	1	10	0	—	.....		
Sulphur:	Sublimed Flowers "	10	10	0	—	.....		
"	Recovered "	7	0	0	—	.....		
Soda:	Ash deg.	0	0	1 1/16	—	0	0	1¼
"	Caustic (White 70%) ton	10	17	6	—	.....		
"	" " 60% "	9	12	6	—	.....		
"	" (Cream 60%) "	9	7	6	—	.....		
"	Crystals "	8	2	6	—	8	8	0
"	Bicarbonate "	6	10	0	—	.....		
"	Hyposulphite "	7	5	0	—	.....		
Solvent Naphtha	gal.	0	1	5	—	.....		
Tartar, Cream of	cwt.	4	19	0	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: There is no change in caustic soda or bleaching powder, demand being good and prices steady, but the inquiry for soda ash is rather slower. Crude carbolic is quite neglected. Benzoles also are flat. Creosote is active. Sulphate of ammonia is quoted lower, but little business is being done. Sulphate of copper has receded slightly on spot, but has more attention for forward delivery. There is more inquiry for borax. Sulphur is more plentiful.

OILS.

		£	s.	d.
Cocoanut:	Cochin per ton	34	0	0
"	Ceylon "	29	5	0
Cottonseed	"	20	15	0
Cod	"	24	0	0
Lard	"	34	10	0
Linseed	"	21	17	6
Olive, Spanish	"	45	0	0
Palm, Lagos	"	25	10	0
Rapeseed:	English "	30	10	0
Seal:	Pale "	26	0	0
"	Brown "	.....		
Sperm	"	50	0	0
Whale	"	22	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	.....		
Petroleum:	(Refined) "	0	0	5¾
	Spirit	0	0	7

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HOME INDUSTRIES.

LONDON, 18th June, 1891.

The Money Market.—Money continues cheap and plentiful, the shipment of over a million of gold to Russia making no impression, as it had been fully expected for some time. Gold continues to arrive at the Bank from other quarters in large sums, and thus rates are kept very easy. Despite the cheapness of money, business on the Stock Exchange is on an exceedingly small scale. American railways showed signs of recovering tone and strength, but the weakness of one or two stocks largely held in England, notably Denver Preferred and Louisvilles, owing to rumours of diminished dividends, has deprived this market of its slowly returning vigour. Home railways have fared no better—rather worse, indeed—the returns of those lines which publish periodical net revenue statements being such as to point in the direction of shrunken dividends. Foreign securities continue firm, and South Americans show an improvement. Among miscellaneous shares home breweries have shown a weaker tendency. The mining market looks a trifle better, but business there is still very dull.

The Junior Engineering Society.—On the 30th ult. a large party of members of this Society availed themselves of the opportunity kindly afforded by the locomotive superintendent, Mr. W. Kirtley, for visiting the locomotive, carriage, and waggon works of the London, Chatham, and Dover Railway, Wandsworth Road. They were received and shown over by the manager and other members of the staff, by whom the numerous features of interest were pointed out and fully explained. The boundary wall encloses an area of about 18 acres, and the relative positions of the shops are conveniently arranged with a view to the systematic execution of the work. In the sawmill a very complete plant of modern wood working machinery was shown, for the treatment by sawing, planing, mortising, and tenoning of the rough log for the purpose of making the finished parts of the carriages and waggons, which were subsequently seen in various stages of construction. In the locomotive department, the boiler-makers', coppersmiths', erectors', and smiths' shops; the fitting and machine, and the pattern, wheel, and heavy tool shops were each inspected. The running shed, which is situated immediately outside the works, was also visited. It covers an area of area of 5,906 square yards, and will hold ninety engines. Types of the company's various classes of locomotives were here seen.

The Whitehead Torpedo at the Naval Exhibition.—It has at last been managed to successfully launch the Whitehead torpedo in the lake at the Royal Naval Exhibition. The torpedo is launched from a torpedo tube similar to that used on board a man-of-war, in a depth of 5ft. of water and with a range of about 70 yards. When fully charged, the torpedo contains about 200lb. of gun cotton; it travels at a rate of 30 miles an hour, and at any pre-arranged depth from 10ft. to 17ft. under the surface. The torpedo has, however, been so adjusted that it runs in the lake at the Exhibition without causing injury to the public, the lake, or the machine itself. The torpedo is discharged by a charge of 3oz. of powder, exploded in the rear end of the tube by electricity from the torpedo house. The motive power is compressed air, which is carried at a pressure of 1,500lb. on the square inch. The charge is exploded on coming into contact with any object. A light carried on the nose of the torpedo enables its location to be clearly seen, and so assists in its ultimate recovery. The arrangement on the lake is that the torpedo is discharged in the ordinary way, and runs under the target, where an obstacle is so placed as to cut off the compressed air from the engines, and also to nearly "bring up" the torpedo. A small charge is exploded when the torpedo comes into contact with this obstacle under the target, which represents in a small measure what would happen if the real charge of 200lb. of gun-cotton, 400 times as powerful, was fired.

The Society of Engineers.—On the 17th inst. a visit was paid by the Society of Engineers to the Linde British Refrigeration Company's Ice Works at Lower Shadwell and the City and South London Electric Railway Company's Depot at Stockwell. The ice works at Lower Shadwell, which are said to be the largest in Europe, if not in the world, were completed in 1889, and are capable of producing about 120 tons of ice per day, and of storing about 500 tons of frozen meat.

The Society of Arts.—On the evening of the 17th inst. a conversazione of this Society was held at the South Kensington Museum, among those present being Sir Richard Webster, M.P. (Chairman), Lord Bramwell, Sir. P. Cunliffe Owen, Sir R. Rawlinson, Sir F. Abel, and a large number of distinguished members and guests. During the evening selections of music were played by the bands of the Grenadier Guards and the Scots Guards, and a concert of ancient English music was given in the lecture theatre.

The Sanitary Institute.—An examination for local surveyors was held on the 5th and 6th inst. by the Sanitary Institute. Questions were set in writing on the 5th inst., and a *viva voce* examination took place on the 6th inst. Eleven candidates presented themselves for examination, of whom eight were certified to be competent, as regards their sanitary knowledge, to discharge the duties of local surveyor.

Change of Address.—The office of the Junior Engineering Society has been removed from 64, Reedworth Street, Kennington Road, S.E., to 29, Fentiman Road, Clapham Road, S.W.

MANCHESTER, 18th June, 1891.

Mining Statistics.—The returns furnished by the Inspector of Mines for the North and East Lancashire district show that there were 280 coal and 23 metalliferous mines in the district. The production was 10,607,977 tons of coal, valued at £4,287,000, and 110,570 tons of fireclay, valued at £16,585. There were 55 fatal accidents, of which the majority occurred between 11 a.m. and noon.

Town Gardening.—As a corollary to the researches of the Town Gardening Committee of the Field Naturalists' Society into the condition of the air in Manchester a grant has been made by the Royal Society to assist in making further inquiries. The work is being carried out in connection with the Royal Horticultural Society, who are pursuing the subject in London, and the observations are to include investigations into the bacteriology of the air, with a view to ascertain the conditions of infectious and other diseases. Similar experiments are being made in Leeds and Liverpool.

Paper Makers' Hours.—The movement for shorter hours on the part of the workers in paper mills is extending. It is stated that thirty-four of the Scotch mills have already adopted the proposed stoppage on Saturday at 2 o'clock. Meetings have been held at Darwen, Radcliffe, and Bury, at which the resolution to insist on a stoppage on Saturday at 1 o'clock was unanimously agreed to.

The Half Time Movement.—At a meeting of the Manchester District Union of Elementary Teachers, recently held, a resolution strongly supporting the limitation of the age at which children can be employed was passed. It was insisted on that the much higher standard of efficiency required by the Education Department rendered it absolutely necessary that children should remain all their time at school to a later age.

The Engineering Trades.—There are a number of indications in some of the departments of engineering of a waning trade. Orders are more difficult to get, and prices are being complained of. At the same time, there is nothing acute in the situation, as old contracts continue to occupy the various works to a fair extent. In the locomotive trade signs of falling off are apparent, and the tool trade is by no means so busy as a few months ago. Cotton machinists, however, are still fully and actively engaged, and in this department there is still new business to be had. Messrs. W. H. Bailey & Co., Ld., are very busy in their pump department, especially in the department devoted to a pump specially constructed for pumping out deep mines. They have also had a large order for testers of various kinds from India. One or two of the machinery export houses are getting some good contracts for machinery, but, generally speaking, there is considerably less activity than formerly. The contract for the shafting, rope pulleys, hangers, pedestals, pulleys, gearing, and other fittings for the new mills for the Fustian Cutting Machine Company, Ld., of Ordsal Mills, Manchester, has been secured by Messrs. Geo. Richards & Co., Ld., Broadheath, near Manchester.

The Linen and Jute Trades.—The condition of trade both in the home and shipping branches continues to be most unsatisfactory. As an example of the difficulties against which merchants have to contend it may be mentioned that the Brazilian trade is affected adversely by the action of the Government in insisting upon duties being paid in gold. Importers have protested, but in vain, and, according to advices just received here, they now threaten to abstain from withdrawing goods from the custom-houses until the obnoxious order is rescinded. The rate of exchange is adverse to business with South America. In the home trade special efforts have been made to diminish the amount of stocks this week by means of clearing and other sales. The amount of goods in the hands of retailers is said to be above the average, but warehousemen are slightly better off in this respect. Under existing conditions, it is not easy to see how employment can be found for so many men as were at work twelve months ago. Prices, however, remain firm in all branches, and the situation is strengthened by the fact that French spinners maintain a very firm attitude when quotations are asked for delivery to English buyers. Trade with the United States has fallen off. In handkerchiefs there has not been such a large demand here for machine embroidered descriptions, which are being turned out by St. Gall houses in extensive quantities, but in Glasgow and in New York they are said to meet with a good sale, to the injury of the Irish hand embroiderers. Irish firms can only escape the threatened danger by resorting more largely to the use of the Swiss embroidery machine.

GLASGOW, 18th June, 1891.

Pig Iron.—The dealing in pig iron during the past few days has been very small. The price is thus purely nominal, and any considerable operation on either side of the account would necessarily seriously affect it in one way or in the other.

Engineering.—A new rotary engine has been brought out by Mr. A. F. G. Brown, of Swindridgemuir, Dalry, Ayrshire. The engine has been made by Messrs. John Lang & Sons, of Johnstone, and it is claimed that it is more economical than other engines of this type already in the market. The steam inlet valves of the cylinder bear tightly against the piston, the cavities in which are so adjusted that the valves are opened by the pressure of steam behind them at the proper moment for the admission of steam, while the exhaust effects the automatic closing of the valves. The cylinder is supplied with steam twice during each revolution. The diameter of the cylinder employed in the original engine is 10¼in. by 8½in. A series of indicator diagrams was taken by the McInnes indicator, and it is said that this is the first time the indicator has been used to indicate a rotary engine. The power indicated was 29 h.p., with a pressure in cylinder of 80lb. per square inch. The tests were made by Professor Jamieson, of the Glasgow and West of Scotland Technical College.

British Association in 1892.—The British Association meeting in Edinburgh, in 1892, will be presided over by Sir Archibald Geikie, the vice-presidents being Lord Provost Boyd, the Marquis of Lothian, Earl Rosebery, Lord Kingsburgh, Principal Sir William Muir, and Sir Douglas Maclagan. The meeting will begin on September 29th, 1892.

Scottish Railways.—On the 16th inst. the Select Committee of the House of Commons found the preamble proved of the Caledonian, Lanarkshire, and Dumbartonshire Railway Bill. The new railway will start from Stobcross, Glasgow, with a junction to the line from Buchanan, and will pass near to the existing North British Railway by Clydebank and Bowling to Dumbarton. The present Vale of Leven line runs from Dumbarton on the west side of the River Leven. The new line will go on the east side by Jamestown and Cartocharan, terminating on the shore of Loch Lomond, near the River Endrick. The district at the extremity of the line is not at present served by a railway. The practical passing of the measure will bring about competition between the Caledonian Railway and the North British Railway for the traffic in the Vale of Leven. In finding the preamble proved, the Committee imposed upon the Caledonian Company the obligation to facilitate the extension of the Yoker line to the North British line at Dalmuir, and to subscribe to the capital of the West Highland Railway to the extent of £40,000. Besides invading Dumbartonshire, which has hitherto been closed to its operations, the Caledonian Railway is attempting to secure a footing in Fifeshire. The Bill is still before the Committee.

Security Company.—The first public safe was opened in Glasgow on the 16th inst. by the Security Company. The safe is situated on the ground floor and basement of the Stock Exchange Buildings in Buchanan Street.

(From our own Correspondents.)

LIVERPOOL, 17th June, 1891.

The Mersey Railway.—Although the Prince of Wales travelled in a through carriage from Chester to James Street Station in Liverpool to inaugurate the opening of the tunnel six years ago, it was only on the 15th inst. that this through connection was opened to the public, and a regular service of trains initiated. After great opposition, and in face of enormous difficulties, the directors have successfully pushed forward the enterprise, and by this new connection with the main line of the Joint Railways their financial troubles will most probably be swept away. The previous development of the railway system and connections to the various favourite resorts in the Wirral peninsula has made the place more prosperous, and building operations are increasing very rapidly. As an inducement to people to live on the Cheshire side of the Mersey, the company propose to issue contract tickets at a specially low rate; these, no doubt, will be taken advantage of, and the Woodside Ferry receipts will suffer a still further reduction in consequence. The extension of the railway to the Cheshire lines system is approaching completion.

The Liverpool Water Supply.—The shield used in the construction of the tunnel under the Mersey was, last week, about 95ft. from the Lancashire side, a distance of 10ft. 3in. having been driven in one week. A horizontal air-lock will be in use this week, when it is expected that more rapid progress will be made. A pipe between Norton and the Mersey has been found to be split, and this has detained the washing out of the temporary pipes in preparation for the continuous supply.

Liverpool Engineering Society.—The following summer excursions have been arranged for members of this Society:—On the 27th inst. the Thirlmere Aqueduct will be visited, on August 3rd the Dore and Chinley Railway (Midland Railway, Derbyshire), and on September 12th the Norton Water Tower.

LEEDS, 17th June, 1891.

The Iron and Steel Trades.—There is no increase of business in the iron trade. The majority of makers continue to be short of orders, and the mills are working irregularly. Although prospects appear to be very uncertain, there is little chance of any reduction in prices. The price of fuel remains firm, and unless there is some reduction in price in this direction, it will be impossible for iron manufacturers to lower their prices. The activity is perhaps greater in the engineering branch than in the iron industry, engineers and makers of heavy machinery being still well supplied with orders. There is a hope that the present low prices may stimulate consumption, and lead to a better state of things. There is a fairly good inquiry for steel, although prices are reported to be not very remunerative, and manufacture of girders at the Leeds Steel Works is now in full operation.

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THE COAL TRADE.—Considering the season, a good business is being done in coal for domestic use. There is a fair demand for locomotive and gas coal. Tenders received by the gas committee of the Leeds Corporation for a year's supply of coal show a reduction on the prices paid by the committee last year.

SHEFFIELD, 17TH JUNE 1891.

A NEW STEEL PROCESS.—On the 12th inst. the experimental open-hearth furnace at the Technical School melted its first charge, which was successfully teamed in the presence of many persons interested in steel manufacture. The plant throughout has been designed by Mr. B. H. Thwaite, C.E., but has been modified in some respects to meet the requirements of Professor Arnold, of the above-named institution. The designers hope to revolutionise modern methods of making high-class tool steels by removing all impurities from Swedish pig iron and retaining the precise amount of carbon necessary. The process, if successful, will certainly have an important bearing upon the future of the open-hearth process, and may transfer a considerable amount of our trade with Sweden to Sheffield firms.

LOCAL COMPANIES.—Messrs. John Brown & Co., Ld., of the Atlas Works, have issued a balance sheet for the year ending March 31st last, in which the directors say that the iron and steel trades are not in such a prosperous state as when they made up their last report, although their various departments have worked satisfactorily during the past year. The gross profit is £190,556 15s. 8d., or, after deducting interest on debentures and loans, £174,914 1s. A dividend at the rate of 10 per cent. per annum is declared; £88,000 is added to the reserve fund, which will thus amount to £200,000; and £21,461 15s. 8d. has been carried forward to next year's account. The retiring directors are Mr. John D. Ellis and Mr. H. D. Pochin.

GENERAL TRADE. Orders for railway material keep manufacturers well employed, although the pressure of work has somewhat diminished. Rolling mills and forges would be glad to have more orders. Engineers are only moderately well employed, as they depend solely upon local orders.

FUEL.—Fuel of all classes is still in good demand, although there is a decided falling off in household coal. Manufacturers expect soon to be able to buy engine slack for less than 8s. per ton.

LEICESTER, 17TH JUNE, 1891.

WOOL SPINNING AND YARN TRADES.—There is considerable lack of confidence prevailing in the local wool market, but prices are well maintained. There is a general feeling that the new clip when it comes into the market will not very materially affect prices, as the stocks of old wool are very limited and in few hands. It is believed that the stocks on hand are less than the average of many years past. Choice lots of short wool are wanted and skin wools sell fairly well. Good half hog and ewe wool of strong staple make are quoted at 23s to 24s. per tod. Choice lots, including good proportions of Shropshires, are at 24s. 6d. to 26s. 6d. per tod. Spinners are fairly well employed, but find competition very keen, and prices obtainable are not in proportion to the value of the raw material. Lambswool fancy and knitting yarns are in better request for prompt delivery. Cashmeres are moderate and cotton yarns flat.

HOSIERY TRADE.—There is a slight improvement in this trade, but the amount of business is under the average. More inquiries are being made for light fabrics. In heavy and medium goods there is more activity, and production is being enlarged to meet the anticipated demand.

BOOT AND SHOE TRADE.—This important industry is still in a very depressed state. Very few firms are busy, and the aggregate output is much under the average. There does not appear to be any prospect of immediate improvement. This quietness of trade seriously affects some of the smaller firms.

SWANSEA, 17TH JUNE, 1891.

LARGE VENTILATING FAN.—The Union Engineering Company, of Manchester, have built, to the order of the Cambrian Navigation Company, for their No. 3 pit at Clydach Vale, a Schiele's fan, which is stated to be the largest ever constructed, and is capable of giving out under favourable conditions half a million cubic feet of air per minute. The pit itself is also of exceptional dimensions, being 21ft. in diameter within the walling, and is the largest in South Wales. These collieries, which employ about 1,500 persons, are lighted by electricity both on the surface and underground.

INCREASED USE OF SAFETY LAMPS.—Mr. I. S. Martin, H.M. Inspector of Mines for the South-Western district, reports that the number of safety lamps used in his section now exceeds 9,400, whereas in 1875 there were only 1,755 employed.

CANNEL COAL IN FLINTSHIRE.—It is announced that Mr. Hopwood, of Pontybodkin, has made a valuable discovery of coal in Flintshire. He was working a small colliery when he struck a fine seam of cannel, which he has proved by borings to exist in great thickness under an area of about three miles. It is proposed to sink two shafts as soon as possible.

NOTICES AT STEEL WORKS.—In consequence of the falling off of orders for bars, owing to the impending stop month at the tinplate works, notices have been posted up at the Rhymney Iron Works to terminate the present contracts with the workmen, and to work on the "day to day" principle. It is also rumoured that the only blast furnace now working on the Rhymney side of the works will be shortly stopped, which will cause about 150 men to be out of work. Notices have also been posted up at the Briton Ferry Steel Works that all contracts will terminate on the 27th inst. The Elba Steel Works at Gowerton have already closed. A strike is now taking place at a tinplate works which is extraordinary under existing circumstances. The workmen at the Fairwood Tinplate Works, rather than work on the "day to day" system, have preferred to add another fortnight to their enforced idleness. This strike makes it evident that the men, as well as the masters, have been reaping great advantage from the recent heavy demand for tinplates.

CARDIFF, 17TH JUNE, 1891.

THE COAL MARKET.—The steam coal market continues firm, and there is no sign of weakness in prices. Best quality is quoted at 15s. 3d. to 15s. 6d. per ton; second, 14s. to 14s. 9d.; third, 13s. 3d. to 13s. 9d.; fourth, 12s. 9d. to 13s. Household sorts are dull. Coke finds a limited market at last week's prices. The iron and steel trades show no animation. Steel bars have fallen in price on account of the stoppage in the tinplate works. Rubio ore, first quality, realises 13s. per ton c.i.f. Cardiff and Newport, 50 per cent.

CARDIFF PHOTOGRAPHIC SOCIETY.—An International Photographic Exhibition, including photographic apparatus and appliances, will be held in the Public Hall, Cardiff, from 12th to 26th August next, during the visit of the British Association. All exhibits must be delivered at the Public Hall, Cardiff, on or before August 7th.

BARROW-IN-FURNESS, 17TH JUNE, 1891.

HEMATITE.—The market is again quiet in hematite this week. Orders are coming to hand very slowly from both home and foreign sources. The gradual reduction which has taken place in stocks week by week for a considerable time has been checked, and while last week stocks remained steady, this week they have been increased by 31 tons, and now amount to 139,574 tons. Prices have fluctuated somewhat during the week, and are now at 50s. per ton net cash for warrant iron, while makers are asking 51s. for Bessemer mixed numbers net f.o.b. There are 41 furnaces in blast, and 36 standing idle. Last year 45 furnaces were in blast.

STEEL.—There is a quieter business in the steel trade. The Siemens plate mills at the Barrow Steel Works have been stopped pending the laying down of new and powerful engines and the erection of a new light mill. In the West Cumberland district the steel works are indifferently employed. The West Cumberland works at Workington and the Moss Bay Steel Works, are short of orders, and the steel works of Messrs. Hampton & Facer, at Maryport, are doing only a small business. The Bessemer trade is not brisk, and makers are depending only on orders received some time ago.

IRON ORE.—Orders for iron ore are comparatively few, and business is slacker. Iron ore is quoted at 9s. 6d. to 9s. 9d. per ton net at mines. A cargo of iron ore is being shipped this week to New York.

SALT AND COAL.—It has been determined to develop on a large scale the recent discovery of salt on Walney Island, which is situated within the borough of Barrow. The salt is found within an area of about 10 square miles with a depth of the very best salt varying from 97ft. to 450ft. within 100 yards of the surface. It is proposed to raise every year and manufacture 150,000 tons of salt at Barrow, and the supply is considered by experts to be inexhaustible. In connection with this discovery of salt Mr. Russell is of opinion that a valuable bed of coal will be found underlying the salt deposit at a depth that will not be unworkable. A find of coal would be of immense importance to the industries of Barrow.

TUBULAR FRAME WAGGONS.—This week the Tubular Frame Waggon Company, Barrow, has despatched or shipped new waggons to the Waterford and Limerick, Great Northern of Ireland, Southern Railway of Spain, Aranco Railway of Chili, and the Great Northern Railway (England). The company have also under construction waggons for the Gas Company of Brussels, the German State Railways and the Italian Railways, the Tralee-Dingle Railways, and the Furness Railways. They are also preparing drawings for other railways, on which work will be commenced at once. The prospects of tubular frame waggon building at Barrow are good, and already orders are in hand to employ the works for over two years.

MIDDLESBROUGH, 17TH JUNE, 1891.

PIG IRON.—There was a large attendance at the weekly market on 'Change yesterday, but business was very bad. Indeed, most of the small quantity of iron that was sold was for sending into the warrant stores, a better price being obtainable for warrants than for makers' iron. The general quotations for makers' No. 3 Cleveland pig was 40s. per ton, but buyers generally would not pay more than 39s. 9d., and offered 39s. for August delivery. No. 1 was quoted at 42s. 6d., No. 4 foundry at 39s., and No. 4 forge at 38s. Local hematite is 51s. per ton for mixed numbers. For Cleveland warrants 41s. cash has been paid, and sellers are asking from 41s. 1½d. to 41s. 3d. per ton. A large quantity of iron has been sent into the public stores during the last few days, and the stock held by Messrs. Connal & Co. up to the 15th inst. amounted to 131,697 tons, an increase for the month of 6,128 tons.

MANUFACTURED IRON AND STEEL.—In the finished iron and steel trades prices are unchanged, and manufacturers say that they are very unprofitable. It is probable that at the present time further reductions in quotations would no more tempt consumers than the present rates do, and the loss would only be increased. Quotations are:—Common bars. £5 12s. 6d.; iron angles, £5 5s.; steel angles, £5 15s.; steel plates, £6; iron plates, £5 10s.; all less the usual 2½ per cent. for cash on the 10th of the month and f.o t. at works. Heavy steel rails are £4 10s., and cast iron chairs £3 per ton, both net, at works.

SHIPMENTS.—Shipments are falling off, and for last week only amounted to 14,840 tons, as against 21,580 for the week ending the 6th inst. The total shipments for the month up to the 15th inst. were 35,700 tons, as compared with 43,349 tons during the same period of May. Of the iron shipped this month 20,770 tons went to Scotland, 3,380 to England and Wales, and 11,550 tons to foreign ports.

ENGINEERING.—The first annual report of Messrs. Head, Wrightson, & Co., Teesdale Iron Works, South Stockton, which has just been issued, is very sasisfactory. The gross profit for the year ending April 30th was £33,531 19s. 5d. After providing for the payment of the directors and management, interest on debentures, and interest on purchase money to vendors, a dividend of 7½ per cent. per annum is recommended.

NEWCASTLE, 17TH JUNE, 1891.

THE FITTERS AND PLUMBERS' DISPUTE.—A conference of representatives from both these sections of workmen and employers connected with the larger engineering works in the district was held at the office of the Employers' Association on the 15th inst., when the questions in dispute were fully discussed, but no settlement having been arrived at, the meeting was adjourned till to-day. The matter is causing a good deal of anxiety in business circles, as, unless some basis of settlement can be found, a lock-out affecting many thousands of men must necessarily take place. Already one-fourth of the society men have been discharged from the various works, and an equal number have received notices of discharge for the 20th inst. The employers state that their object in discharging the men is to afford what aid they can to Messrs. Palmer's Shipbuilding and Iron Company, whose works have for several weeks past been practically stopped through the dispute. The employers having committed themselves to this policy, they will probably carry it out as far as may be necessary. The refusal of the engineers to allow the dispute at Messrs. Palmer's to be submitted to arbitration is the cause of the present crisis, which, so far as existing indications serve to show, can only be ended by their withdrawing from so untenable a position.

SALE OF A STEAMER.—The fine steamer "Port Augusta," which has formed one of the "Port" line of steamers, belonging to Messrs. Milburn, of London and Newcastle, has been sold to the Russian Steam Navigation Company, of Odessa.

ENGINEERING.—In the marine engineering establishments business is just now in a somewhat disorganised state, owing to the dispute respecting the apportionment of work. The locomotive works, however, are well employed, and at Messrs. Stephenson's establishment there is much activity. Messrs. T. Toward & Co., of the St. Lawrence Iron Works, have just carried out an extension of their establishment, which is expected to double the productive capacity. The firm are at present very fully occupied with the manufacture of tanks and boilers of a light description. There is now on view at the show rooms of Messrs. Allen & Robson, Dean Street, a new tube stopper, which is specially designed for stopping leaky tubes of the "Serve" type. The new stopper is said to answer its purpose admirably.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending the 13th inst. amounted to 111,890 tons, being a decrease as compared with the corresponding week last year of 7,313 tons. It is understood that the new coal staiths will be ready for use by the end of July.

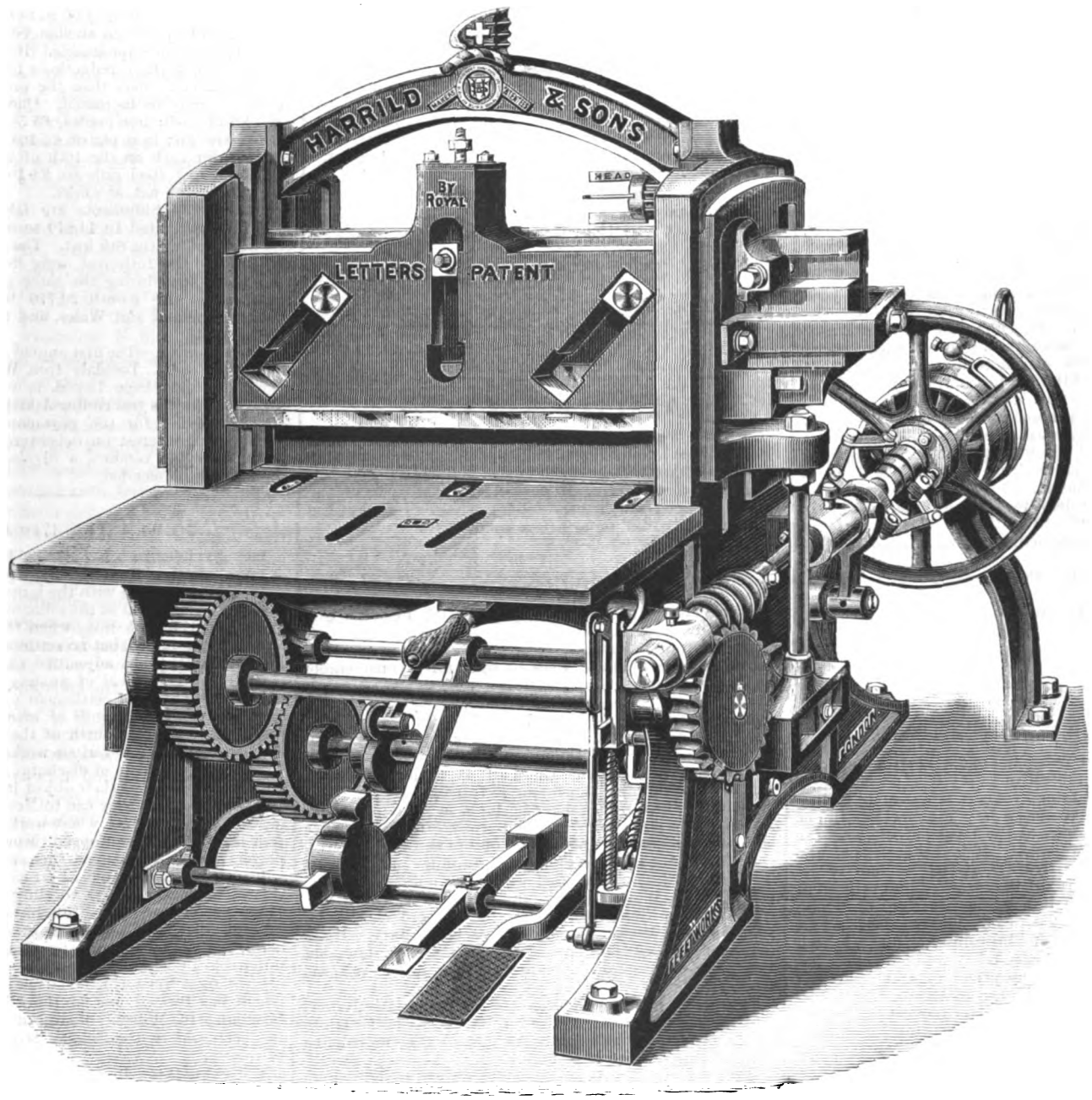
DUNDEE, 17TH JUNE, 1891.

JUTE AND FLAX TRADES.—The prospects of the new jute crop are said to have suffered from a too copious rainfall, but the reports with reference to the crop do not appear to have affected the market. There is little business in new jute, and the prices of the old crop are adverse to sellers. Jute yarns are very firm, but transactions are limited, as the demand for fabrics is very small, and manufacturers find a difficulty in selling at remunerative prices. There is little demand for flax, either on spot or contract, and business is only for immediate wants. Flax yarns are quiet, and there is less business in linen, both on home and foreign account, but makers are still well employed.

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IMPROVED PAPER CUTTING MACHINE.

CONSTRUCTED BY MESSRS. HARRILD & SONS, ENGINEERS, 25, FARRINGDON STREET, LONDON, E.C.



GENERAL VIEW.

NEW STEEL MAKING PROCESS.

AN interesting industrial event took place on the 12th inst. at the Sheffield Technical School, which was witnessed by members of the School Committee, students, and other gentlemen interested in steel manufacture. The company met for the purpose of witnessing the working of a new steel process due to Professor Arnold. The Professor conducted the operations, and the chief feature of the occasion was the getting out of the first heat from the new experimental open-hearth furnace which has just been completed at the school. The operation, according to our Sheffield correspondent, was very successful, the ingots teamed being of a composition never previously heard of in the history of steel. This process, which is the outcome of the researches recently made by Professor Arnold, opens up possibilities for the cheap and rapid manufacture of high-class steels which are likely to bring about a revolution in the present processes of manufacture. The process consists in practically removing the whole of the impurities from Swedish pig iron, with the exception of the exact proportion of carbon required for a given purpose, thus obtaining the ideal carbon and iron steel, homogeneous in structure and absolutely free from blowholes, these results being obtained without the presence of more than mere traces of manganese and silicon, and also without the use of iron ore. The average time occupied by this process in the conversion of a ton of pig iron into the highest class of steel yet made will be about three hours, the fuel used consisting of about half a ton of rough slack. The new furnace, together with the general plant, was designed to Professor Arnold's specifications by Mr. B. H. Thwaite, C.E., of Liverpool, and is intended to produce three tons of steel per day of 24 hours. The cost of the really necessary portions of this plant would, we understand, be no more than that of an ordinary twelve-hole crucible furnace. Much can hardly be said at present as to the capabilities of the process, but it is anticipated that the range of the metal produced will vary from what would be considered wrought iron to the hardest tool steel.

IMPROVED PAPER CUTTING MACHINE.

THE illustration given above represents the "Self-Clamp Trimming Machine" which has recently been introduced by Messrs. Harrild & Sons, 25, Farringdon Street, London, E.C. This machine possesses several important improvements over the ordinary guillotine machines. As we described at some length the various improvements which have been made in this machine in our "Abstract of British Specifications" of last week, it will only be necessary to refer briefly to the general features of the appliance. We have had an opportunity of witnessing the working of the machine, and can testify to the successful manner in which it carries out the various operations. The principal improvement embodied in it consists of an ingenious method of imparting the up-and-down motion to the knife beam with the object of doing away with counterbalance weights. These are usually adopted to prevent the knife frame and beam descending of their own weight when the machine is disconnected from the driving power or the brake has been applied. This is effected, in this case, by means of worm and spur gearing giving motion to slide blocks which move in vertical guides in the side frames of the machine. These slide blocks are in turn connected by rods to upper slides carrying the knife frame and pressure beam. The pressure beam moves in vertical guides, and the knife frame during the lower portion of its stroke moves in the inclined guides shown in the pressure beam, so that, by its oblique movement, the knife acts upon the paper with a drawing cut.

The clutch mechanism on the first motion shaft for stopping and starting purposes consists of a split clutch on the shaft, having projecting bosses, which enter corresponding holes in the fly-wheel, causing the wheel and clutch to rotate together. The clutch has flanges tapped to receive quick-threaded screw bolts, which, when given a slight turn by means of toggle levers connecting them with a sleeve on the shaft, cause the clutch to grip the shaft, the whole mechanism being rotated together. The knife is capable of withdrawal from the frame at the sides of the machine, instead of having to be lifted off at the front, as in the old machines.

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Advertisements intended for insertion in the current week's issue should reach our London Offices not later than the afternoon mail delivery on Thursday. Scale of charges for displayed advertisements on cover and inside pages will be forwarded on application. Orders for single advertisements must be accompanied by payment in order to ensure insertion, the charge for which is 2s. 6d. for the first four lines or under, and 8d. for each additional line. Situation advertisements (Vacant or Wanted) 1s. for two lines or under, and 6d. for each additional line—which averages eight words. While all practical regularity in the insertion of serial advertisements will be observed, it can only be absolutely guaranteed in the case of those ordered to appear weekly.

As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 389, Strand, London, W.C.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 19TH JUNE, 1891.

THE GREAT SIBERIAN RAILWAY.

WE have several times given what information we could with regard to the proposal to construct a railway across Siberia, but hitherto the matter has been, to a very great extent, a matter of speculation. It has now, however, passed, not only into the region of practical politics, but also into that of practical engineering. That the immediate, and, indeed, the main reason for the construction of the line at the present time is a political one cannot, of course, be denied, and while it is no part of our province to discuss politics in a party sense, still, when any political action affects industrial and commercial interests, we feel it to be our duty to consider it as regards those interests. The construction of a line of railway across an immense country like that of Siberia is certain to have most important effects on commerce and industry, not only as regards that country, but also as regards neighbouring countries and those which carry on commerce with them.

The first sod of the new railway was cut by the heir to the Russian throne at the end of last month, and the official *Gazette* justly places great emphasis on the importance of the event. That organ mentions, as if it were a matter of national pride, that the line is to be made at the cost of the Imperial Exchequer. When the scheme was first proposed it was suggested that foreign financiers might advance the money, and the Russian directors would remit them their dividends. But men who have money to lend like to have some reasonable expectation that a dividend will be paid, and as the traffic along the proposed line is likely to be very limited for some years the suggestion did not meet with approval. Whether the Russian Minister of Finance has duly considered the extent of the responsibility he has assumed we do not know. Notwithstanding the improvement which has taken place during recent years in the revenues of the Russian Empire, they are not yet in a position to bear the burden lightly. That it will be no light burden if the present intentions are carried out will be evident when it is stated that the Government has resolved to push forward the work with all possible speed, so that the line may be open for traffic in 1895. We are afraid that the engineering difficulties were not fully allowed for when this estimate was formed. We understand that there are no parts of the line which would offer any difficulties under ordinary circumstances. But when it is remembered that the line will traverse an enormous extent of unpeopled country, and that local assistance, either in the way of construction or the supply of materials, will be very limited, we see at once that the expenditure must necessarily be very large. The Russian Government is, however, evidently in earnest in the matter, for they have decided that all the money shown in this year's Budget for works of this class shall be devoted to it, and all other public works and railways are to be left to private enterprise. The energy which is being displayed by the Russians in the construction of the Siberian line will probably give a great impetus to railway construction in China. The Chinese have never hesitated to spend money for purposes of defence, and, in fact, almost all the money they have spent on Western appliances or institutions has been either directly or indirectly devoted to this purpose. We understand that already a railway from Pekin to the Amoor has been surveyed by English engineers, with the object of enabling China to defend the province of Manchuria, and, if necessary, to act in the aggressive should her interests be menaced. On the other hand, the Russian Foreign Minister in some of his despatches has pointed out the immense importance of the Siberian line in the event of a collision either with China or any of the Western Powers, for the line is to be in connection with Vladivostock, which is to be converted into a strong fortress and naval port, but which, in the meantime, is very much at the mercy of any European Power. The construction of the line has been estimated at thirty-five million pounds sterling, and it is quite evident that the interest on this amount, and what is required for maintenance and management, will not be met by revenue, and the deficiency must be met by subsidy. This, however, will not be all loss, for there must result from the construction of the line a very considerable saving in the expenses connected with the government of Siberia. What we ourselves are chiefly interested in is the effects which the line will have on commerce and industry. There can be little doubt that when it is completed it will revolutionise the tea trade with China, and that almost all the tea will come overland. Even as it is, all the best tea comes by caravans, as the sea voyage spoils it, and what is now true of the highest qualities will then be true of all. Some of those who have been doing all they can to promote the construction of the line have described in an enthusiastic manner its brilliant future, and have expressed the opinion that it will result in the creation of a large overland traffic with China and Japan, especially in those goods which are valuable, but not heavy and bulky. They even look forward to depriving England and France of the greater portion of the Eastern carrying trade. That may come in the distant future, but, even if that should be the case, the change will be gradual, and we shall have ample time to suit ourselves to the altered conditions.

The most important industrial result of the construction of the line will be the development of the resources of Siberia, and the impetus which must thereby be given to China. If we can conceive the resources of these countries being fully utilised we may form some idea of what effect such an advance would have on the industrial future of the world. Some who know the resources of China, and the intellectual and physical powers of the Chinese, have expressed the opinion that the future centre of the industrial world will be much nearer Pekin than London. Certainly if America continues to make the progress she has done during recent years, and Russia and China follow in her footsteps, we shall have a very strong argument for an Imperial Federation of all the possessions of Britain, and for a free exchange of all their productions and manufactures. The immediate results of the construction of this line on Siberian prospects will be very considerable. Its vast mineral resources will be developed, and especially its gold mining industry. Eastern and Central Siberia have alone in fifty-four years given to Russia about £120,000,000 worth of gold, while the Ural and Western Siberia have furnished an even greater quantity. With improved machinery and appliances

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a much greater proportion of gold might have been extracted from the ore, and with greater facilities for transport the number of mines will be very much increased. The other mineral resources are also believed to be very great, but in regard to these little definite information is as yet forthcoming. There are immense tracks in Siberia capable of development for the purposes of agriculture and cattle breeding, which would not only be able to supply food to the increased population which is certain to be the result of the construction of the line, but also to allow a large quantity to be exported to other countries. This may come in good time, for it is believed by many that in a very few years the United States of America will require to import food to supply its increasing population. Thus another remarkable instance of the change of trade and commerce with changed conditions would be afforded. We have briefly indicated some of the possibilities resulting from the construction of the Siberian Railway, and may express a hope that it will require to be used only for the development of trade and commerce, and never for the purposes of war.

THE NAVAL DEFENCE ACT.

The article by Lord Brassey in the *New Review* gives an interesting and reliable summary of the naval force of Great Britain, assuming the completion of the seventy vessels ordered to be built under the Naval Defence Act of 1889. The conclusion at which Lord Brassey arrives is, that the additions to the Navy under this Act will greatly raise the position of Great Britain as a naval Power. It would indeed be rather deplorable if this were not the result of the expenditure of £21,500,000 in addition to the normal outlay upon the Navy. The new force, however, as yet exists largely on paper, for before beginning to deal with the programme of Lord George Hamilton, the dockyards have been busying themselves in completing ships already in progress before the Naval Defence Act was passed. Most of these vessels are now completed, and although none of the new first-class battle-ships will be ready for commission for a long time to come, eighteen second-class cruisers of the "Apollo" type, 3,400 tons, and four second-class cruisers of the "Pallas" type, 2,575 tons, are expected to be passed into the first reserve in 1891-92. Besides the eight first-class battle-ships, each of 14,150 tons, of which the "Royal Sovereign" is the type, including the first-class protected cruisers, each of 7,350 tons, of the type of the "Royal Arthur," there are forty vessels on the "Hamilton programme" which fall to be added to the Navy during the next few years. Lord Brassey quotes from the speech of M. Gerville-Reache, the reporter of the French Budget Committee, by way of summarising the position when those additions are made to the British Navy and when the other contemtemporary accessions are made to foreign navies. M. Gerville-Reache reports that in 1895 the following will be the strength of the navies of France and Great Britain as compared with those of the chief European political combination:—

Relative Strength of European Navies

Class of Vessels.	Ironclads over 10,000 Tons.	Ironclads under 10,000 Tons.	Coast-guard Ships and Plated Gunboats.	Plated Cruisers over 4,000 Tons.	Plated Cruisers between 2,000 and 4,000 Tons.	Despatch Boats and Small Rapid Cruisers.	Counter Torpedo Boats.	Torpedo Boats.	Torpedo Gunboats.	Cruisers of Old Type.	Total Ships Fit for Active Service.
Great Britain	22	32	15	31	51	36	44	156	3	15	402
France	13	20	22	11	5	13	13	187	none	16	299
Triple Alliance ...	17	30	29	13	17	18	39	372	7	24	556

It must be noted that the official expression "fit for active service" is very elastic, and that the numerical statement relating to ships of war is apt to be misleading for several reasons. In the class of ironclads over 10,000 tons, for example, M. Gerville-Reache's number for the British Navy includes three obsolete ships, the "Agincourt," the "Minotaur," and the "Northumberland," while almost all of the thirteen French ironclads are of the most modern construction. The French Navy has been increasing rapidly, and probably the statement is designed partly for Parliamentary purposes, in order to show that further increase is necessary. Especially in torpedo boats, the French are evidently determined to keep the prominent position they have already attained. In 1891 they will construct no fewer than ninety-seven boats of various classes, seventeen sea-going torpedo boats, twenty-four first-class boats, and fifty-six second-class. These additions are, of course, included in the figure given in the table. Germany has at present in construction four first-class ironclads, each of 10,000 tons; two coast defence ironclads, each of 3,600 tons; two cruisers of 5,000 to 5,500 tons; one cruiser of 3,600 tons; one of 1,580 tons; one torpedo sloop of 700 to 800 tons; and two cruisers of 1,800 tons. The speed of the cruisers will be from 18 to 20 knots, and of the ironclads from 16 to 17 knots. Italy is spending this year £3,000,000 in additions to her navy. Altogether six ironclads of 13,090 tons of the "Sicilea" type are now in course of construction. Besides the "Sicilea," "Rè Umberto," and "Sardegna," three other vessels are in hand. Eight cruisers of 2,300 tons, and three deck-protected cruisers, with a displacement of 3,530 tons and a speed of 17 knots, are also being built. There are besides thirteen torpedo sloops and a number of sea-going torpedo boats. Russia has in course of construction three ironclads, each of 10,150 tons, and six of 8,500 tons, and one cruiser of 11,000 tons. While there are many reasons against an unnecessary and excessive increase in naval armaments, it is satisfactory to note that Great Britain relatively to the other naval Powers fully retains the preponderance which has become a tradition.

THE ROYAL SOCIETY CONVERSAZIONE.

The second conversazione of the Royal Society this year was held on the 17th inst., in the Society's rooms at Burlington House.

Professor J. J. Thomson showed a number of experi- on the discharge of electricity through gases without the aid of electrodes, some of which had been shown at the recent meeting of the Physical Society at Cambridge, while others were new. The discharge tube in all these experiments is made to form the secondary of what is essentially an induction coil, and the discharge passes round a closed circuit in the gas. One of the most interesting of these illustrated the fact recently discovered by Professor Thomson, that a magnetic field facilitates a discharge of this kind along the lines of force, while at right angles to them the discharge is retarded.

Professor J. Perry had quite a number of exhibits, of which the following are the most important: (1) A steam engine indicator. This consists of a mirror mounted excentrically upon a disc of thin steel forming one side of a flat cylindrical box into which the steam can be admitted, and was described and illustrated in our issue of the 29th ult. Professor Perry states that the instrument can be relied upon at any speed, however high. (2) "A Simple Means of Destroying Electric Sparking." Sumpner and others have shown that the spark occurring when an inductive circuit is broken could be got rid of by shunting the current just before breaking, through a condenser of sufficient capacity. The capacity required for any ordinary circuits is, however, so great as to make the use of condensers of the ordinary construction quite out of the question, owing to the enormous size which would be necessary. Cromwell Varley, however, pointed out many years ago, that a voltmeter is a condenser, and Professor Perry finds that a few small voltmeters built up of test tubes with electrodes of lead wire in acidulated water form a condenser of sufficient capacity. Four of these were used in the experiment shown. He also exhibited a variable secohm standard and electrical supply meter, and some examples of the twisted strip electrical measuring instruments.

Mr. J. Joly exhibited an instrument, to which he has given the name of "Meldometer," for determining the melting point of minute quantities of substances, by comparison with those of bodies whose melting points are known. The method consists in measuring the thermal expansion of a ribbon of pure platinum, when a minute quantity of a substance, dusted on its surface, and observed through a microscope, is melting. The platinum ribbon is heated by an electric current, and the thermal value in degrees Centigrade of its expansion determined by preliminary observations with bodies of known melting point. The expansion is read by an electro-contact method. The instrument exhibited has a range up to about 1,600° C., and reads to within 2° C.

Professor C. A. Carus-Wilson showed a very ingenious method of experimentally studying the distribution of strain in beams supported at the ends and loaded between the supports. The method consists in submitting a strip of glass to similar stresses and studying the distribution of stress in the glass by means of polarised light.

The Cambridge Scientific Instrument Company exhibited some beautifully constructed instruments, among which was a small cathetometer in which a reading microscope takes the place of the vernier, and the movements take place on geometrical slides. Mr. Crookes showed a series of vacuum tubes illustrating the phosphorescence of various precious stones under molecular bombardment *in vacuo*, and another series illustrating the electrical volatilisation of gold and other metals. Professor Norman Lockyer showed some photographs of a group of sun spots, some solar metallic comparison photographs, and a series of photographs illustrating the orientation of the temples at Karnak and Edfou, and showing that, notwithstanding the elaborate details of the architecture, the principal axes of the temples were kept perfectly clear from end to end.

Professor Roberts-Austen exhibited some beautiful specimens of a new alloy of gold and aluminium, possessing a deeper and more brilliant colour than any other alloy known. Mr. Ludwig Mond exhibited some objects of pure nickel deposited from nickel-carbon oxide, and also some objects plated with nickel by exposure to the same compound. Mr. W. Gardener showed some methods of demonstrating certain important phenomena associated with the absorption and the flow of the water taken up by plants.

Professor S. P. Thompson exhibited an apparatus showing a remarkable optical illusion. On two rotating discs, A and B, are spiral patterns in black and white, which seem to move radially inwards and outwards respectively. Let the observer gaze fixedly for about one minute at the centre of A, and then suddenly transfer his gaze to any object—say the face of a friend—he will see that object apparently enlarging from the middle outwards. After similarly gazing for a minute at B, and then looking at any object, he will see it apparently diminishing. This experiment disproves the theory of M. Javal (Director of the Ophthalmological Laboratory of the Sorbonne), that the complementary subjective illusions of motion are due to involuntarily slipping of the muscles of the eyeball. They cannot slip radially in all directions at once.

Mr. Wimshurst exhibited some electrical influence apparatus, and an electromotor driven by the current obtained from an influence machine. Mr. Francis Galton had a very interesting and important exhibit illustrating his system of identification by means of finger prints. Some of the diagrams show that the essential details, however minute, of the patterns remain unchanged from infancy to old age.

Lantern exhibitions of meteorological photographs were given during the evening by Mr. A. W. Clayden, and of photographs illustrating the district affected by the great eruption of Skapta Tokul in 1783, by Dr. T. Anderson.

The National Telephone Company had connected the Archives Room for the evening with Birmingham and with the Gaiety Theatre at Manchester.

THE FARADAY CENTENARY LECTURE.

On the 17th inst. a lecture was delivered at the Royal Institution by Lord Rayleigh, F.R.S., in commemoration of the centenary of the birth of Michael Faraday, H.R.H. the Prince of Wales being in the chair. The lecturer said that Faraday had been identified with the Royal Institution for a period of 54 years, and found there his opportunity for work and his home. Faraday had been fired by contact with the genius of Davy, and volunteered his services in the laboratory of the Institution. The discovery of Faraday's powers was not the least of Davy's discoveries. Dr. Tyndall, who had possessed opportunities of watching the action of Faraday's mind in dealing with the problems of science, had written an account of him, which had been published in the "Proceedings" of the Institution. The lecturer then described Faraday's great discovery of the induction of electrical currents. The experiment on induced currents was not at that time a simple one, and Faraday did not attain truth without great difficulty. In December, 1824, he attempted to obtain electrical currents by means of a magnet, but it was only on August 29th, 1831, that he obtained the first evidence of induced currents. On September 23rd of that year he wrote to his friend, R. Phillips: "I am busy just now again on electro-magnetism, and think I have got hold of a good thing, but can't say. It may be a weed instead of a fish that, after all my labour, I may at last pull up." Maxwell had invented a differential gearing to imitate the action of induced currents, and the lecturer showed Huygens' gearing, which was an even more exact analogue of the action of such currents. The lecturer showed how Faraday's discovery had been utilised in the construction of alternating current machines for the purposes of electric lighting. The experiments made by Elihu Thomson on the different actions produced by a plate of glass and of copper in electromagnetic screening were then shown. Some of Faraday's most important

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discoveries were of a similar character. Elihu Thomson's experiment on the repulsion between an electro-magnet and an aluminium ring was also shown. The lecturer said that self-induction was analogous to momentum. As regards mechanical analogues, the lecturer remembered, when a boy, seeing a machine which punched holes in an iron plate 1in. thick, and being told that, even when the machine was disconnected from the engine, the momentum of the fly-wheel would be able to punch several holes, whereas the power of the engine alone, without the fly-wheel, would have been insufficient to punch a single hole. Faraday, he said, felt doubts as to the soundness of the views then held as to the nature of electricity, and was especially desirous not to be misled by the use of words, which often conveyed a meaning beyond what they really were intended to carry. He proved or re-proved the identity of lightning and the electricity of the voltaic cell. He introduced the use of the term "electrode," and had succeeded, as Maxwell said, in banishing the term "electric fluid" to the region of newspaper paragraphs. Faraday also made important experiments on diamagnetism, which had been afterwards developed by Sir W. Thomson. An iron ball would take up a position intermediate between two poles of different polarity, but an eccentric position between two poles of the same polarity. Faraday's experiments had been systematised by Sir W. Thomson. A discovery of immense significance, of which the consequences were not yet fully understood or developed, was that of the rotation of the plane of polarisation of light under electric force. The nature of the vibrations which constitute light was shown by means of a model. The rotation of the plane of polarisation by electric force in a beam of light passing through carbon disulphide was then shown. Sir W. Thomson had shown that this rotation was independent of the direction of the ray, and that there must be something of the nature of rotation in the medium when it was subjected to electric force. The exact nature of this action may not be discovered for some time. In one of his acoustical papers, Faraday stated that he had observed on a flat sea shore that undulations parallel to the course of the wind were caused in the water left behind by the receding tide. The lecturer had been able by close observation to see the same phenomenon, and to recognise the stationary undulations with their ridges parallel to the wind. Faraday must have possessed extremely close powers of observation to recognise this for the first time. Faraday had shown that, after a number of rapid inhalations and exhalations of breath, it was possible to hold the breath for a long time. The knowledge of this fact would have been useful in a recent accident due to the upsetting of a paraffin lamp. If Faraday had undergone a course of mathematical training, he might possibly have been in better *rapport* with the scientific men of his time. Mathematical training and mathematical capacity are entirely different, and Maxwell had said that Faraday's mind was essentially mathematical. The way in which Faraday made use of the idea of lines of force in his magnetic theories showed a mathematical mind, and mathematicians of the future might derive great aid from his valuable and fertile ideas.

Sir William Thomson, in proposing a vote of thanks to Lord Rayleigh for his suggestive lecture, said that the nineteenth century would probably be regarded as the most prolific of all ages by reason of the numerous applications of electricity. Faraday pursued science for the sake of increasing natural knowledge, and left others to apply his discoveries. With reference to Wilde's machine, Faraday said to Wilde: "I gave it you a baby, and you have brought it back a giant." Sir George Stokes seconded the vote of thanks, which was carried unanimously. Sir Frederick Bramwell then read some letters which he had received from persons who had been elected honorary members of the Institution in connection with the Faraday Centenary, and Professor A. Cornu and Professor E. Mascart of Paris, Professor P. Tacchini of Rome, and Professor J. D. Van der Waals of Amsterdam received from the Prince of Wales their diplomas of honour.

A MEMORIAL TO WILLIAM SYMINGTON AT LEADHILLS.

Almost three years ago a movement was started for the purpose of celebrating in some tangible form the centenary of completion of the "Charlotte Dundas" by William Symington, and at that time we directed the attention of our readers to the claims of Symington to recognition as one of those whose work led to the great development which has taken place in steam shipping. We urged his claims, not only on account of the value of his work, but also because during his lifetime he received little encouragement, for it must be remembered that he died broken-hearted and all but penniless. This unfortunately has been the fate of many benefactors of their race, but this much is to be said in favour of the gratitude of human nature, that there generally comes a time when the public conscience is awakened, and an attempt is made to atone for past neglect. We must confess, however, that in the case of Symington that time does not yet seem to have fully come. The movement to which we alluded only resulted in a bust of Symington being placed a few months ago in the Museum of Science and Arts in Edinburgh, and, although this was better than nothing, every one who was interested in the matter felt that something more was wanted.

Another short step has now been taken, which is very appropriate, and which will serve to keep Symington's memory green in his native village of Leadhills; for on Friday of last week there was there unveiled a very appropriate memorial. It takes the form of an obelisk of pure Greek design, about 30ft. in height, and is of polished granite. On the back and front are bronze medallions, the front being a portrait medallion of Symington, taken from a photograph of an old chalk drawing. Underneath is the inscription:—"William Symington, the inventor of steam navigation. Born 1764; died 1831. Erected by public subscription." The medallion at the back represents a model of the "Charlotte Dundas." The memorial may be looked upon as the spontaneous outcome of local feeling regarding the claims of Symington.

THE LATE DAVID BROOKS.

The death of David Brooks, the veteran American electrician, occurred at Philadelphia, on the 30th ult. He was born at Brooksvale, near Cheshire, Conn., on January 26th, 1820. He left College at the age of twenty years, and took a place as instructor in mathematics in the United States Navy. At this time Professor Morse and his associates were engaged in their first experiments with the electric telegraph. Mr. Brooks left the Navy in 1845, to devote himself to the development of this great invention. During that year he put in operation, in connection with James D. Reid, the first telegraph line built in America after Professor Morse's experimental line between Baltimore and Washington. This ran from Lancaster to Harrisburg, Penn., and Mr. Brooks received the first message sent over it. In the following year he built the line across the Alleghanies, connecting Philadelphia and Pittsburgh. From 1854 to 1867 Mr. Brooks was in the service of the old Atlantic and Ohio and the Western Union companies. In the latter year he resigned, and devoted himself to his many inventions and improvements in telegraph and telephone service. In 1873 he was appointed by General Grant as United States Commissioner to the Vienna Exhibition. Mr. Brooks, whose inventions have been of great importance in the development of telegraphy, was a constant contributor to the technical press, and various articles from his pen have appeared in our own columns. We are indebted to our contemporary, the *Electrical World*, for our portrait of Mr. Brooks.



THE LATE PROFESSOR JENKINS.

Our readers will be pained to learn that Professor Philip Jenkins, of Glasgow University, died, after a brief illness, on Saturday afternoon last. A few days previously he caught a slight chill, which brought on an attack of peritonitis, and, although his case was serious from the first, hopes of his recovery were not abandoned until Saturday morning, from which time he rapidly sank. He leaves a widow and three young daughters to mourn his premature death.

Philip Jenkins was born at Dale, in Pembrokeshire, in 1854, and was thus 37 years of age. After serving an apprenticeship as a shipwright in H.M. Dockyard at Pembroke, he entered the Royal School of Naval Architecture in 1873, in which at that time the present Chief Constructor of the Navy was instructor in naval architecture. Under his tuition, and that of the other eminent teachers in that school, he passed with the highest distinction through a complete course of instruction in naval architecture, and thus gave promise of the good work which he afterwards performed. On the completion of his course of study in the school he entered the service of Lloyd's Registry, along with some of his fellow students. At that time the Committee of the Registry were being very severely criticised for their methods and regulations regarding the building of ships, and they felt that they ought to strengthen their position by retaining the services of men who had good practical experience, and who were also thoroughly well versed in the theory of their business. Jenkins and his companions soon exercised considerable influence on the work of the Registry, and the criticisms which had been made regarding it were for the most part met. Their influence, however, was not confined to their official positions, but was communicated to the profession through papers read before the Institution of Naval Architects, and these papers were recognised as proceeding from men whose opinions were of great weight. The papers were chiefly on the strains to which ships were subjected, and their strength considered as structures. This department of the subject remained the one to which Jenkins continued to direct special attention, and last year he read before the Institution of Naval Architects an important paper, "On the Strength of Ships, with Special Reference to the Distribution of Shearing Stress over a Transverse Section," and which was very highly spoken of in the discussion which followed. For more than a year he has been a member of a special Committee on Bulkheads, and we understand that the report on the subject is quite completed and will shortly be published. It is certain to be very carefully studied at the present time, when the subject of the speed and safety of steamships is receiving so much attention.

On the appointment of Professor Elgar, of Glasgow University, to the position of Director of Dockyards, Mr. Jenkins was asked to act as his *locum tenens*, and this he did with so much ability that shortly afterwards he was appointed to the Chair of Naval Architecture, which he has continued to fill with the highest efficiency. At the meeting of the Institution of Naval Architects, in Glasgow, in July, 1888, he read a paper giving a very complete account of the course in naval architecture at Glasgow University, which showed the breadth and depth of his knowledge, and the thorough manner in which he had arranged the work of his department. His system may be considered a model for all similar departments in universities or technical institutions. His energies were not by any means confined to his college duties. In addition to a fair share of consulting work, he had taken a very active part in the formation of the new Shipping Registry in Glasgow, and held the appointment of scientific adviser to it. His quiet and pleasant manner endeared him to his students, his colleagues, and his friends. In short, his death has left a blank not only socially, but also in the scientific world, to which he was so well qualified to impart information regarding his own department of investigation and practice.

Letters to the Editor.

CHARLES' BRUSH HOLDER.

To the Editor of "Industries."

Sir,—With regard to "Charles' Brush Holder," described in your issue of the 5th inst., I may say that I designed and have used for the last two years a brush holder similar to the one described, and I can fully confirm your opinion as to its simplicity and efficiency. To my brush holder I add an improvement, not obtained in Mr. Charles' holder, in the form of an adjustment screw for regulating the tension of the spring. I have had a dynamo running through the past winter, and the brushes on the same have never required attention, which I attribute to the use of this brush holder.

Yours, &c.,
R. Forster,
Electrican to Messrs. J. Sunderland & Co.

Halifax, 12th June, 1891.

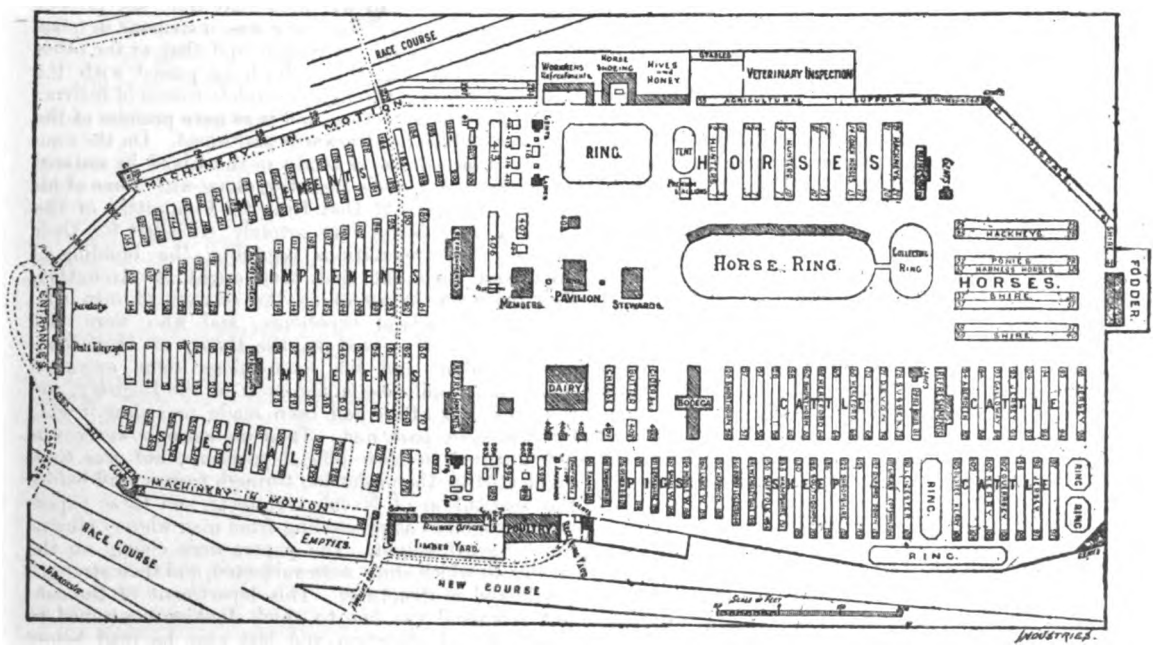
THE STEAMSHIP OF THE FUTURE.

To the Editor of "Industries."

Sir,—The two articles which appeared in your last issue, namely, "The Steamship of the Future" and "Safety in Ocean Travelling," direct the attention of your readers to matters which are rapidly assuming increasing practical importance. In these, as in all other matters, it is safer to proceed by a gradual evolution than by a sudden revolution. A steamship to cross the

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THE ROYAL AGRICULTURAL SHOW.



PLAN OF SHOW YARD.

Atlantic in three days is no doubt within the possibilities of the not very distant future, but in the meantime shipowners and shipbuilders should show that a five days' steamer can be built with ease. Your estimate of 30,000 h.p. is, in my opinion, on the safe side. I think that 25,000 h.p. would be found sufficient if all other conditions were proper, but, as you point out, all these figures must be largely matters of guess in the absence of practical experience. Experiments with models are no doubt useful, but with these higher speeds the elements of uncertainty are very much increased, and the only sure way is to advance slowly in the size and speed of the actual boats.

With regard to bulkheads, the importance of which you point out, we are waiting, with a certain amount of impatience, the report of the Special Committee which has been sitting for some time on the subject, and which is said to have been completed for a considerable period. It may be assumed that shipowners and shipbuilders have practically decided, after a good deal of hesitation, to have all their largest and swiftest ships with twin screws, a decision which is justified, not only on grounds of safety, but also of efficiency.

While advising caution in the construction of these large and expensive ships, it would, however, be well if shipowners, shipbuilders, and marine engineers allowed their imagination a little play occasionally as to the possibilities of the future, for it must be remembered that imagination has a most important function in scientific and industrial development. The man who boasts that he is a "practical man," and does not indulge in experiments, forgets that if all were like him no progress would be made. He is like those very prudent people who are so very much afraid of making a mistake that they seldom or ever do anything beyond the ordinary routine of everyday life. The whole subject of prime movers *may*, for instance, be revolutionised by a proper use of the imagination, for, instead of increasing the size of our engines, we may find some more direct method of utilising the energy inherent in the fuel than through the rather clumsy means of a steam engine. In electric motors, any one with a little imagination must at once be struck with the roundabout methods adopted, and come to the conclusion that, if we knew a little more about electricity, we might at once dispense with a great deal of heavy and expensive machinery.

The steamship of the future may have a much simpler and much more efficient prime mover than anything at present imagined; it may be built of material at once lighter and stronger than any at present within the reach of engineers and shipbuilders, and consequently it may become possible to greatly increase the speed without adding to the danger. The improvements in navigation to which you have alluded make a difference in speed of comparatively little moment.

Yours, &c.,

Glasgow, 18th June, 1891. M.I.N.A.

AN ATLANTIC LINER ON FIRE.

ON the night of the 9th inst a fire broke out in the hold of the Inman and International steamship "City of Richmond," during the voyage from New York to Liverpool. The vessel left New York on the 3rd inst., and when the fire was discovered it was in lat. 25 N., long. 39 W. There were on board 105 cabin, 71 second cabin, and 119 steerage passengers, and a crew of 146, the cargo including 2,000 bales of cotton. A strong hurricane, with heavy cross seas, was experienced on the 7th inst., and the heavy seas continued up to the 9th inst. At midnight on the 9th inst. the alarm of fire was given, and the passengers were quickly on deck. It was soon discovered, on opening the hatchway near the cabin, where the smoke was first seen, that the cotton in the hold was on fire. Captain Redford and the officers made every effort to extinguish the fire by forcing water and steam into the hold, and all apertures were closed in order to prevent the access of air. The fire was at last checked by these means, but the cotton still continued to smoulder. Preparations were made for victualling the boats, but it would have been very difficult to put them off, in consequence of the heavy sea then running. At 8 a.m. on the 10th inst. a sail was sighted, and, after signals had been made, a vessel drew near, which proved to be the "Counsellor," of the Harrison Line, bound for Liverpool. This vessel agreed to remain alongside the "City of Richmond." During the evening of the 10th inst. an attempt was made to examine the hold, and four bales of smouldering cotton had been removed when it became necessary to shut down the hatches. On the night of the 10th inst. the Cunard steamer "Servia," seeing the signals of distress, drew near, and on the morning of the 11th inst. the "City of Richmond" and the "Servia" proceeded together. The Inman Line steamer "City of Paris" came up with the two vessels on the afternoon of the 12th inst., and a consultation took place between the captains of the three vessels. It was ultimately agreed that the "Servia" should accompany the "City of Richmond" to Queenstown, whilst the "City of Paris" should proceed on her voyage to New York. On the 13th, water and steam continued to be poured into the hold, but the vessel appeared to be getting hotter. On the morning of the 14th the vessel arrived at Queenstown, and proceeded to Liverpool, crossing the Mersey bar on the morning tide of the 15th inst.

On the afternoon of the 17th inst. the vessel was taken into Hornby Dock, and the part of the hold in which the fire originally broke out having been open, dense clouds of smoke and flames issued from it. The heat of the vessel was very great, and a powerful stench arose from the burning meat and cotton. A large quantity of water was again poured into the hold, but little effect seemed to be produced.

THE NORWOOD JUNCTION RAILWAY ACCIDENT.

MAJOR-GENERAL HUTCHINSON, of the Board of Trade, has issued his report on the above accident, which, it will be remembered, was caused through the collapse of a bridge. The report states that "the cast iron girder which failed, causing the floor of the bridge to give way, and the wheels of the engine and tender, and then all the succeeding vehicles in the train, to leave the rails, had been in its place on the west side of the up main line for about 31 years, and during the whole of that time had had concealed in the interior of the web and in the outer part of the lower flange a very serious flaw, abstracting at least one-fourth from the strength of the girder." This flaw was invisible when the girder was in position, and even when the girder was cast, owing to the practice of using sheet iron in the foundry operations at special parts of the castings, such as gussets, where the flaw could not be perceived. The report further states that, apart from the flaw, "this girder did not possess a sufficient theoretical margin of safety for the passage of the engines now in use on the line—its calculated breaking-weight at the centre, supposing the bottom flange to be perfect, not exceeding 71 tons, whereas, for the engine drawing the express train, this breaking-weight should have been at least 83 tons, and more for other engines running on the same line."

The attention of the London, Brighton, and South Coast Railway Company had been drawn by the Board of Trade to this deficiency of strength after a previous accident on this bridge in 1876, when two similar girders at a different part of the same bridge were broken owing to an engine becoming derailed, and they were then recommended to substitute stronger girders, a recommendation which had, unfortunately, been unheeded. The Brighton Company, the report goes on to show, "is therefore deserving of much blame for having omitted to substitute stronger girders for the existing ones, after attention had been thus specially directed to the weakness of the latter." The comparatively slight personal injury and damage to rolling stock caused by the accident, the report states, is owing to the strength of the vehicles and the prompt action of the engine-driver Hargreaves in applying the Westinghouse brake. The General commends the promptitude of the signalman Sawyers, who was on duty in the Norwood North cabin, in at once blocking the "up local" and "down main" lines. The engineer to the company states that there are only five such cast-iron bridges still in existence on the main line between London and Brighton, and the Board recommends the immediate reconstruction of these with wrought-iron girders.

THE ROYAL AGRICULTURAL SHOW.

THE fifty-second annual Show of the Royal Agricultural Society will be held at Doncaster from to-morrow, the 20th inst., to Friday, the 26th inst., inclusive. On the first day the implement department only will be open to inspection, and the show of live stock will be open on Monday, the 22nd. On Tuesday, the 23rd, at 12.30, a general meeting of the members of the Society will be held. The usual competitions will be held during the week, such as horse-shoeing, butter making, &c., while lectures and demonstrations in dairy work and bee-keeping will take place at intervals. We give above a plan of the show yard, which is reproduced from the Society's official catalogue, and which may be of use to our readers.

Reviews.

THE DESIGN OF STRUCTURES. By S. Anglin, C.E. London: CHARLES GRIFFIN & Co. 1891.

It is very appropriate that the publishers of Professor Rankine's series of well-known manuals, which laid the foundation of engineering science in this country, should continue to place before the public the developments which are in great part due to Rankine's work. Some time ago we had occasion to notice the excellent treatise of Professor Fidler on bridge construction, and now we have before us a more general treatise on the design of structures, which is of very high quality. There may not be very much that is original in it, but what ordinary students and engineers want is not so much originality as a clear and concise statement of the present state of knowledge in different departments. Mr. Anglin's object has been to supply students of engineering and architecture with a concise text-book on structures, requiring on the part of the reader a knowledge of elementary mathematics only, and he has performed his work in a most admirable manner. He has tried to treat the different branches of the subject from a practical as well as from a theoretical standpoint, and with this object he has introduced, and carefully worked out, a large number of practical examples such as occur in the everyday experience of engineers. These will be found most useful, not only for their practical applications, but also because in some cases they are solved both analytically and graphically, the one method being used to check the other.

Throughout the book Mr. Anglin has made a very judicious use of graphic statics in its application to the determination of stresses on framed structures. We have often complained of the manner in which some writers and teachers take up this branch of the subject; they make it too much of a hobby, and elevate it into the position of a special science, almost as intricate as that of which it is only meant to be the tool. The first three chapters of the book are preliminary, and deal chiefly with the strength and elasticity of the materials used in construction, and will be found to contain a

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most useful synopsis of the subject. The fourth chapter considers briefly the mechanical laws relating to stresses on structures and the graphic methods of representing them. The action of loads of different kinds on beams placed in different conditions is next very fully considered, and in a very clear and concise manner, and illustrated by well-chosen examples. Columns and struts, girders of different kinds, framework, arches, roofs, and bridges are all taken up very fully, and in a manner which will be most useful both to students and engineers. In these departments, and in order that the work may be useful as a book of reference to those engaged in the profession generally, several chapters are devoted to the practical side of the subject, especially to such matters as strength of joints, punching, drilling, riveting, and other processes connected with the manufacture of bridges. On these subjects Mr. Anglin writes with the experience of many years in the bridge yard, and the information which he gives will be found to be of great value to the practical bridge builder. Mr. Anglin's book comes very near to our ideal of what such a text-book should be, and we have very much pleasure in recommending it to the attention of our readers who may be interested in the subject.

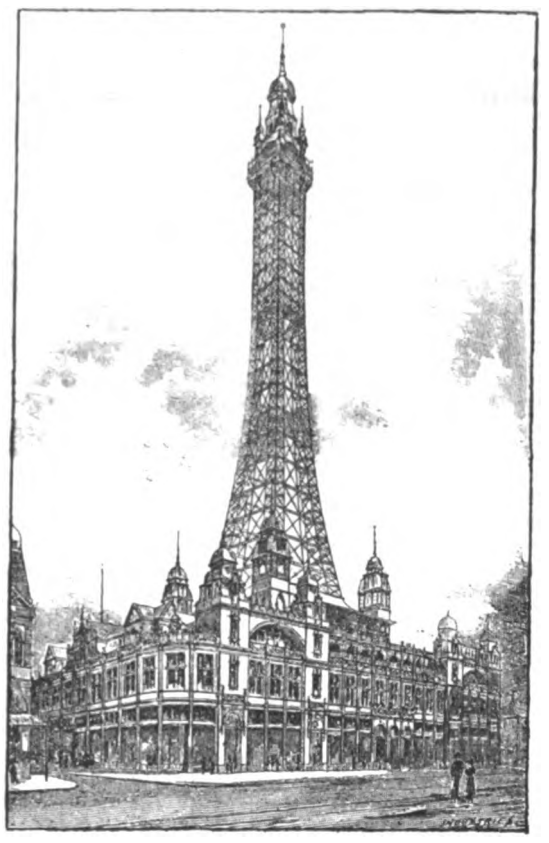
Wedding's Basic Bessemer Process. Translated from the German by William B. Phillips, Ph.D., &c., and Ernst Prochaska, Metallurgical Engineer. New York: Scientific Publishing Company. 1891.

It is natural that Germany, having derived more advantage from the basic process than any other country, should contribute to technical literature the most complete work upon its methods. This we have in the book before us, which is an English translation made for the express purpose of acquainting American metallurgists with the details of an invention that has not met with a favourable reception at their hands; the Pottstown Iron Company, of Pennsylvania, being as yet the only firm that has made any serious attempt to manufacture basic steel in the United States. Throughout the book, following the German original, the process is called by the name of "Thomas" alone, and, except for a reference to Percy C. Gilchrist on page 30 this gentleman might have had no connection with the discovery, for his name is even absent from the index, an omission of a somewhat remarkable character, seeing that the opening chapter is chiefly historical. The early attempts at dephosphorising are described, and it is shown how the important discovery was arrived at that, of all the methods and materials which can be employed for the manufacture of a basic converter lining, the mixture of dolomite and anhydrous tar now usually employed is the most practical. The construction and lining of the converter are, in common with other mechanical points, very fully illustrated. Owing to the large amount of slag resulting in the basic practice much larger converters have to be used for the same charge than in the acid process. The ratio, the author tells us, is about 6·5 to 10—that is, a converter able to take 10 tons of iron in the acid process could only take 6·5 when used for the basic process. In regard to the materials, it is considered that the best pig iron for use in the basic process is that made at Ilsede, Germany. It contains about 3 per cent. of phosphorus, over 2 per cent. of manganese, 0·5 per cent. of silicon, and less than 0·1 per cent. of sulphur. The absence of any large amount of sulphur is important, for, to use the author's concluding words, "It is still an open question how to desulphurise, practically and economically, a phosphoritic pig iron in the basic Bessemer converter." The use of the term "recarbonisers" to designate spiegeleisen and similar carbon-containing compounds, is hardly correct. A material is "carbonised" when, as for example, a piece of wood is charred, the carbon is present in it from the commencement of the operation, but it is "carburised" when the carbon is added to it, as in the manufacture of steel. "Recarburisers" is therefore the better expression to designate such materials as spiegeleisen and ferro-silicon. The details of practice and the chemical and physical reactions of the process are very fully discussed, and illustrations showing the best arrangement of a basic Bessemer works are also given. Not the least important is the section that refers to the utilisation of the slag, which is largely used for agricultural purposes. It is an interesting fact that, since vanadium behaves exactly like phosphorus, the whole amount present in any ore is found in the basic converter slag, and this element can be profitably extracted from it in the form of sodium vanadate used as a pigment. That excellent steel can be produced by the basic Bessemer process is now a well-established fact. Nevertheless, the necessity for the use of lime in the slagging operation seems to be opposed to the manufacture of an ingot iron that shall not have its welding properties interfered with. To the absence of this violent action is probably due the improvement in the quality of the steel obtained from the basic open-hearth furnace, a branch of the subject upon which Mr. Ernst Prochaska has added a supplementary chapter from his pen giving an account of the progress made during the last six years. It is found that the best results in the basic open-hearth furnace are obtained on a magnesite bottom, a material which remains intact when exposed to the highest heat of a regenerative gas furnace, whilst dolomite exposed to the same treatment fluxes.

In conclusion, we may add that although this important work appeals with special interest to the steel maker, the copper smelter will find in it much that may be of value in his future practice as foreshadowed by Mr. Gilchrist in his paper on "The Basic Process as Applied to Copper Smelting," read before the London Section of the Society of Chemical Industry, an abstract of which appeared in *Industries* of 9th January last.

THE BLACKPOOL EIFFEL TOWER.

The accompanying illustration represents the Eiffel Tower which it is proposed to erect at Blackpool, the well-known Lancashire watering-place, the designs for which have been made by Messrs. Maxwell & Tuke, of Manchester. The situation chosen for the tower is between the North and South Piers. The tower will be between 400ft. and 500ft. high; the base will be used as a circus, the first floor will contain a menagerie and aquarium, and the second floor a concert room and floral hall. The tower proper will be 100ft. square at the base,



and 30ft. square at the foot of the cupola. The first gallery, 70ft. above the ground, will be 80ft. square, and the second gallery, 300ft. above the ground, will be 30ft. square. Hydraulic lifts, capable of accommodating 20,000 visitors a day, will run up to the second gallery, and thence broad staircases will lead to the six upper galleries and the lantern and cupola. The tower will be constructed of wrought iron and steel, and will be lighted throughout with electricity. We are indebted to the *Graphic* for our illustration of the tower.

THE INSTITUTION OF CIVIL ENGINEERS.

The following is a detailed list of the awards made for communications submitted during the past session:—

For Papers Read and Discussed at the Ordinary Meetings.

1. Telford Medals and Telford Premiums to Llewellyn Birchall Atkinson, A.K.C., and Claude William Atkinson, A.K.C., Assoc.MM.Inst.C.E., for their joint paper on "Electric Mining Machinery." 2. A Telford Medal and a Telford Premium to Rookes Evelyn Bell Crompton, M.Inst.C.E., for his paper on "The Cost of the Generation and Distribution of Electrical Energy." 3. A Telford Premium to Frederick Ewart Robertson, M.Inst.C.E., for his account of "The Lansdowne Bridge over the Indus at Sukkur." 4. A Telford Premium to Edward Walter Stoney, M.E., M.Inst.C.E., for his description of "The New Chittravati Bridge, Madras Railway." 5. Telford Premiums to Professor John Milne, F.R.S., and John McDonald, for their joint paper "On Vibratory Movements of Locomotives, and on Timing Trains and Testing Railway Tracks." 6. A Telford Premium to William Langdon for his paper on "Railway Train Lighting." 7. A Telford Premium to William Thomas Henney Carrington, M.Inst.C.E., for his paper on "The Reception and Storage of Refined Petroleum in Bulk."

For Papers Printed in the Proceedings without being Discussed.

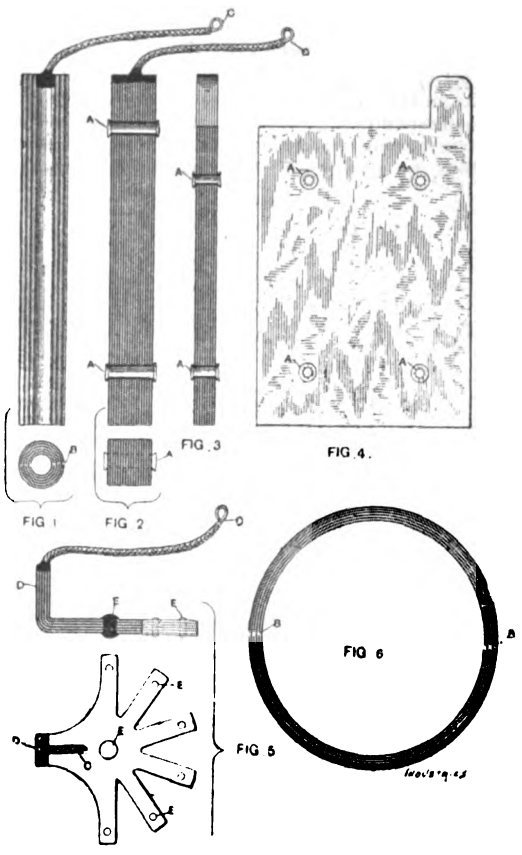
1. A Telford Premium to Bryan Donkin, Jun., M.Inst.C.E., for his paper on "Thermometers in and about Steam-Cylinder Walls; with some Experiments on the Temperature of the Metal under Different Conditions." 2. A Telford Premium to John James Webster, M.Inst.C.E., for his paper on "Fire-proof Construction." 3. A Telford Premium to Charles Preller Sheibner, Ph.D., Assoc.M.Inst.C.E., for his account of the "Carrara Marble District Railway."

For Papers Read at the Supplemental Meetings of Students.

1. A Miller Prize to Edmund Lewin Hill, Stud. Inst.C.E., for his paper on "The Counterbalancing of Locomotive Engines." 2. A Miller Prize to John Henry Barker, Stud. Inst.C.E., for his paper on "The Design of Locomotive Cylinders." 3. A Miller Prize to William Archer Porter Tait, B.Sc., Stud. Inst.C.E., for his account of "The Lanarkshire and Ayrshire Railways." 4. A Miller Prize to Bertram Chatterton, Stud. Inst.C.E., for his paper on "Disintegrators." 5. A Miller Prize to John Walter Brown, Stud. Inst.C.E., for his account of the "Malta Dockyard Caisson No. 4." 6. A Miller Prize to Auriol Sealy-Allin, Stud. Inst.C.E., for his description of "A New Type of Water-Motor." 7. A Miller Prize to William Herbert Wheeler, B.A., Stud. Inst.C.E., for his paper on "The Cleaning and Deepening of Rivers and Canals by means of the Transporting-Power of Water."

IMPROVED BATTERY ZINCS.

Messrs. David Moseley & Sons, Chapel Field Works, Ardwick, Manchester, have brought out an improved form of battery zinc, which we illustrate herewith. The object of the invention is to get over the difficulties due to local action. Each zinc is made up of laminæ of thin sheet, each sheet being amalgamated separately, so that the zinc is practically amalgamated throughout. Fig. 1 shows a Leclanché cell zinc. It is built up of concentric tubes made of amalgamated sheet zinc. Fig. 2 is a rectangular rod, the strips composing it being held



together by ebonite tubes, with the ends expanded by a hot tool, so as to hold on the principle of boiler tubes. Figs. 3 and 4 show a composite plate, and Figs. 5 and 6 a star and a cylinder respectively. It is claimed that these zincs are free from local action, because the metal is purer and more homogeneous, as it is rolled in thin sheets and thoroughly amalgamated. Also that they are as cheap as ordinary zincs, do not get covered with crystals, and never require cleaning. With the view of testing these claims we are trying a "Moseley" and an ordinary zinc in a newly set up pair of Leclanché cells.

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SETTING UP STANDARD CELLS.

By S. Skinner, M.A.

The Board of Trade has issued a preliminary memorandum on the preparation of the Clark's cell, which is a standard of electromotive force or electric pressure. It affords the most convenient method of testing the graduations of volt and ampere meters, and it is probable will come into general use for testing household electric meters. The memorandum contains instructions for preparing the cells, and, although these are very full, experience tells us that it will not be out of place to explain and expand some of the details. The principal sources of error in a Clark's cell are—(1) The paste may be acid; (2) it may not be saturated with zinc sulphate; (3) the solution may be supersaturated; and (4) the mercury may be impure. (1) and (2) cause the e.m.f. to be too high, and (3) and (4) cause it to be too low. We propose to indicate here the precautions necessary to guard against these faults.

To prepare the zinc sulphate solution, the instruction is to dissolve 2 parts by weight of pure recrystallised zinc sulphate in 1 part by weight of water, with the aid of a gentle heat. To this a small quantity of zinc carbonate is added, in order to neutralise any free acid.

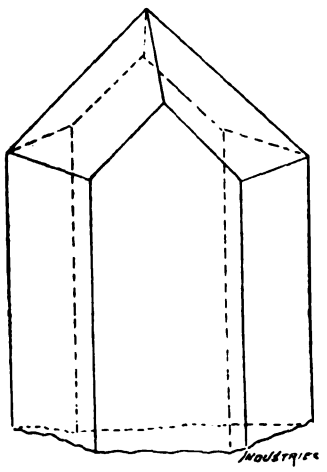


Fig. 1.

This milky solution is to be filtered, whilst warm, into a stock bottle, where part of the zinc sulphate, on cooling, separates in crystals. The solution, which is milky from the presence of an excess of zinc carbonate, becomes quite clear after passing the filter, but on cooling there is the separation, in addition to the zinc sulphate in trans-

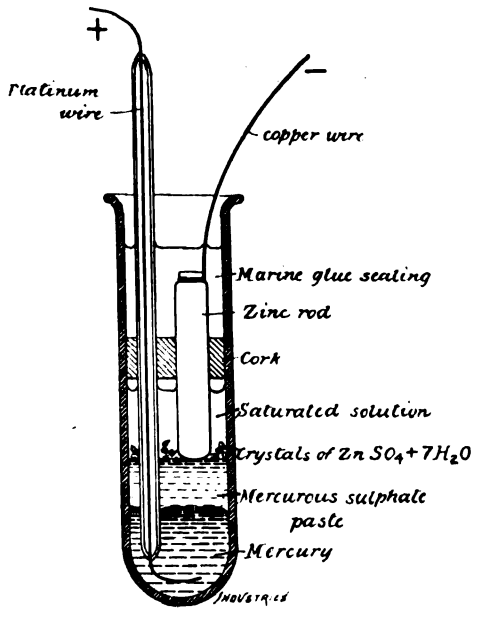


Fig. 2.

parent crystals, of a small quantity of very minute white opaque crystals. The presence of these crystals does not matter; they are a basic sulphate of zinc due to the interaction of the carbonate on the sulphate. Very frequently no crystals of any kind appear on cooling, especially if the bottle be very clean and has been kept still. This is due to the phenomenon of supersaturation. To bring the crystals down, the best method is to drop in one or two; the smallest quantity is sufficient from the purchased sample. The solution, when prepared, should just turn a blue bitmus paper to a purple colour.

There are several kinds of crystallised zinc sulphate, and it is essential to use the rhombic crystals $ZnSO_4 + 7H_2O$. These separate from solutions below 30° C., and have the shape shown in Fig. 1. If the solution has crystallised whilst still warm, say, at 30°, it is highly probable that the salt separated is $ZnSO_4 + 6H_2O$ (monoclinic crystals), and should this be used the e.m.f. will be too low. We cannot lay too much stress on the use of the right crystals; it is one of the most important features of the cell.

To prepare the paste mercurous sulphate is washed with cold distilled water *until free from acid.* The water is then drained off so as to leave the powder as dry as possible. If the sample of mercurous sulphate contains mercuric, it will be indicated at this stage by the powder becoming yellow. To the drained powder zinc sulphate solution is added to bring it to the consistence of cream, then a little mercury and some crystals from the stock-bottle to saturate the water left adhering to the paste from the washing. This is warmed and well ground together, and at this stage the yellow colour should disappear, since the mercury added will change any mercuric salt back to mercurous salt. When this is cold still more crystals should be added, so that we may be absolutely sure that there are present actual crystals visible to the eye besides the mercury, mercurous sulphate, and saturated zinc sulphate solution.

A finished cell is represented in Fig. 2, drawn three-quarters size from an actual cell. The e.m.f. of the cell is 1·435 Rayleigh volts at 15°, diminishing by ·001 volt for every degree above 15°, or increasing by the same amount for each degree below that temperature. The cell should be mounted with a thermometer in close contact to indicate its temperature.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*From our New York Correspondent.*)

(*Concluded from page* 571.)

At the opening of the meeting on the 21st ult. the Chair was authorised to appoint five delegates to the Frankfort Electrical Congress.

The first paper read was by Professor Geo. S. Moler, on "An Alternate Current Potentiometer," designed for determining what values of the potentials of alternating currents will produce given effects, and to be used principally for calibrating alternating current voltmeters. The instrument, briefly described, is as follows:—An incandescent lamp is so arranged and connected that it can be switched back and forth from the terminals of an alternating current line to those of a direct current line, which can be altered in voltage till the lamp glows with the same intensity when fed by either line. Then, while switched into the direct current line, the voltage of that line is measured by a direct current standard voltmeter or potential instrument, and the voltage so read is equivalent to that of the alternating current, which produces the same effect in the lamp. The switch is so constructed that it snaps back and forth, making the change of connection so quickly that the slightest change of intensity of the light can be easily detected. The lamp has a blackened hood with an opening in one side, through which it is viewed while the sliding resistance is being adjusted. This enables the observer to make a much closer setting than otherwise. A very close setting may also be made by observing the slight reflection of the light from the blackened surface of the hood. The sensitiveness of the instrument increases with the brightness of the lamp up to a certain point. It is best to use a lamp about the voltage which is to be measured. Mr. Weston thought that the plan was a good one, and should give accurate results. Professor George Forbes suggested that the sensibility of the instrument could be greatly increased by using two lamps in a properly constructed photometer, with a switch arranged to connect either of them with an alternating or continuous current.

A paper was then read by Mr. Frank J. Sprague, entitled "Considerations which should Govern the Selection of a Rapid Transit System." It referred especially to the requirements of New York City. Professor Forbes, in the discussion which followed, spoke of the success of the South London Railway as proving the possibilities of electric traction on a large scale. That system was now working perfectly, some of the earlier difficulties having been entirely overcome.

Mr. George W. Walker afterwards read a paper on "Electric Meters," which, after briefly describing various meters in use, described one of his own invention, which was in operation on the platform. He thought inventors had erred in striving to produce a meter registering in a similar manner to a gas meter. The principle of the meter described was that of photographing a record of the movements of an ammeter needle, which eliminated friction. The roll of sensitised paper was moved by clockwork set in operation by the turning on of a single lamp. A 1 c.p. lamp was sufficient to make the record. After a certain period of time, say, a month, the roll is taken from the meter, and the record developed, and measured with a planimeter. The discussion indicated that there was a practical reason for preferring a dial recorder, as it was more satisfactory to the customer.

Mr. Milton E. Thompson then read a paper on "A Study of an Open Coil Arc Dynamo," which was intended to determine accurately, by taking instantaneously throughout the revolution, the character of the external and internal currents and electromotive forces.

A paper was then read by Dr. Wm. H. Wahl, on "The Future of the Aluminium Problem from the Chemical Standpoint." He stated that there were other methods besides that of fusion for obtaining alumina in the liquid state. He believed there were solvents for alumina, and, if the fluid condition was as important as was believed in inducing chemical reactions, there was a possibility of establishing conditions favourable to the reduction of alumina by carbon at temperatures, perhaps, far below the fusion point of alumina. The fluorides of the alkalies, and the alkaline earths, we had reason to believe, dissolve alumina freely, and there were other compounds into which alumina enters that may be dissolved in the proper menstrua. Summarised, the case stands thus: The processes in which electricity is applied, either for the direct reduction of aluminium by electrolysis, or as the agency for producing the heat required to effect its reduction by chemical reactions, have outstripped the metallurgical methods in the race for supremacy, and have taken a decided lead. Within the past two years the metallurgical processes, as represented by the improved methods of Castner, Netto, Grabau, and others of less renown, have been forced to abandon the field to the electrical methods of Hall, Minet, Cowles, and Heroult.

At the close of the meeting the members of the Institute were given a reception at the Electric Club, at which a very interesting collection of historical matter was displayed, which had been gathered for the occasion.

PENN'S IMPROVEMENTS IN PETROLEUM LIGHTING.

The Penn's Lamp and Lighting Company, Limited, have recently introduced to the public some improvements in petroleum lighting which are worthy of notice. The first is the gravitation system, which enables a building or town to be lighted from a central reservoir placed in an elevated position, by means of pipes, in a manner similar to that employed for gas illumination. The delay in satisfactorily accomplishing this end has been hitherto due to the difficulty of regulating the supply of petroleum to the lamps. This difficulty has now been overcome by the use of a float and regulating valve (shown in Figs. 1 and 2) in connection with each lamp. Referring to the illustration, A is the oil cylinder in which the wick is suspended, and contains a closed float E connected by a rod F to a valve G. The special feature of the valve G is that it is of conical form, but recessed between its largest and smallest diameters, and that the oil is directed against the recess, thus rendering the valve extremely sensitive. The oil is admitted from the inlet pipe I, which is in communication with the reservoir while the valve is depressed, passing upwards into the oil cylinder. The increasing level of the oil raises the float, and with it the valve, and thus the supply is arrested. As the oil in the cylinder is consumed the valve descends and permits a fresh supply to enter. Thus the oil in the cylinder is practically kept at a uniform level, with the result that the lamp burns steadily. We recently had an opportunity of inspecting various forms of these lamps supplied from one reservoir at the company's offices, Abchurch Yard, Cannon Street, London, E.C. We understand that an installation has been applied at Cuxton Station, on the South-Eastern Railway, with the supply tank fixed at a level of 23ft. above the level of the platform. From the tank the service pipes descend below the rails, rising to each lamp column or suspended light, wall bracket, and two-light pendant. The light given is very satisfactory. By means of a small flash-light the lamps can be lighted and extinguished without trimming the wick, except at long intervals, and the wick can be raised and lowered from a distance by the lever N and wires R. The method of doing this is as follows:—To the outer extremity of the spindle K is fixed a circular disc having holes in its periphery, and attached thereto is the lever N. At starting the wick is adjusted to the required height, the lever being in the meantime free; but it is then fixed to the disc by the set screw Q passing into one of the holes therein. It follows that the wick can be lowered or raised the exact distances necessary by pulling the wires

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PENN'S IMPROVEMENTS IN PETROLEUM LAMPS.

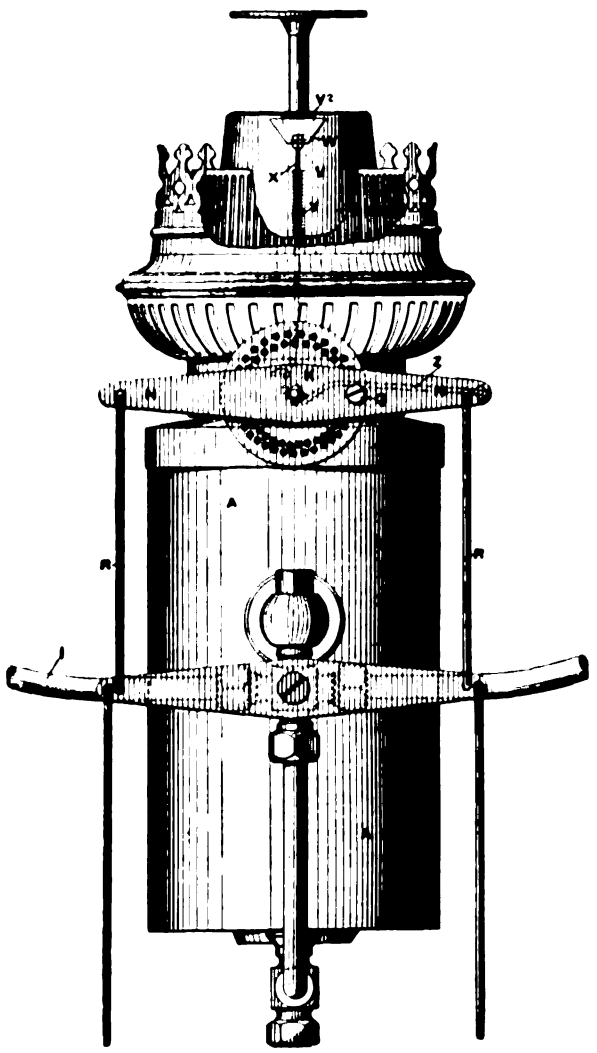


FIG. 1.

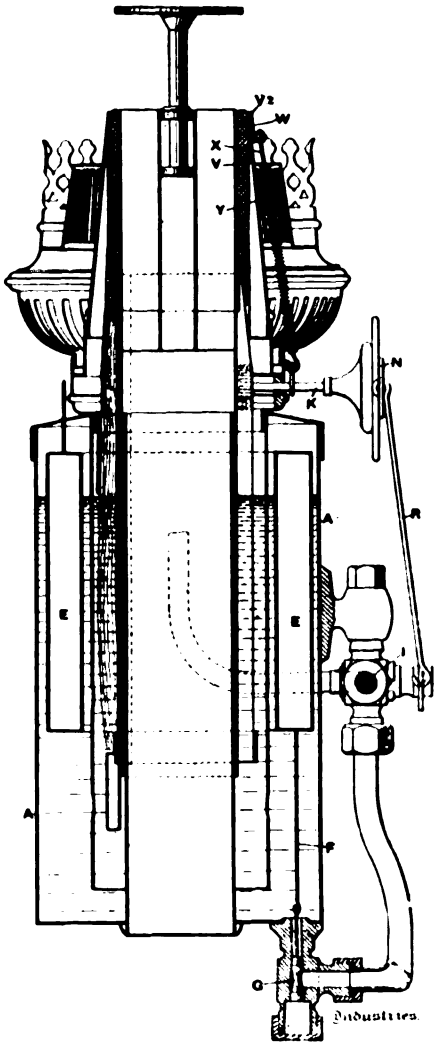


FIG. 2.

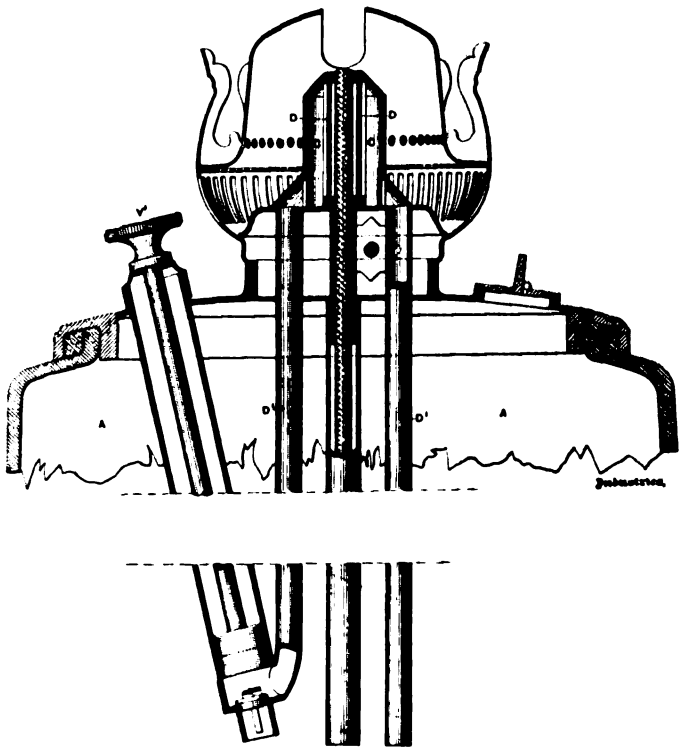


FIG. 3.

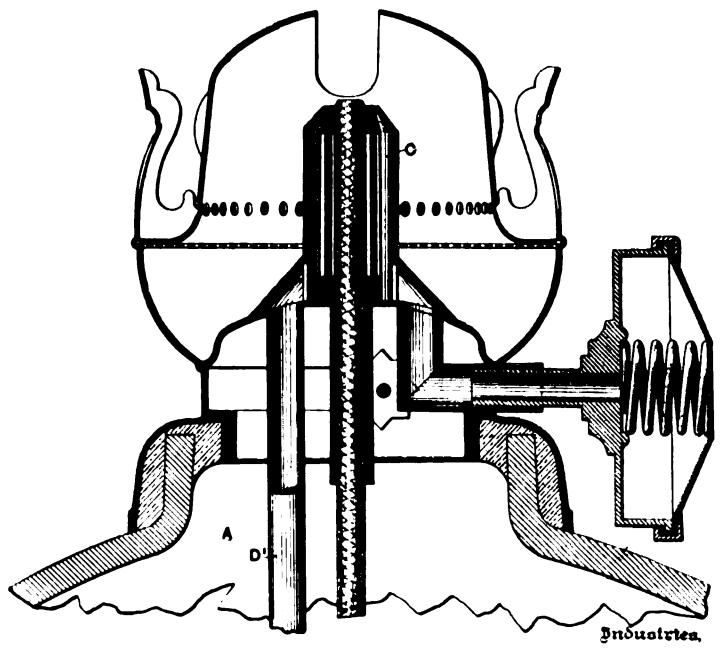


FIG. 4.

R. The supply of oil is stopped entirely on extinguishing the lamp by attaching the lever mentioned to a similar one fixed to a cock in the inlet pipe, so that both levers operate simultaneously. To maintain a small flame for the flash-light, a portion of the wick tube V is cut away at V^2, but a sliding piece W is placed over it, thus restoring the uniformity of the top edge of the tube. This slide is attached by a rod X, kept in position by the spring Y to another rod Z fixed to the lever N. When the wick is lowered the slide is also moved, and that portion of the wick, being unenclosed, remains alight. Raising the wick replaces the slide, and the light is communicated to the entire wick.

The second improvement consists of an addition to the present style of burner by which the "intermediate" oils are rendered available for illuminating purposes by being fed to the wick at the top instead of being drawn up by capillary attraction in the usual manner when light oils are used. The manner of feeding the oil is shown in Figs. 3 and 4. Round the wick tube or case D of an ordinary petroleum burner, which is perforated, a metal jacket C is fixed; inside this is a packing of a certain nature pervious to the oil, but impervious to air without pressure. From this jacket one or two tubes D^1 drop to the bottom of the oil reservoir, a wick being inserted in the wick case and the tubes charged with oil. The flame will be maintained at its fullest power until the whole of the oil is consumed from the reservoir and from the tubes. The tubes are charged by forcing the air from them by a small pump V^1, shown in Fig. 3, or by means of exhaustion by a diaphragm and spring, shown in Fig. 4. The wick may be enclosed, with the exception of the top portion, in a sealed case, and have no contact with the oil excepting through the perforations.

RETORTS FOR VITRIOL WORKS.

PLATINUM stills, at all times costly, have had their value largely increased by the late rise in the price of platinum, and the question of the advisability of their use has had imported into it fresh factors of importance. A manufacturer buying a still for £2,000 had to balance the advantages gained by the use of so costly a piece of plant against the interest that had to be reckoned on its price. Seeing that the price of platinum is now double what it was a comparatively short time ago, the increased expenditure that must be incurred to secure precisely the same advantages as in former days may turn the scale in the opposite direction.

But the investment of a certain amount of capital is not the only matter to be considered in this connection; there is deterioration to be thought of. Provided a cast-iron pan remain sound, few will grumble (except possibly the consumer) at the gratuitous distribution of a little iron mingled with the product which it has aided in preparing; indeed, a faint advantage may accrue from the reduction of its thickness and the consequent greater readiness with which heat may be transmitted through its walls.

Returning to our main proposition, that, in the case of vessels made of materials of no great rarity, there will be small objection to the removal of trifling amounts of their substance in the course of their time of service, it appears that, with the enhancement of the cost of the material, the loss caused by the corrosion of a vessel made of that material may rise until it becomes considerable. Applying this principle to the particular case before us, it is plain that the corrosion of platinum vessels has been at all times a serious matter, and is doubly so now. Even in the laboratory, it is fully recognised that the loss of weight of a platinum crucible or dish in constant use is not only large from a chemical point of view, but may be perfectly appreciable commercially. Turning, then, to large scale operations, we may expect the losses from this source to be worthy the closest consideration.

Data on which to base general conclusions of this kind exist no doubt in plenty in the records of manufacturers themselves, but are often inaccessible, to the great detriment of the particular branch of technology with which they are concerned. Some figures have, however, lately been contributed by C. Heræus to the *Chemiker Zeitung*, which are worthy of attention. The teachings of electro-chemistry lead to the belief that a pure metal will in general be less readily attacked by a corrosive liquid to which it may be exposed than one to some extent contaminated with impurities. The example that at once occurs to one is that of zinc, which is all but unacted on by dilute sulphuric acid if pure, but if of only commercial quality dissolves with rapidity in that menstruum. But the exceptions to this rule are many and weighty. It is generally conceded, although the opposite view has been authoritatively advanced, that pure lead for vitriol chambers is a costly mistake, a small proportion of antimony being considered greatly to increase its power of resistance. It is, therefore, neither surprising to find that the first impression as to what is the proper quality of platinum to be used

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for stills was that it should be pure, nor astonishing to discover that there is ground for supposing this view mistaken, and that a certain alloy is preferable to the pure metal. Formerly, platinum for stills was required to contain not more than 0·5 per cent. of iridium, and, in spite of the statement current in the text-books that an alloy containing 10 per cent. of iridium was better at least for laboratory purposes, no record of direct experiment appears to have been made until lately. A sample of extremely pure platinum, containing only 0·01 per cent. of iridium, was taken as the basis for experiment, and alloys, composed of 95 per cent. of platinum and 5 per cent. of iridium, and 90 per cent. of platinum with 10 per cent. of iridium, prepared therefrom. These alloys were rolled into sheets, weighed, and exposed in a still used in the preparation of sulphuric acid of 98 per cent. strength for forty days. At the end of this time the test specimens were weighed again, and the loss of weight compared with that suffered by a similar piece of pure platinum. Calling the loss of weight of the pure platinum 100, that of the 5 per cent. alloy was 73, and that of the 10 per cent. alloy 58—a very significant result. There appears, therefore, good reason to suppose that a trial of the 10 per cent. alloy would at least be worth making. With the present high price of platinum the extra cost due to the introduction of iridium is of less moment than heretofore, while the diminution of loss becomes a goal more desirable of attainment. One word of caution may, however, not be out of place: 10 per cent. iridio-platinum is not always quite to be depended upon; vessels made by firms of repute have sometimes been found anything but satisfactory in actual use. Possibly it is not easy to free the iridium from allied metals, such as osmium, that have disagreeable peculiarities, but whatever the cause it is a certainty that this alloy may prove troublesome, and even useless for some purposes.

To some the attack of platinum by sulphuric acid may seem almost incredible, but it is real enough even with the pure acid, and is probably greater when nitrous compounds are present. It is well known that gold is by no means unattacked by nitric acid (especially in the presence of nitrous acid), and indeed such perceptible quantities are dissolved that in recent researches in pure chemistry it has been found necessary to abandon the use of platinum retorts, the joints of which were soldered with gold, in favour of such apparatus as allowed the nitric acid that was being prepared to come in contact with no metal but platinum, and thus maintain its purity. But the order of attackability of gold and platinum by nitric acid appears to be reversed in the case of sulphuric acid. An experiment executed in a manner similar to that already detailed showed that, taking the same standard of comparison as before—viz., the loss of weight of pure platinum as 100—the loss of weight of gold was only 13, or but little more than an eighth of the former quantity. Acting on the result of this experiment, Heræus has taken out a patent for coating the interior of the platinum retorts used in the manufacture of vitriol with gold at the bottom and as far up the sides as the boiling acid reaches. As gold and platinum are at present not far from being the same price, the economy of such a proceeding is obvious. Even in the event of the price of platinum falling to its former level, there will be a large margin, and it is highly improbable that the substitution of the one metal for the other for this purpose will ever prove unprofitable, as, for that to come about, the price of platinum must be only about one-eighth that of gold—*i.e.*, about 10s. an ounce.

Notes.

RAILWAY CARRIAGE COOLING APPLIANCE.

An improved apparatus for providing railway carriages with a cool and pleasant breeze has just been brought out by Mr. George Payne, of the Locomotive Department, Indian Midland Railway. It is fitted under the body of a carriage, is self-revolving, is so arranged that it will catch the air from all directions, and it possesses, according to the *Indian Engineer*, other advantages, one of the most important being that it will keep working for fifteen minutes after the train has been stopped.

A SEWER SCRAPER.

An apparatus has been invented by M. Emil Sokal for the purpose of clearing away the sludge in the sewers of Warsaw, Russia, when the fall is too slight to admit of its being removed by the ordinary means of flushing. The contrivance, states the *Engineering Record*, consists of a wooden template or mould, fitted to the profile of the sewer, and resting on a batten 1½in. thick, which is pointed at the end for the purpose of penetrating and loosening the sludge. The flushing sluice above the portion of the sewer to be cleaned is closed, and water allowed to accumulate. About 6ft. or 10ft. lower down the template with the pointed scraper is set up; the sluice is now opened, and the scraper, which is under the control of a workman, moves on and clears the deposit. If this be very solid and hard, a small shutter in the template is opened and water sufficient to thin it is admitted, or the scraper may be used more than once at any desired spot.

THE DE WILDE-REYCHLER CHLORINE PROCESS.

W. Jurisch, who has made a study of the commercial aspects of this process, to the inception and progress of which we have from time to time referred, considers that it will prove preferable to the Hurter-Beacon process, both on account of the plant being less costly to instal and work, and because of the fact that the chlorine is evolved in such a concentrated form that bleaching powder of full strength can be made from it. In Belgium, Holland, France, and Germany bleach works and paper factories are about to adopt it extensively.

BRITISH GOODS IN INDIA.

We learn from the *Lucknow Advocate* that a somewhat curious movement has been organised in Calcutta, the object being to boycott everything English. A League has been formed, and its members have bound themselves to have nothing more to do with Manchester cloth, Liverpool salt, and English imported goods. The immediate result has been an impulse to the production and sale of hand-made cloth and piece goods of Bombay. If this be carried out it is practically the imposition of a voluntary tariff, and it will be rather curious to observe how far what is supposed to be a feeling of patriotism will counterbalance the tendency to purchase in the cheapest market.

CURIOUS CAUSE OF ELECTRICAL FAULTS.

The London Electric Supply Company find that where they use concentric wires faults suddenly occur. These they find to be due to mice making contact between the earth and the insulated high-pressure terminal. A current passes and blows the fuse, and the burnt remains of the mouse are found. Probably mice are attracted by the warmth of the transformers, which, when not too hot, also attract beetles and other insects. When the mice get near the high-pressure terminal there is an electrostatic force which acts on their antennæ. This attracts their attention, and they investigate the terminal and find that, whether knowledge comes after death or not, death is apt to come first. If such calamities occurred in the United States, the daily press would reek with sensational accounts of the dangers of electricity for months afterwards.

ELECTRICITY AS AN INCENTIVE.

An American inventor, Mr. A. B. Holson, has patented the combination of a battery, an induction coil, and a horse. If the horse is indolent the induction coil is brought into use to inspirit him. This invention should be used in conjunction with that of Mark Twain for obviating the risks attendant on too high velocities when attained by horses attached to conveyances. A small derrick is arranged above the quadruped; and if his velocity, or, as our electrical friends will have it, his resistance, is dangerously increased, in spite of tension applied to the controlling gear, he is elevated till he is no longer in contact with the ground, and his further proceedings are rendered innocuous. It would seem that horses will soon be under more perfect control generally, for, according to our contemporary, *Invention*, Mr. T. Cannon has just patented a form of bit which has a tube and funnel, so that medicine may be readily poured into the animal whether he feels inclined for it or not.

STANDARD THERMOMETERS.

It is well known to thermometer makers that a freshly blown glass bulb contracts slowly in volume for a very long time, and various processes have been invented for hastening this secular contraction. The ordinary process of boiling in oil takes a very long time, and we therefore wish to call attention to some results which have recently been obtained, in which the glass was heated in boiling sulphur. Two experimenters, Messrs. Callendar and Griffiths, have studied the alteration of a bulb of soft German soda glass at the temperature of sulphur vapour. Their bulb at the commencement held 59·710 cubic centimetres, and after a quarter of an hour's immersion in sulphur vapour its volume was 59·574 c.c., showing a decrease of ·136 c.c. The same bulb was then re-heated for two hours at that temperature, and its volume had decreased by ·056 c.c., and after a similar re-heating its volume was 59·505, showing only a further decrease of ·013, at which it remained practically steady. So that a long and tedious operation may be immensely shortened by the use of boiling sulphur. Sulphur may be readily boiled in an iron vessel with the lower end in the fire, and sufficiently tall to condense the vapours. The boiling point of sulphur is 444°—that is, a temperature only slightly below that at which the glass in question softens. This fact explains the observed results. The glass should be in contact with the vapour only, as it is blackened by contact with the liquid sulphur.

INDUSTRIAL ESTABLISHMENTS AT ODESSA.

From a recent official report we learn that there are now upwards of 300 industrial establishments in Odessa, covering almost all branches of industry. Those giving employment to men chiefly are respectively iron foundries, sugar refinery, jute sack factory, tobacco factory, flour mills, &c. The jute factory was opened in 1887 and it has been gradually extending its operations till there are now at work 179 looms driven by two engines, each of 300 i.h.p. One hundred and forty men, 400 women, and 60 children are employed in the works, two years' instruction from two Dundee women having sufficed to initiate them in their duties. Six Englishmen are permanently employed as engineers and technical workmen, the rest being Russians. The works turn out annually from 1,800 tons to 2,200 tons of sacks of various sizes and qualities, besides a small amount of Dutch carpeting. The effect of these works on the importation of jute sacks may be estimated from the following figures:—Imports of jute sacks in 1888, 2,058 tons; in 1889, 1,710 tons; and in 1890, 716 tons.

RAILWAYS IN GERMANY.

The following returns of the results of the working of railways in the German Empire for 1890 have been published by the Imperial Statistical Bureau, and will be of interest for the purposes of comparison with those of the United Kingdom:—

Total mileage	Miles	25,660
Locomotives		13,496
Carriages for conveyance of passengers only		25,404
Waggons for conveyance of general merchandise, minerals, live stock, &c.		237,559
Travelling post-office cars		1,647
Passengers conveyed		337,000,000
General merchandise, live stock, and minerals conveyed	Tons	212,100,000
Average distance which each ton was conveyed	Miles	64⅝
Receipts from passenger traffic		£16,695,000
„ from goods traffic		43,660,000
„ miscellaneous		2,875,000
Total receipts		£63,230,000
Total working expenditure		£34,150,000
Amount paid into the public treasury by the German State lines		26,500,000
Proportion of expenditure to receipts per cent.		54·02
Receipts per mile of railway open—		
From passenger traffic		£667
From goods traffic		1,821
Total per mile		£2,488
Expenditure per mile of railway open		£1,344
Receipt per passenger and per mile		½d.

The total mileage in the United Kingdom is about 20,000 miles, and the number of locomotives about 16,000, the former being less than the corresponding number in the above table, and the latter greater, and these and similar items explain why the expenditure per mile of railway open is only £1,344 in Germany against £1,934 in this country. Another remarkable fact is that more than double the number of passengers are conveyed in the United Kingdom as compared with Germany, but of course a great part of this can be explained by the different domestic habits of the two countries, a comparatively small proportion of the people travelling from country districts into towns, and the facilities for urban travelling being much less extensive than in this country.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

1st June, 1891.

9147. Ellis, A. W. ..... Filtering apparatus.
9166. Taylor, C. ..... Apparatus for singeing textile fabrics.
9167. Taylor, E. ..... Manufacture of ornamental tubing.
9185. Smith, W. ..... Fluid pressure motors.
9203. Tuckfield, C. ..... Automatic steering gear.
9209. Priestman & Priestman Igniting device for gas engines.
9210. Van den Ende, M. J. ... Moulding apparatus.
9213. Ball & Lenggenhager Rotating mechanism for rock drills.
9214. Sigmund, C. ..... Sounding apparatus.
9216. Jefferies, S. ..... Machinery for making bricks and similar articles.
9225. Metcalfe, H. W. ..... Speed indicators for steam engines.
9230. Gestetner, D. ..... Milling or rotary cutters.
9238. Ambler & Branter ..... Machine for moulding hollow ingots.
9246. Day, J. ..... The propulsion of boats and wheeled vehicles by gas or explosive vapour.
9247. Day, J. ..... Gas engines.
9248. Brunner, A. ..... Compound locomotive engines.
9250. Hosking, T. ..... Utilising the waste heat from steam boilers.

2nd June, 1891.

9255. Morrell & Mott ..... Railway rail joint.
9256. Robertson, Orchar, & Robertson ..... Let-off mechanism of looms.
9259. Johnson, J. Y. ..... Station indicators (*Allison*).
9263. Adams, J. H. ..... Gauges for marking and cutting.
9266. Crosland, J. F. L. ..... Steam boilers.
9268. Bosshardt, F. ..... Governors for gas engines (*Huntington*).
9286. Willford, G. W. ..... The manufacture of laminated springs.
9306. Langerfeld, A. ..... Hydraulic embossing machine.
9318. Boult, A. J. ..... Apparatus for charging retorts (*Klonne & Bredel*).
9321. Lake, H. H. ..... Scotch yokes for steam engines (*The Laforge Engine Company*).
9323. Huelser, C. ..... Gasifying contrivance for petroleum motors (*M. Grob & Co.*).
9328. Lake, H. H. ..... Magazines for breechloading weapons (*Bruce*).
9335. Newton, H. E. ..... Printing machinery (*R. Hoe & Co.*).
9347. Osborne, J. H. ..... Screw propellers.
9349. Riggs, L. S. ..... Automatic cut-in valves for air brakes.
9350. Murphy, J. A. ..... Traverse motion for winding cords or yarns on bobbins.
9352. Lefebvre, A. J. ..... The permanent way of railways.
9354. Zube, J. ..... Retort furnaces.
9357. Gough, H. D. ..... Differential pulley blocks.

3rd June, 1891.

9366. Gibbons & Gibbons ..... Apparatus for charging inclined gas retorts.
9369. Evans, W. ..... Screw propellers.
9380. Boyd, J. ..... Machinery for winding yarn or thread.
9381. Rongier, H. ..... Differential pulley blocks.
9396. Frohlich, S. G. ..... Looms for weaving coloured fabrics.
9401. Bell & Bell ..... Mechanical stokers and steam boiler furnaces.
9407. Nuttall, J. ..... Governors.
9422. Larsen, A. C. ..... Centrifugal machines.
9424. Mackay, F. N. ..... Compression pumps for ice or cold producing machines.
9432. Lake, H. H. ..... Couplings for railway vehicles (*Caldwell*).
9438. Garrett, J. W., Jun. ... Hydraulic motors.

4th June, 1891.

9452. Atock, L. ..... Looms for weaving.
9456. Bragg, W. B ..... Bulkheads, or the like, in ships.
9463. Hughes, E. W. M. ..... Manufacture of railway carriage couplings.
9469. Pilkington, S. H. ..... Picking motion for under pick looms.
9473. Broadbent, H. ..... Pneumatic power hammers.
9474. Smith, R. H. ..... Indicators for steam, gas, and other engines.
9475. Brown & Balfe (both of the Firm of Thomas Taylor & Sons, Ld.)... Machinery for preparing yarn.
9484. Hosking, T. ..... Combined feed-water heater, draught inducer, and smoke consumer.
9488. Schmidt, W. F. ..... Looms for weaving.
9489. Oxley, T. ..... Pickers for use in looms.
9498. Cameron, A. ..... Driving pulleys.
9519. Edwards, E. ..... Steam engines.

5th June, 1891.

9543. Hoyer, F. ..... The generation of steam for steam engines.
9548. Watt, Kershaw, & Hargreaves ..... Pickers used in looms.
9549. Thompson, W. ..... Apparatus for drawing fibres.
9550. Ellis, W. I. ..... Gas exhausting machinery.
9558. Watkins, A. A. ..... Hydraulic engine.
9559. Hammesfahr, E. ..... Applying driving belts to pulleys.
9560. Banks, B. R. ..... Machine for casting bullets.
9564. Richard, T. ..... Pumping or raising liquids.

6th June, 1891.

9576. Govan, A. A. ..... Coupling railway carriages.
9579. Soucheire, L. ..... Means of converting reciprocating into rotary motion.
9583. Shone & Ault ..... Machinery for compressing and exhausting air or other fluids.
9599. Von Mertens, F. R. ..... Driving mechanism for the axles of locomotives mounted on turning frames or bogies.
9603. Boult, A. J. ..... Apparatus for automatically supplying feed water to steam boilers (*Laillet*).
9607. James, W. ..... Hydraulic apparatus for transmitting motion to engines and other machines.
9609. Biggs & Thomas ..... Apparatus for cleaning tin or terne plates.
9613. Hulme, S. ..... Roving and similar frames.
9620. Walker, A. G. ..... Railway signalling apparatus.
9631. Owston, W. C. ..... Water circulation and consumption of smoke in furnaces for steam boilers.
9632. Edwards, E. ..... Railways for transporting ships (*Dymcoff*).
9645. Horn, W. W. ..... Rail splice and bolt for railroads (*Weller & Mann*).

ELECTRICITY.

1st June, 1891.

9227. Siemens Brothers & Co., Ld. ..... Telephones (*Siemens & Halske*).
9241. Thompson, W. P. ..... Electric railways (*Harding*).
9245. Linhart & Seitz ..... Telegraphic apparatus.
9249. Rowan & McWhirter ... Electromagnets for holding tools.

2nd June, 1891.

9272. Callendar, H. L. ..... Resistance boxes.
9291. Bishop, A. E. ..... Arc lamps.
9300. Sykes, W. R., Sen. ..... Railway signalling apparatus.

3rd June, 1891.

9403. Raeburn, J., Jun. ..... Insulating appliances.
9418. Macdonald, R. ..... Movable submarine batteries.
9423. Grenfell, H. H. ..... Holder for incandescent lamps.
9435. Lauckert, E. F. H. H. ... Transformer.
9436. Williamson, A. D. ..... Transformer.

4th June, 1891.

9462. Alcock, A. U. ..... Electrostatic switch and phase indicator.
9507. Dayton, C. A. ..... Stop motion for engines.
9522. Stanley, Jun., & Kelly Alternating current electromagnetic motors.

5th June, 1891.

9555. Gwynne, J. E. A. ..... Carbons or electrodes for arc or other lamps.

6th June, 1891.

9606. Thompson, W. P. ..... Apparatus for holding telephone receivers (*Stein, Jun.*).
9627. Abel, C. D. ..... Thermo-electric batteries (*Gülcher & Pintsch*).
9628. FitzGerald, D. G. ..... Negative elements of voltaic batteries.
9637. Alabaster & Gatehouse Automatic cut-out.
9642. Watt, H. ..... Lamps.

CHEMISTRY.

2nd June, 1891.

9280. Frost & Kayser ..... Azo colouring matters and their application for dyeing.
9332. Brochocki, C. T. S. de D. Production of chlorine compounds for bleaching.

3rd June, 1891.

9388. Taylor, M. ..... Apparatus for the production of carbonic acid gas, and the employment thereof in the extinguishing of fire.
9439. Lake, H. H. ..... Collecting the vapours of solvents (*La Société Anonyme des Parfums Naturels de Cannes*).

4th June, 1891.

9457. Parkinson, J. H. ..... Separating oxygen from atmospheric air.

5th June, 1891.

9575. Rylands, D. ..... Process for the manufacture of carbonic acid gas.

6th June, 1891.

9636. Willcox, B. ..... Black azo colours (*Farbenfabriken vormals Friedrich Bayer & Co.*).
9646. Luhmann, E. ..... Production of carbonic acid.

MISCELLANEOUS.

1st June, 1891.

9170. Lamb, G. W. ..... Railway and fog signals.
9171. Luhmann, E. ..... Extraction of gases from fluids.
9193. Jacks, R. ..... Composition for coating ships' plates (*Sharp*).
9194. Blakemore, J. ..... Nuts.
9217. Boyce & Hollier ..... Anchors.
9219. Niewerth, H. ..... Obtaining metals and other minerals.
9224. Wilson & Pirrie ..... Boat disengaging gear.
9237. Brewster, F. W. ..... Supporting, lowering, and raising ships' boats.

2nd June, 1891.

9284. Taylor, J. ..... Belt fastener.
9288. Harding, T. W. ..... Combs for cleaning the brushes of cotton cards.
9325. Starley, J. K. ..... An improved joint.
9333. Collet, A. ..... Manufacturing wood pins and keys for railway purposes.
9341. Rogers, J. H. ..... Manufacture of tin and terne plates.

3rd June, 1891.

9434. Menzies, J. ..... New composition.
9440. Horn, W. W. ..... Metallic lathing for walls of buildings (*Gibson*).

4th June, 1891.

9497. Beddoes, W. ..... Life-saving belt (*Woods*)
9504. Simmonds, F. N. ..... Punches.

5th June, 1891.

9526. Labois, L. ..... The manufacture of white lead.

6th June, 1891.

9591. Palmer, W. ..... Apparatus for photographing engineering drawings.
9600. Gautier, L. ..... Endless chain.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

6600. Evans.
6873. Dény.
8701. Agudio.
8873. Daw & Daw.
8890. Renouf.
9061. De Ferranti & Wright.
9142. Miller & Miller.
9207. Hoskins.
9223. Bradbury.
9449. Mackinlay & Darwin.
9636. Cowburn & Peck.
10033. Bayly (*Thomas*).
10151. Roberts & Wheater.
10372. Andrews.
10444. Bayly (*Brown*).
10736. Oudin & Kratz-Boussac.
10805. Mills (*Edison*).
10918. Curtis & Carey.
11023. Thompson (*White*).
11068. Blakeney.
11186. Harris.
11275. Toft.
11581. Rowan & Armour.
11673. Sturgeon.
11705. Walker.
11734. Bayly (*Schriver*).
11769. Marsh.
11884. Duckham.
11932. Fayod.
11979. Giles, Roberts, & Boake.
12001. Skinner.
12013. Sinclair & Mackay.
12078. Barker & Wilson.
12111. Pollitt & Mangnall.
12122. Mathewson.
12131. Brand.
12157. Tiratay.
12158. Tinckham.
12192. Howarth & Stott.
12244. Newton (*Swan*).
12258. Wright.
12267. Chester.
12299. Sugg.
12341. Morton.
12370. Winson.
12386. Johnson (*Badische Anilin & Soda Fabrik*).
12467. Matthews.
12684. Fairfax (*Crane*).
12791. Shorrock & Martin.
6612. Webb.
8593. Holmström & Acland
8839. Bürde.
8889. Renouf.
8907. Hanbury.
9123. Dauber.
9198. Wise (*Chemische Fabrik Buckau Actiengesellschaft*).
9630. Rendall & Rawstron.
9727. Williams.
10126. Parham.
10199. Hardt.
10414. Whitehead.
10655. Bayly (*Currie*).
10777. Porritt, Porritt, Porritt, & Fenton.
10831. Van Vestrant.
11022. Thompson (*White*).
11024. Thompson (*White*).
11122. Kitto, Kitto, & Kitto.
11266. Shaw.
11391. Lizot (*née* Lecomte).
11632. Guhrauer.
11690. Askham & Wilson.
11720. Jones & Woodhouse & Rawson United, Ld.
11812. Green.
11926. Hamilton.
11937. Hazlitt.
11980. Griffiths.
12000. Walton.
12004. Ménetrel.
12039. Dobson (*Bourcart*).
12084. Gresham.
12115. Johnson.
12130. Brewster.
12152. Smith, Sen., Smith, Jun., & Smith.
12165. Kasparck.
12227. Rodary.
12255. Redfern (*Simms*).
12259. Oddie.
12272. May.
12314. Holt.
12356. Johnson (*Badische Anilin & Soda Fabrik*).
12392. Duncan.
12437. Lake (*Manning*).
12624. Clark (*Horgan*).
12744. James.
12993. Johnson (*Von Heyden*).

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13092. Hoff.
13214. Bochkoltz.
13474. Wise (*Bemelmans*).
13610. Halstenbach.
13946. MacLaine.
14175. Heymann & Schmidt.
15175. Poggio & Poggio.
15452. Page.
16836. Lowe.
17316. White & Hancock.
18600. Robinshaw, Schofield, & Heap.
13169. Munro.
13401. Robinson.
13491. Harness.
13632. Loosemore.
14065. Korbuly.
14416. Johnson (*Badische Anilin & Soda Fabrik*).
15460. Gage.
17203. Cotton.
18148. Carey.
19726. Bonne (*Weiss*).
20740. Thomas.

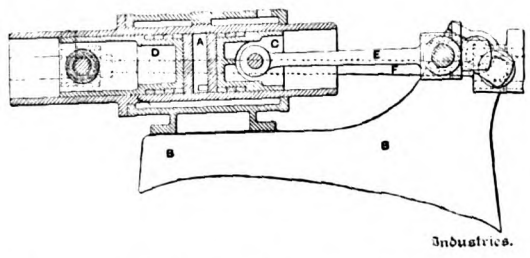
1891.

199. Jerger.
827. Wills & Roberts.
1070. Adams.
1730. Prentiss.
2026. Herosé & Moulton.
2194. Batson.
3348. Tilghman & Tilghman.
3817. Gardner.
4695. Baldwin.
5386. Imms.
5493. Berdux.
5614. Pratt.
5781. Lake (*Tallmadge*).
6110. Stein.
6389. Chesebrough.
6505. Sutcliffe.
6670. Wood.
6801. Harris.
6841. Rung.
6921. Kuhn.
7094. Lane (*Culmer*).
7303. Maxon, Boyer, & Staniland.
7373. Jensen (*Schroeder*).
7462. Lane & Clare.
7557. Pirnie.
7571. Jardine (*Sival*).
7580. Bell & Welsby.
7584. Fauler.
7715. Washburn.
7729. Hatfield.
7748. Moore.
7751. Bolthoff.
7757. Fish.
7758. Lake (*Nye*).
7774. Thompson (*Drosten*).
7784. Kolstö.
7790. Heitz.
7832. Von Wehrstedt.
476. Banta. (11th June, 1890.)
1729. Prentiss.
1734. Dredge.
2119. Payne.
2343. Webb.
3529. Hughes.
4265. Brady.
5332. Smith.
5452A. Wacker. (28th March, 1891.)
5637. Barker (*Farmer*).
5843. Moschek & Brunner.
6299. Boult (*Wicke & Pfeiffer*).
6390. Johnson.
6644. McCarthy.
6783. Hills.
6831. Parcell.
6911. Prideaux, Chave, & Baker.
7302. Jarkovski.
7334. Boult (*Kneifel*).
7341. Pleukharp.
7347. Kimplen.
7530. Miller.
7567. Martin, Honychurch, & Morling.
7582. Klumpp.
7589. Lundberg. (30th October, 1890.)
7744. Hungerbühler.
7749. Longenecker & The Peirce & Coleman Company.
7765. Newton (*Reeks*).
7778. Thompson (*Williams*).
7787. Hammond & Gordon.
7805. Mittag.
8114. James & James.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Gas Engines.—*G. Robson, Sunderland.*—The improvements described relate to gas engines and to other motor engines operating upon like principles. The novelty of the invention is said to consist, substantially, of constructing the cylinder of the engine so as to contain two pistons of equal diameter, but having unequal strokes and working in opposite directions, but actuating the same crank shaft. An engine is described, as an example, which is arranged as shown in the sectional elevation below,



having a motor cylinder A, with a water jacket, mounted on a bed-plate B, in the usual way. In this cylinder, which is open at both ends, are a pair of trunk pistons C D, one of which C operates a crank by a single connecting rod E, the other piston operating by a double connecting rod F a pair of cranks on the same shaft. The piston C has a greater stroke than the other, and the cranks may be set at any desired angle with one another, the angle of 215 degrees being chosen in the example. The gas and air valves may be arranged and operated as may be most convenient. When an explosive mixture is admitted to the cylinder and ignited, the pistons are driven outwards from each other and are returned by the momentum of the engine when the products of combustion are driven out through the exhaust port, and the pistons moving out again, a fresh charge of explosive mixture may be drawn in and compressed upon their return stroke. Steadiness, regularity, and high speed are said to be the characteristics of this arrangement. Claims: A double-piston single-cylinder engine, wherein the pistons travel unequal distances in opposite directions, and actuate one crank shaft, as described; the engine as aforesaid in which the rearmost piston is connected by two lateral connecting rods, and the foremost piston by one medial rod, to the same crank shaft, the cranks of which may be set at any suitable angle to each other.—No. 9496. June 19th, 1890. 6*d*.

Air Compressors.—*H. H. Lake, London.* (*E. Hill, South Norwalk, U.S.A.*)—Formerly air compressors designed to compress air to a very great extent were composed of two single-acting cylinders, a large one being used as the primary compressor, and from which the air was led to a smaller auxiliary cylinder where it was still further compressed. When the compressor was first started the large cylinder would be doing its full share of the work while the smaller one was doing practically nothing; this would cause the machine to run heavy on one side and light on the other. This could be remedied by making the cylinders double-acting, but it was found practically impossible to construct a piston for the auxiliary cylinder which would prevent leakage from one side to the other. With single-acting cylinders, where the power is applied only in one direction, there is considerable loss of power on the return stroke, and the compressor works very irregularly and so produces undue strains on the machinery. This invention is designed to overcome this difficulty, and consists of a combination of double-acting primary cylinders with a pair of single-acting auxiliary cylinders oppositely arranged so that an even resistance is produced in all parts of the machine. The accompanying illustrations show this invention carried into effect, Fig. 1 being a side elevation, and Fig. 2 a plan. A is the steam cylinder, B the driving shaft having two

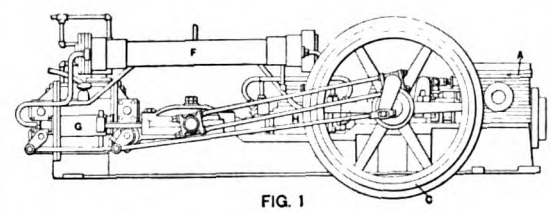


FIG. 1

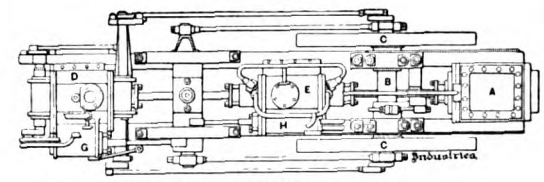


FIG. 2

fly-wheels C C, D represents the first or principal compressing chamber, and E the second compressing chamber. These cylinders are both double-acting and have pistons on piston rods actuated by connecting rods, crossheads, &c., as will be clearly seen in the illustrations. The cylinder D discharges into a receiver, not shown, and from which the cylinder E draws the air and discharges it into a second receiver F. G and H are two single-acting cylinders arranged at the sides of D and E respectively, which have their pistons worked from one of the crossheads in such a manner that while one piston is forcing air the other is being withdrawn. They are of equal area and both draw air from the receiver F and discharge into a common outlet. The inventor describes methods for packing the final compressing cylinders and mentions that in some cases the second or intermediate cylinder may be dispensed with. There are four claims, embracing the following: The combination of a double-acting air compressing cylinder discharging into a receiver with a pair of single-acting cylinders of equal capacity and arranged to operate in opposite directions and drawing air from the receiver. —No. 5254. March 24th, 1891. 8*d*.

Platen Printing Machines.—*A. Morfitt, Nottingham.*—In platen machines constructed according to this invention the locking or holding of the rocking platen is more secure whilst an impression is being taken, and it is possible to obtain a continuous removal and redistribution of the ink upon the inking rollers, to ink the forme more perfectly than heretofore, and to increase the inking surface. An ordinary type of platen machine is described, to which the improvements are applied. A shaft extending transversely across the machine at the rear of the platen is carried in bearings in the main frame, and is caused to receive a partial rotation by means of a cam, lever arm, and spring; a portion of the shaft between its bearings is reduced in diameter, the reduced portion being eccentric to the bearing ends, and being partly flattened to allow the platen frame to pass in close proximity thereto. A suitable cam, above referred to, operates as soon as the platen frame is in position to receive an impression bearing against a fixed stop, and causes the eccentric portion of the cross shaft to rotate into a recess in the platen frame and lock it, and also jam it against the fixed stop. The improved inking appliances consist of rider rollers of tubular form, free to revolve on fixed axles, there being a thread formed on the axle, and a corresponding thread in the hollow of the roller, or *vice versâ*. These rider rollers bear upon inking rollers which are caused to bear upon the type and inking surfaces by means of springs, the rider rollers being free to rise and fall whilst in contact with the inking rollers, and being moved endwise thereon by the screw threads whilst receiving therefrom a motion of rotation, so that a continual redistribution of the ink takes place, even while the ink is being taken off by the type. Claims: Locking the platen by an eccentric partially flattened to allow the platen to pass, and actuated by a cam, roller arm, and spring; also the rider rollers having a rotative and endwise motion upon the inking rollers.—No. 5100. April 2nd, 1890. 8*d*.

Steam Boilers.—*R. G. Ruffles, London.*—In this specification is described an apparatus applicable to steam boilers or other heating appliances, whereby a continuous circulation of the liquid to be heated is provided for by a tubular arrangement through which the water is caused to circulate continuously in an upward direction without liability of any conflicting currents therein, and wherein the main body of water so circulating is surrounded (for any desirable longitudinal extent) by a tubular film, which latter, throughout its length, is exposed to the direct effect of the fire, and is, at its top and bottom parts, in free communication with the said surrounded body of water. This arrangement results in causing an exceedingly rapid conversion of the said film of water into steam, which, continuously escaping into the said surrounded body of water at the upper communication of the film-containing chamber therewith, is effective in inducing (after the manner of an injector) at the head of the inner column of water a continuous pull, and consequently an upward following of that column, and is also resultant in causing an exceedingly rapid upward circulation of the water in the film-containing chamber; owing to the communication existing between the film chamber, at its lower end, and the inner column, a similar upward current is set up in both the film and the inner column. The outer tube is of the Galloway or similar type, the inner tube being fitted into it, closing its upper end, except for the communication with the inner tube by openings in the wall of the latter. The bottom end of the inner tube is provided with a conical deflector, to deflect the water from the centre of that tube, and cause it to pass into the adjacent and concentric inlets to both tubes. Or the outer tube may be connected at its lower end with another tube passing along the flue and being bent upward, so as to draw its supply of water from above the crown of the flue at a point further along than the concentric arrangement is fitted. Claims: The arrangement of double concentric tubes as described, constituting an arrangement for inducing circulation in steam and other boilers.—No. 7121. May 7th, 1890. 8*d*.

Direct-acting Engines.—*H. E. Newton, London.* (*C. C. Worthington, Irvington, New York State, U.S.A.*)—In this invention a vertically arranged duplex engine is especially designed to permit of the use of steam expansively, and also to secure the balancing of the parts, so that the power exerted by the steam pistons will be substantially the same upon the up and down strokes. The invention may be understood by an immediate reference to the illustrations, in which Fig. 1 is a side elevation and Fig. 2 a plan. The engine as therein shown consists primarily of two high-pressure cylinders A B and two low-pressure steam cylinders C D. The cylinders A C form one side of the duplex engine, and the cylinders B D the other side, the two cylinders being connected so as to use steam upon the compound principle. The cylinders are provided with induction and exhaust valves of ordinary construction, and the piston rods G H of the cylinders A B are provided with the usual connections E, by which the valve of each cylinder is operated from the piston rod of the other, in the manner common in duplex engines, the other two piston rods I J being provided with similar connections F, by which the valves of those cylinders are operated in the same manner. Fulcrumed upon the framework beneath the main steam cylinders is a pair of rocking beams K L, which are respectively connected by links M with the piston rods G I and H J. By these means the pistons of the cylinders A C, and the parts connected therewith, are caused to move in unison, one piston and its connected parts making the up stroke while the other piston and its connected parts are making the down stroke, thus causing the weight of the condensing piston and its connected parts to be counterbalanced, or substantially counterbalanced, by the weight of the ascending piston and its connected parts, thus balancing the engine, and causing the available power exerted upon the pistons to be the same upon the up and down strokes. The ends of the beams K L are provided with bearings to receive the ends of the piston rods of two pairs of oscillating compensating cylinders O, pivoted on trunnions supported in suitable bearings, as shown. These compensating cylinders are supplied with a motive fluid under suitable pressure, through pipes which communicate with

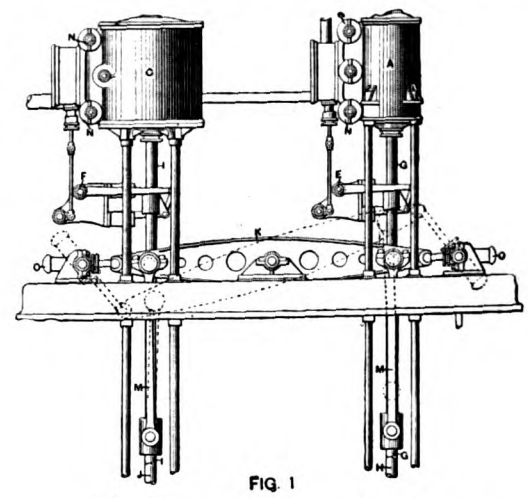


FIG. 1

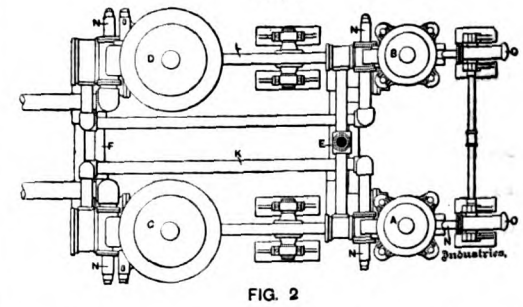


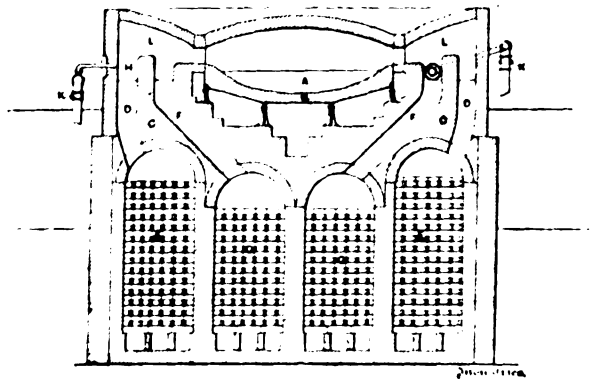
FIG. 2

one trunnion of each. The operation of the engine takes place as follows:—Let it be assumed that the piston of the cylinder C has completed its down stroke, and the piston of the cylinder A its up stroke, thereby bringing the compensating cylinders and the beam K into the position indicated by dotted lines; it will be observed that when the beam K is in this position the angle of the rods of the compensating cylinders with relation to the beam K is such as to resist the downward movement of the piston of the cylinder A, and the upward movement of the piston of the cylinder C. During the first parts of the strokes of these pistons the power developed by the steam against their pistons will be resisted by the power developed in the compensating cylinders, but as the pistons of the main cylinders proceed upon their strokes this resistance will, owing to the constantly changing angle at which the piston rods of the compensating cylinders act upon the beam K, be gradually reduced until the pistons of the cylinders A C arrive at the middle of their strokes, as indicated by full lines, at which time the piston

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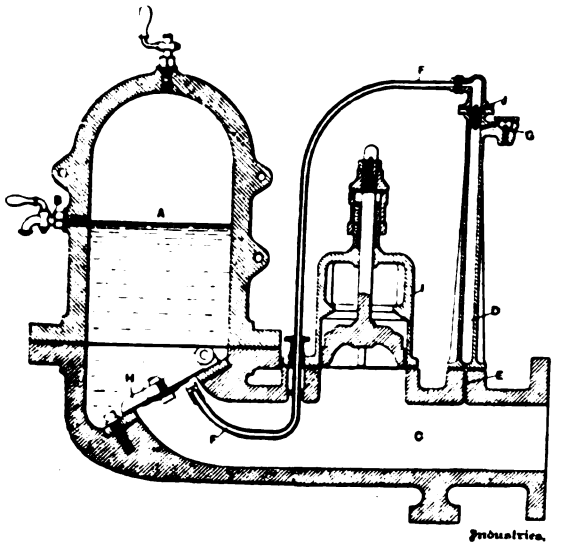
rods of the compensating cylinders will be brought into line, and will, therefore, oppose each other, but offer no resistance to the pistons of the main steam cylinders. During the last part of the stroke of the pistons of the main steam cylinders the operation will be reversed, and the pistons of the compensating cylinders will offer a gradually increasing assistance to the main steam pistons. The operation of the compensating cylinders permits of the use of steam expansively, and the engines are therefore provided with suitable cut-off valves N, operated in any convenient manner. Claims: The combination of parts arranged and operating substantially as described and illustrated. —No. 5251. March 24th, 1891. 8*d*.

WATER-GAS FURNACES.—*S. Fox, Leeds.*—The inventor mixes water gas with ordinary producer or Siemens gas in certain proportions for use in the manufacture of iron and steel in connection with Siemens or other gas furnaces, and eliminates



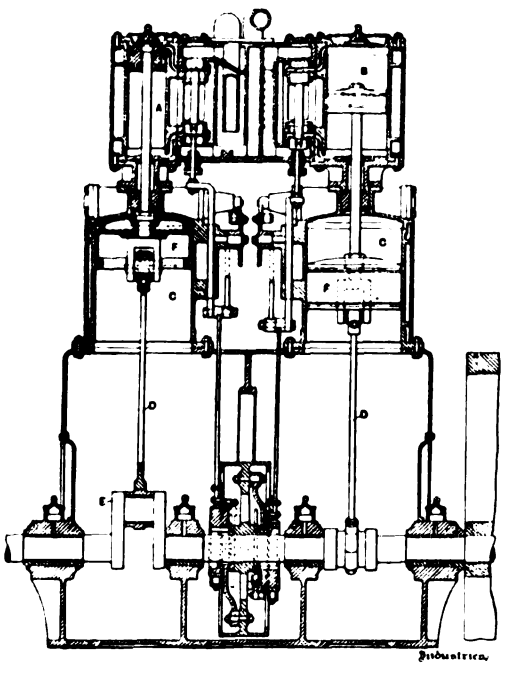
rapidly, by the means described, impurities, by oxidation or otherwise. The inventor states that the necessary temperature for the reduction of metallic substances can be easier attained and maintained than by use of Siemens or producer gas alone. This is carried into effect by leading into any convenient part of the furnace or flue, jet pieces or nozzles for the introduction of the water gas, or a mixture of water gas and producer gas or water gas and Siemens gas, in all of which cases a separate valve is provided to control the water gas, so that the proportion of the gases may be varied to suit requirements. Referring to the accompanying illustration, which shows in sectional elevation the invention applied in two alternative methods to a Siemens gas furnace, A is the furnace bed, B the fire-brick lining, C divisional walls, D admission ports for air, which is previously heated by passing through the checkers E. F are the ports through which Siemens or producer gas is admitted after being heated by passing through the checkers G, H are nozzles for the introduction of the water gas controlled by the valves K. The charge being placed in the furnace bed A, Siemens or producer gas is admitted at the ports F, and mixes in the mixing chambers L with the water gas admitted by the nozzles H, from either one of which chambers L the mixture passes into the furnace. The invention is shown also as applied to a puddling furnace. Claims: The application of water gas in Siemens or other gas furnaces in use with ordinary producer or Siemens gas, or with both, in the manner described.—No. 7827. May 20th, 1890. 8*d*.

HYDRAULIC RAMS.—*W. L. Wise, London.* (*J. Piron, Philippeville, Belgium.*)—To increase the efficiency of hydraulic rams and to render their working continuous and automatic, the inventor provides the ram with an air pump that is automatically worked by water in the pressure pipe of the ram. The pump is provided with two valves, one for admitting air to the pump cylinder and the other to control a pipe leading the air to the air chamber of



the ram. These will prevent any deficiency of air in the ram and reduce shocks due to its working. Means are also provided to automatically regulate the amount of air injected into the air chamber, and consist of a cock placed at about half the height of the air chamber, which allows the air to escape when the water is depressed to a certain level, but will only allow water to pass drop by drop. The accompanying illustration shows the invention in vertical section: A is the air chamber having at its lower end a discharge pipe (not shown in the figure). This chamber is provided at B with an automatic regulating cock as before described. To the pressure pipe C is secured a vertical tube D, constituting an air pump cylinder, which communicates with the pressure pipe by means of a small orifice E. The upper end of the vertical tube D has a non-return air valve J, which controls communication through the pipe F, the other end of which passes into the pressure pipe C and terminates under the air chamber with a non-return valve. The air pump is provided with a vacuum valve G which permits air to enter the tube but will not allow it to return. The pressure pipe is provided with a flap valve H, immediately below the air chamber A, and also with an escape valve I of the mushroom type. When not in action the escape valve I is open; water flowing into the pressure pipe closes the escape valve by momentum, opens the flap valve H, and flows into the air chamber. Water under pressure also enters the vertical tube D, forcing the air through the pipe F into the air chamber. The escape valve I falls by gravity, and the water falling out of the vertical tube D draws in a further supply of air through the valve G. Claims: Causing air to be admitted into the air chamber of hydraulic rams by an air pump worked automatically by the water and the apparatus as described and shown.—No. 9729. June 23rd, 1890. 8*d*.

STEAM ENGINES.—*S. Wilcox, New York.*—In multiple-expansion engines the inventor embodies a series of single-acting low-pressure cylinders axially aligned with the double-acting high and intermediate cylinders, and having connected pistons coupled to a single crank, the steam distribution to the series of cylinders in alignment being governed by the same valve gear. The accompanying illustration shows in vertical section the invention applied as a triple-expansion engine. A is the high-pressure cylinder, B the intermediate cylinder, and C C two single-acting low-pressure cylinders. The vertical space occupied by the single-acting cylinders C, the inventor claims, is only equal to that occupied by the usual cross-heads and guides, so keeping the aggregate height of the engine normal with those of the usual construction. The cylinders C may form a part of the frame of the engine, and support the cylinders A and B above them. This lowers the centre of gravity of the engine, and allows the connecting rods D to be of increased length without rendering the engine top-heavy. The frame may be of any convenient form, and is shown in the illustration as being of the box form, and the cranks E may be fixed at the usual angle—*i.e.*, 90 degrees. The pistons of the



high and intermediate cylinders are connected by piston rods with the pistons F of the low-pressure cylinders, which pistons F have their bearing surfaces elongated to afford proper resistance to wear due to the side thrust of the connecting rods G. H H are piston valves for the cylinders A and B. The low-pressure cylinders have induction and eduction valves of the "Corliss" type (not shown). The receiving chambers have separators for eliminating condensed steam during the passage of the steam from one cylinder to another, and suitable drip valves are provided for removing the accumulated water from the wells of the separators. There are six claims, covering a compound engine consisting of a high-pressure cylinder or high-pressure and intermediate cylinders connected with a single-acting low-pressure cylinder or cylinders arranged in common axial alignment.—No. 1437. January 27th, 1891. 11*d*.

FURNACE BARS.—*W. Fraser, Birmingham.*—This invention relates to hollow furnace bars, through which air is supplied for combustion; instead of casting the bars in the ordinary manner, with an air passage cored out in them, the lower part of the bar is made of sheet metal, the upper portion being cast separately in a chilled mould and slipped on to the lower sheet-metal portion, which is bent into a trough shape to receive it. One part of the cast portion stands above the trough sides, and another part projects between them, the sides of the trough being held together by rivets or otherwise, and fitting into grooves recessed into the underside of the bar. The cast portion of the bar may be lightened by having a sheet-metal backbone, which is placed in the mould and has the body of the bar cast round its upper edge. It is intended that the whole of the air supply to the furnace should be taken through the hollow bars, which are supported by a hollow dead-plate and hollow bearers. The bridge is also hollow, being formed of sheet metal faced with firebrick, and having two chambers, one at the back and the other at the front of the bridge. The ashpit is closed, and the air supply is led through the dead-plate and bars into the front chamber of the bridge, being led over a central division plate and thence through the rear portion of the bridge, so that it may be thoroughly heated before it is finally discharged into the ashpit, at the lower portion of this front chamber. Or the heated air, instead of being discharged directly into the ashpit, may be led into channels formed in the brickwork lining the flue, and delivered at various parts of the fire and behind the bridge. The channels are controlled by suitable regulators hung below the fire-bars so as to divide the ashpit into three sections. The sides of the grate are lower than the centre, so as to obtain an increase of grate surface. An improved bearer for firebars is described, consisting of loose serrated pieces, which may be bolted on to each side of a serrated portion of the bar, in various positions, so as to shorten or lengthen it to fit various sizes of flue. Claims: A furnace constructed with air channels in the sides or lining of the furnace for conveying air from the bridge to the ashpit below the furnace; the arrangement of hollow dead-plate, hollow bars, and hollow bridge to heat the supply of air for combustion; the hollow bar formed as described; the firebar bearer, with extensible ends.—No. 5616. April 14th, 1890. 8*d*.

RAILWAY CHAIRS.—*A. J. Boult, London.* (*G. W. Wells, Worcester, Mass., U.S.A.*)—Chairs for supporting rails are so made under this invention that when in position they are firmly held by interlocking portions, and the use of nuts and bolts is avoided, rendering the chair, according to the inventor, practical, cheap, and efficient. Referring to the accompanying illustrations,

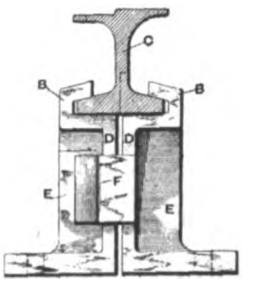


FIG. 1.

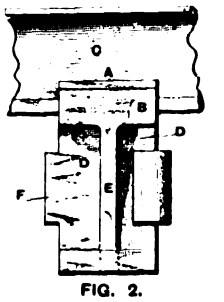


FIG. 2.

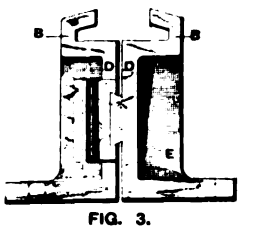


FIG. 3.

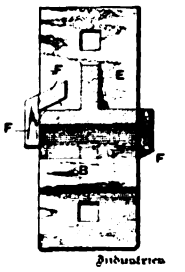
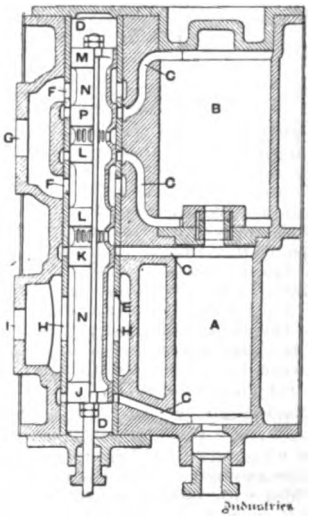


FIG. 4.

Fig. 1 shows an end elevation, Fig. 2 a side elevation, Fig. 4 a sectional plan, and Fig. 3 a modification, of an improved chair, clamping and supporting a rail. A A represent the two similar parts of which the chair is composed, each having at B a head to grip the flange of the rail C, and being composed in the centre of a T-shaped section with ribs D E. From the rib D extends a hook F, which is adapted to catch on the rib D of the opposite portion. The hooks F are bevelled or tapered as shown in Fig. 4, and the manner of fixing the rail is as follows:—The parts A A are locked together, each head gripping the opposite flange; the sections are then spiked to the sleeper, the spikes being driven in slightly oblique directions to force the two sections close together. The chairs may be made of extra width to support the ends of two rails meeting. Another modification is described, in which a dove-tail locking mechanism is substituted for the hooks. Claims: A railway chair, composed of two sections, each section having an inclined or oblique interlocking portion to engage the other section.—No. 5970. April 7th, 1891. 6*d*.

SLIDE VALVES.—*S. L. Brunton & J. G. Statter, both of West Drayton.*—The valves here described are of a kind suitable for various forms of reciprocating double-acting steam or other expansive fluid engines such as gas engines when worked by the expansive force of the gas alone. Referring to the accompanying illustration, which shows in vertical section the improved valve



fitted to a double-acting tandem compound engine, A is the high-pressure cylinder placed below the low-pressure cylinder B. Both cylinders have ports C of the usual form communicating by annular openings with the valve chest D of circular form and common to the two cylinders, and preferably fitted with a liner E having suitable perforations opposite the annular port openings. In addition to these four openings, the liner has three other

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openings, two of them, F F, communicating with the exhaust outlet G, and the third H with the steam inlet I. The valve N is of the hollow piston type, with or without spring rings; the part of the valve from J to K regulates the admission and exhaust to and from the high-pressure cylinder A, and the part from L to M serves the same functions for the low-pressure cylinder B, and the two pistons L and M separate the exhaust steam from the low-pressure cylinder B from that of the high-pressure cylinder A. The valve is provided with suitable lap and lead as are ordinary slide valves. The interior of the valve N and the annular spaces between the pistons K L and L P form the intermediate receivers for the steam on its passage from cylinder A to B. The action of the valve is as follows:—Steam is admitted to the annular space between the pistons J and K, and is led thence alternately to the top and bottom ports of the high-pressure cylinder by the movement of the valve N, the exhaust steam from the high-pressure cylinder passing into the inside of the valve N, from whence it is supplied to the low-pressure cylinder by means of perforations leading into the annular space between the pistons L and P, the exhaust steam from the low-pressure cylinder B passes out into the annular spaces between the pistons L L and P M, and so to the exhaust outlet G. The capacity of the intermediate receiver can be varied to suit requirements. The inventor describes various modifications of the valves, and their application to compound engines with cylinders side by side, and to a triple-expansion engine with the cylinders arranged one above another. Claims: The employment of a cylindrical valve of the piston type to expansive fluid engines, the valve working in a valve chest of circular form, and common to two or more cylinders, and serving for the complete distribution of the expansive fluid to and from all the cylinders in connection with the valve chest.—No. 9213. June 14th, 1890. 11*d*.

RAILWAY COUPLINGS.—*N. Knowles, J. W. Webster, & A. Dornan, all of Bolton.*—By means of this coupling it is claimed that the vehicles can be coupled or uncoupled from either side. A cross-bar or pivot is connected to the draw-bar or other suitable part of the vehicle, and has a hook and link one on each side of the ordinary hook, they being connected to the cross-bar in such a manner as to allow for lateral and vertical oscillations of the vehicles. Under each end of the vehicle a shaft is suitably mounted having levers attached for placing the hooks and links in position to lock or couple on to other vehicles. When the hook is raised into position for locking, it is held by a spring or its equivalent. The link is furnished with a slotted fixing to hold it in position when coupling, or to hold it out of position when not required. Each hook has suitable curved guides to ensure the connecting link being guided correctly in position for coupling. The shaft under the ends of the vehicle is actuated by a lever to uncouple, the hooks dropping clear from the links and leaving the links in a position for recoupling. The accompanying illustrations show the application of the invention, Fig. 1 being a longitudinal elevation, and Fig. 2 a plan. A A

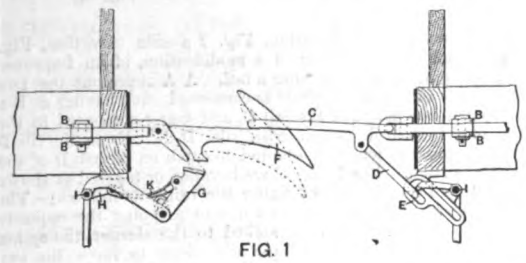


FIG. 1

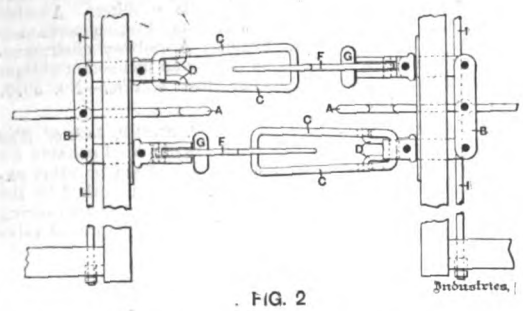


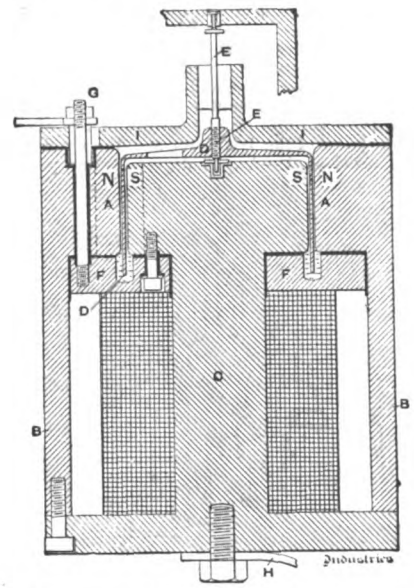
FIG. 2

are ordinary hooks, B B the cross-bars, each connected by means of a pin with a draw-bar. Each cross-bar has attached to it by means of a clip-piece and connecting link the coupling link C, provided with supporting arms D, these being mounted loosely in a slotted fixing E secured to the buffer beam. The cross-bars B B have at the opposite side to the coupling link C, the hook F, which is raised by the pivoted support G, and held in position for coupling. This support G is connected with the lever H on the shaft I by the rod or spring K. An important feature of this invention is that vehicles can be uncoupled without stopping the train, it being effected simply by slackening speed and dropping the supports for the hooks. Claims: Combination of the coupling hook, with the support or lever actuated by a lever and spring or rod from a shaft operated outside of each vehicle, and a coupling link, each being provided with means for raising it into position for coupling.—No. 10779. July 11th, 1890. 8*d*.

HOT BLAST STOVES.—*J. T. King, Liverpool.* (*H. Kennedy, Sharpsburg, Penn., U.S.A.*)—This invention relates to vertical hot-blast stoves which are heated by the combustion of waste gases from the furnaces, and are utilised to heat the blast. These stoves are provided with valves for reversing the currents by which they are traversed, so that at one time the waste heat from the furnace is passing through the stoves in one direction, and, later, the blast of air from the blowing engine is being forced through them in the opposite direction into the furnace. They are used in couples, so that while the waste heat is passing out through one or more, heating them up, the blast is being forced in through an equal number which have been previously heated as aforesaid. When one set becomes heated and the other cold, by the currents passing through them, the valves are reversed, and the currents pass in the opposite direction. The inventor claims: In a hot-blast stove, the combination of a pair of flues separated by a vertical flue wall, and communicating at the upper portion of the stove, or at the crown of the stove above the flue wall, said flues having air and gas inlets at their bases, a common outlet at the top, and an air blast inlet and outlet to and from which the air passes in series through the flues.—No. 8952. June 10th, 1890. 8*d*.

ELECTRICITY.

SUPPLY METER.—*J. Perry, London.*—This invention is based on the theory:—If an electric current is caused to pass through a mass of electrically conducting liquid in proximity to a magnet, in almost any position of the arrangement the liquid particles will be set in motion and continue in motion so long as the current flows. If a solid body, being free to move, touches the liquid, it will also be set in motion, and the inventor discovers that if the magnetic field is maintained constant and the motion is everywhere slow, the velocity of motion at any place is proportional to the current, and by suspending a solid body in the conducting liquid and making it free to impart motion to a train of wheels an electric supply meter is obtained whose only defects are due to solid friction. In all cases the inventor keeps the magnet as constant in strength as is possible, whether it be a permanent magnet or an electromagnet. In the latter case, it must be separately excited, and not excited by the current to be measured. The accompanying illustration shows one form of the



invention. A B C is a tubular magnet having at its upper ends concentric poles N N S S. A concentric cylindric vessel of copper D rotates in the space between the poles, and has attached at its upper end a spindle. An insulated copper ring F, filled with mercury, is fixed at the bottom of the space between the poles, and has a current passing into it and the mercury by the supply conductor G, from whence it passes through the cores of the magnet and leaves by the conductor at H. When a current passes the copper vessel is rotated because it is in a magnetic field, and has the current passing through it, and it also has a tendency to rotate through the rotation of the mercury. One or both of the cylindrical poles have a number of gaps, so that the magnetic field varies and produces a resistance of motion due to Foucault currents. In the claims the word "armature" is used to denote the solid moving body in a motor, whether current pass through it or not, and the claims include the following:—The use of an armature shaped like a hollow cylinder of conducting material or not, immersed in mercury, through which passes an electric current; the use of magnetic pole pieces, the polar surfaces being arranged in surfaces of revolution, and the supply meter as shown and described.—No. 7219. May 9th, 1890. 8*d*.

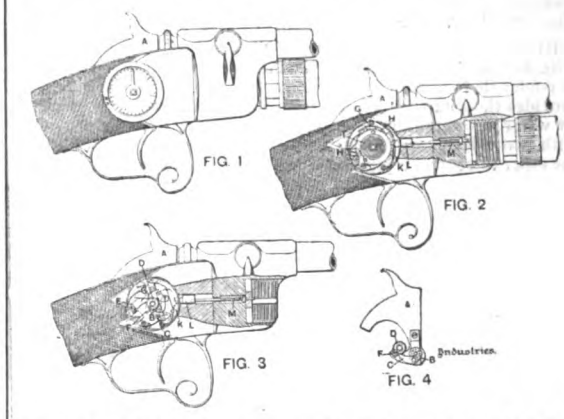
MANDRELS.—*F. E. Elmore, Leeds.*—In specification No. 4499 of 1877 is described a method of manufacturing tubes and other cylindrical articles by electrolytically depositing metal on a revolving mandrel, and burnishing the metal as it is deposited. This invention relates to the construction of mandrels for that purpose. The body of the mandrel is a thin but stiff metal tube coated with a metal or substance which is easily fusible, and which, when cool, sets to a firm consistence. This coating may be applied in various ways, but the following method is preferably adopted:—The tube to be coated is caused to revolve as a roller nearly in contact with another roller, and in the gap between the two rollers is placed the material of which the coating is to be formed. The mandrel tube is kept cool by circulating water, and the adjacent roller is kept hot by steam or otherwise so as to melt the coating material which adheres to the cold mandrel, and is smoothed and polished off by the hot roller. When the coating is of a bad conductor of electricity it is pricked through in numerous places to the metal of the mandrel. When other substances than fusible metals are used to form the coating, the surface thereof is covered with plumbago or other conducting substance. After the metal is deposited on the coated mandrel to the required thickness, the mandrel is heated sufficiently to melt the coating, whereupon the mandrel can be readily withdrawn from the shell deposited on it. Gelatinous or gummy material mixed with conducting powder may be employed to cover a tubular mandrel which is perforated with numerous holes and closed watertight at the ends. After deposition, liquid solvent attacks the coating through the perforations and dissolves it, facilitating the removal of the core. Or the wax coating may be mixed with salt, which, when dissolved out, leaves the coating porous. Claims: A mandrel for the electrolytical deposit of tubes, consisting of a metal tube coated with fusible metal applied and polished by means of a roller; the use of other fusible material, a non-conductor, perforated, and covered with conducting substance, such as plumbago; a metal tube mandrel coated with wax mixed with salt; the gelatinous or gummy coating mixed with a conducting powder.—No. 7932. May 22nd, 1890. 6*d*.

CHEMISTRY.

OBTAINING METALLIC ZINC.—*E. Edwards, London.* (*T. Lange, Brieg, Germany.*)—The present invention consists in making use of a solution of zinc oxide in the form of sulphite instead of sulphate, the presence of sulphurous acid acting beneficially with regard both to the chemical and electrical effects. Sulphurous acid instead of sulphuric acid is used, owing to its property of being readily converted to sulphuric acid by the absorption of the oxygen set free in the bath by the electric current. The resulting sulphuric acid rises to the surface of the bath and may be removed. By the decomposition of the sulphite of zinc (sulphurous acid and zinc oxide) the metallic zinc is freed from its oxygen which passes to the sulphurous acid at the cathode in the bath, and converts it by its addition to sulphuric acid. The chemical combination of zinc with sulphuric acid shows a heat of combination representing 103,230 units of heat, and that of zinc with sulphurous acid only 71,070 units, so that there is a saving in the decomposition of the sulphite of 32,160 units, or nearly one volt less current energy as compared with the decomposition of the sulphate. It follows, therefore, that the electrical deposition of zinc from its sulphite requires 30 per cent. less power. If, therefore, for the production of 1,000 kilos. of zinc per diem from its sulphate at 2·5 volts, about 170 horse-power is necessary, then for the deposit of the same quantity from the sulphite at 1·7 volts, only 120 horse-power will be required. If no sulphurous acid in the form of gas is available direct from the roasting furnace of the ore, it can be obtained in a liquid form in suitable vessels and used for the purpose described. Claims: The process of obtaining metallic zinc from a solution of sulphite of zinc by electrolysis, whereby sulphuric acid is formed as a by-product, substantially as specified.—No. 8716. June 5th, 1890. 4*d*.

MISCELLANEOUS.

COMPRESSED GAS GUNS.—*J. S. Wallace, Belfast.*—The appliance described below is designed for use with guns or apparatus worked by compressed air or gas, to give an indication of the quantity of gas or fluid used, and to show what remains available in the reservoir. In applying this invention to a gun, a counter is connected with any convenient part of the mechanism so that the counter will be operated each time the gun is fired, and so register on a dial the number of such discharges and the amount of available power left, so that the user can readily ascertain when the reservoir will require recharging. The counter is preferably provided with an automatic arrangement to return the pointer to zero upon the removal of the reservoir for recharging. The operation is described with reference to the accompanying illustrations, which show the invention applied to a "Giffard" gun, Fig. 1 being a side elevation, Fig. 2 a similar view partly in section, and Fig. 3 a similar view to Fig. 2 with the reservoir and parts of the registering device removed, and Fig. 4 being a detail. When the hammer A is cocked, the arm or crank B (see Fig. 4) is turned through a small angle drawing back the pawl C so as to engage with a fresh tooth in the ratchet wheel D, the said ratchet wheel being kept in position by the pawl E. When the gun is discharged the pawl C causes the ratchet wheel D to



turn; this gives a rotary movement to the cam or wiper F, which engages with one end of a lever G, the other end of which acts on the ratchet wheel H, which is attached to a spindle, and thus operates a pointer on the outside of the stock. The movement of the ratchet wheel H also winds up a coiled spring I, which, when the reservoir is removed, returns the pointer to zero, the ratchet wheel H having the pawl K and the end of lever G raised free from it by means of the piece L and spring M. Means are also described for preventing the apparatus from registering in the event of the hammer being put down without discharging. Other modifications are described and illustrated. Claims: The method of indicating the quantity of compressed gas that has been used or remains to be supplied in the reservoir of a gun or other apparatus; the employment of a counter driven by the hammer or other moving part; the combination of a suitable alarm to be set in action when the reservoir is nearly empty, and the before-mentioned method of returning counter to zero upon removal of reservoir.—No. 10456. July 5th, 1890. 11*d*.

Copies of the British specifications may be obtained on application to SIR HENRY READER LACK, *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED HELIX-FORMING MACHINE.

THE accompanying illustrations, Figs. 1, 2, and 3, represent a part plan, general view, and a side elevation of an interesting machine which has recently been patented by Mr. J. Laidlaw, of the firm of Messrs. Watson, Laidlaw, & Co., engineers, Glasgow, who are the makers of the machine. This machine is intended for giving a helical form to straight bars. The bars are bent by passing them through a series of rollers, of any number in the series, but preferably three. One of the rollers is carried on the end of a shaft. The upper or neck bearing of this roller serves as an axis for a turntable, which carries one of the rollers at a determined distance from the revolving centre of the turntable. The third roller is carried on a short shaft running in a bearing cast on the framework, and located immediately underneath the turntable. There is a slot in the turntable to allow this third roller to come into suitable position, and at the same time permit of the turntable being moved round as much as is required. It will be seen that since the axis of the first and the axis of the third roller carried from below the turntables have fixed centres, the roller carried upon the turntable may readily be moved into any suitable position relative to the other two rollers to obtain the required curve. Suitable grooves are made in all the rollers to suit the section of the bar to be operated upon. A suitable roller or guiding surface is attached to the table in such a position that the curved bars, when leaving the rollers, are forced over it to give them the required helical form. Referring to Figs. 1 and 3, B, C, and D are the three rollers, of which B is carried on a shaft E, whose upper or neck bearing forms the axis for the table F. The roller C is supported on and moves with the table, and is therefore always at a constant distance from the roller B. The third roller D is carried on an independent shaft which projects through the slot G in the table. It will thus be seen that, by turning the table through a portion of a revolution, the distance between the rollers C and D can be varied at will. A rack Y is formed on the periphery of the turntable, so that the turntable, with the roller it carries, may be turned by means of the hand-wheel H and worm-wheel I. The position of the roller C relatively to the rollers B and D can thus be adjusted to suit the curve into which the bar is to be formed. The rollers are grooved as shown to suit the section of the bar to be operated upon. A guiding surface J is formed upon or fixed to the turntable in

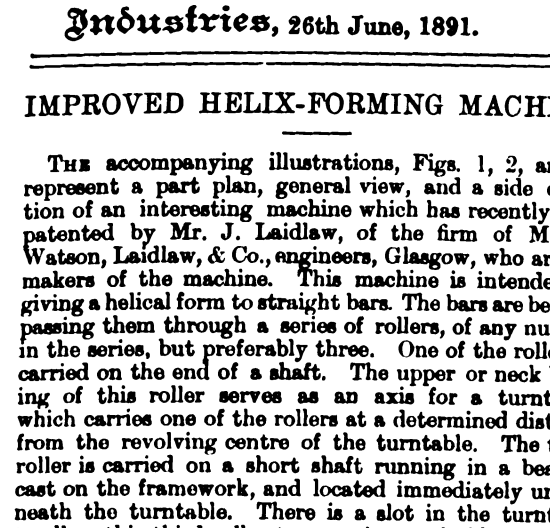


FIG. 1.—PART PLAN.

order to set the bar up into the helical form after it passes through the bending rollers. The rollers B, C, and D are actuated by reversible gearing beneath the table, as shown in Fig. 3, the roller B and spur-wheel K being driven by the worm and worm-wheel L M, the said spur-wheel K gearing with the spur-wheel N, which actuates a toothed wheel on the axis of the roller D. The wheel O, on the shaft of the roller C, also derives motion from the spur-wheel K.

AN IMMENSE CONGRESS.

THE Americans always seem ambitious of having the biggest things of all kinds on earth, and they seem determined that the Chicago Exhibition of 1893 shall, at least as regards size, exceed everything that has been attempted before in the way of exhibitions. That under the circumstances was to be expected, but the latest addition to the programme of the Exhibition is one which is almost calculated to take away one's

IMPROVED HELIX-FORMING MACHINE.

CONSTRUCTED BY MESSRS. WATSON, LAIDLAW, & CO., ENGINEERS, GLASGOW.

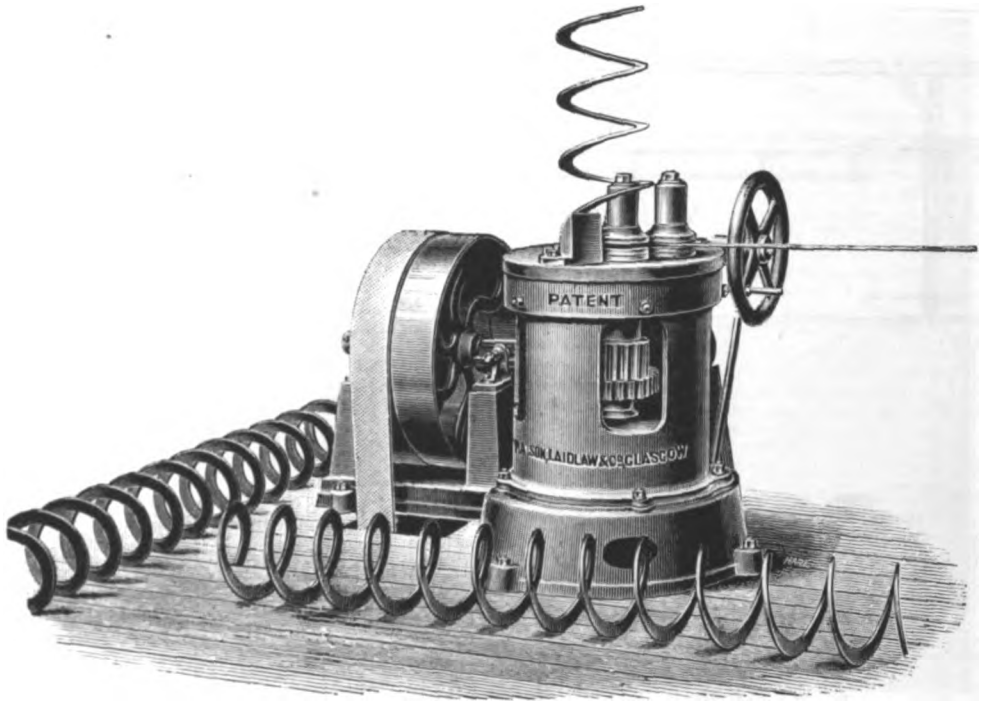


FIG. 2.—GENERAL VIEW.

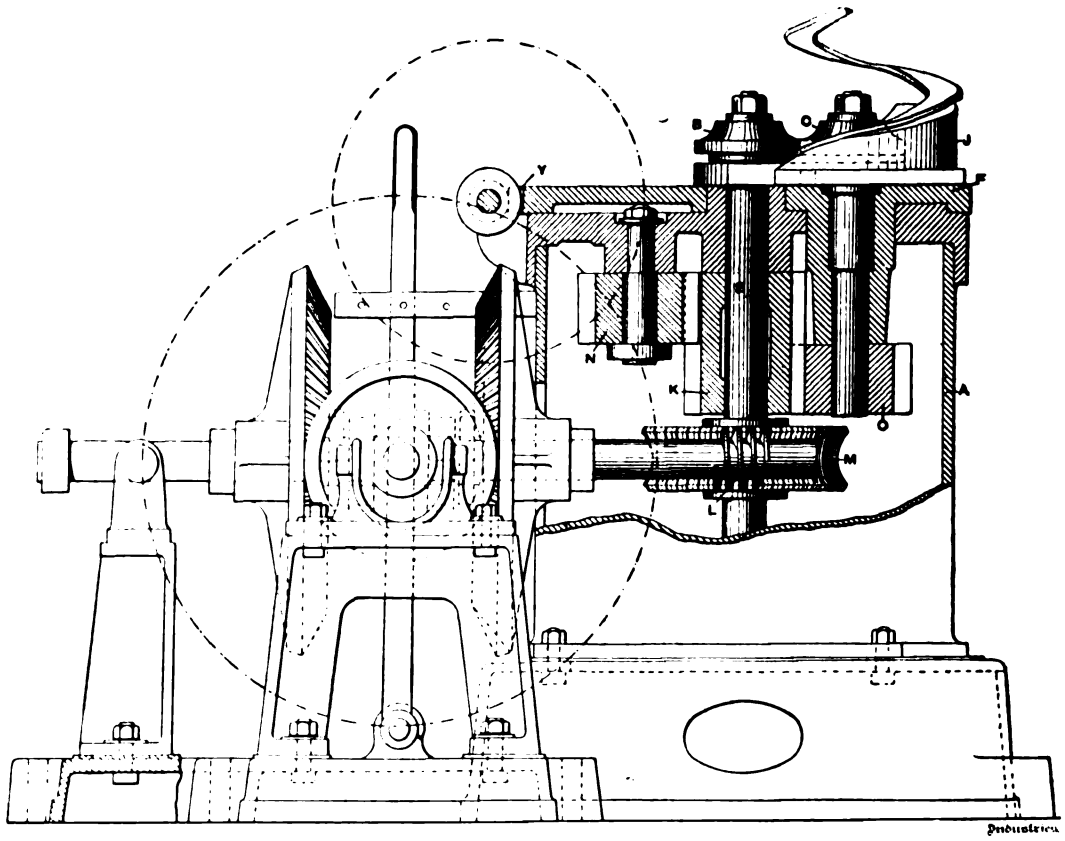


FIG. 3.—SIDE ELEVATION.

breath. They are determined to have the biggest thing in congresses. At the Paris Exhibition there were a considerable number of conferences or congresses, which seemed very complete on paper, but which as a rule did not attract large meetings. The majority of people who visited the Paris Exhibition went to enjoy themselves, and did not allow very serious study to interfere to any great extent with their pleasure, so that very often the conferences were attended only by a few enthusiastic individuals who were responsible for their arrangements. Undeterred by this, the Executive Committee of the Chicago Exhibition have appointed a World's Congress Auxiliary to arrange for the holding of international conventions on all subjects under the sun, the idea being to mark the intellectural progress of the world just as the Exhibition is to illustrate its material and mechanical advancement.

Already considerable progress has been made with the arrangements, and a large number of committees have been appointed to see them carried out. The subjects which are to be discussed seem to cover the whole field of human activity, not only in science and industry, but in connection with several political and religious questions. Particular attention is to be paid to international relations, and the grounds of fraternal union in the language, literature, domestic life, religion, science, art, and civil institutions of different peoples. A provisional programme has been drawn out arranging a series of meetings from the beginning of May till the end of September, embracing almost every conceivable subject, so that all classes of visitors will be certain to find something to interest them. If the Congress is successfully carried out, it should be the means of collecting an immense amount of information. Our only fear is that its very bigness may prevent it from being of much practical utility, and that the records of its proceedings will be so ponderous that a crane will be required to deal with them.

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THE GARRUCHA AERIAL ROPEWAY.

(*For description see page* 603.)

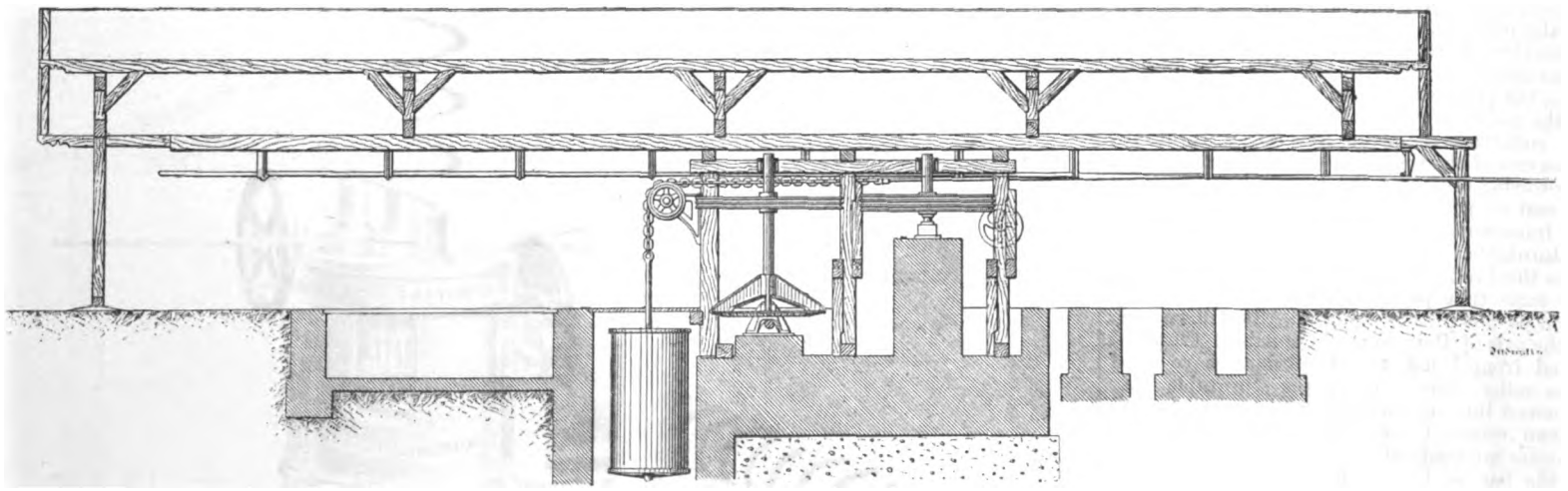


FIG. 14.—LONGITUDINAL SECTION OF ANGLE STATION.

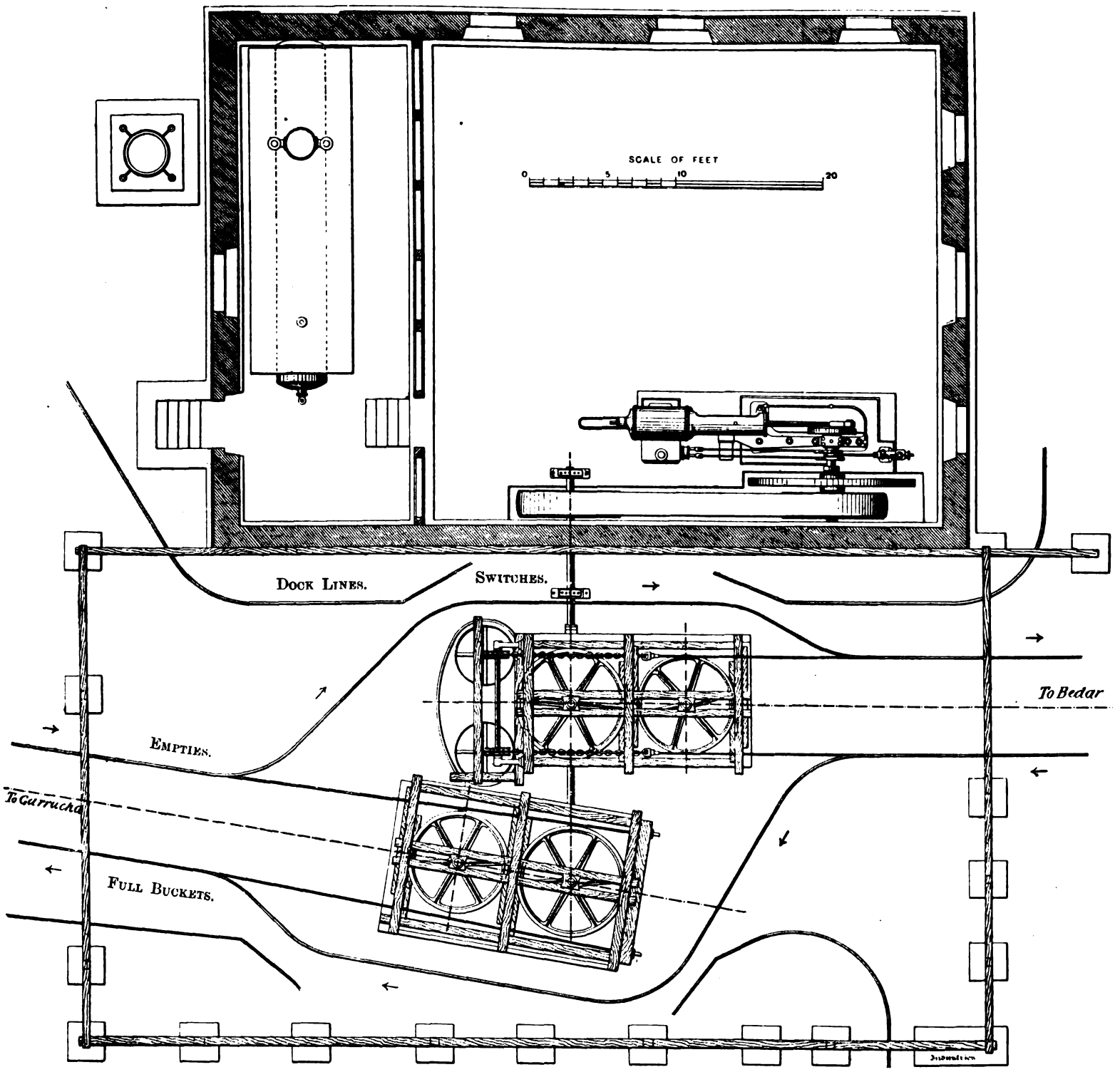


FIG. 15.—SECTIONAL PLAN OF ANGLE STATION.

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THE GARRUCHA AERIAL ROPEWAY.

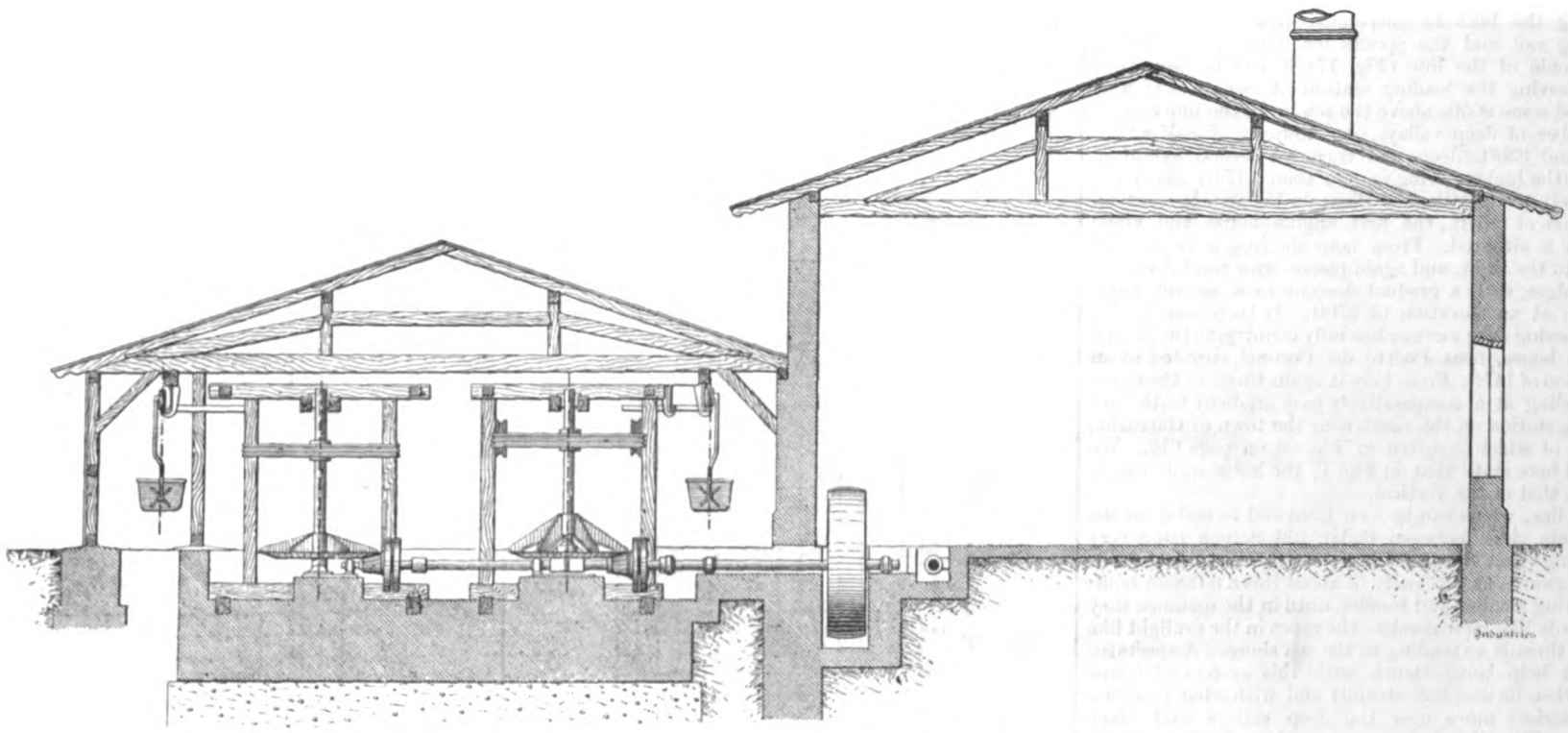


FIG. 16.—TRANSVERSE SECTION OF ANGLE STATION.

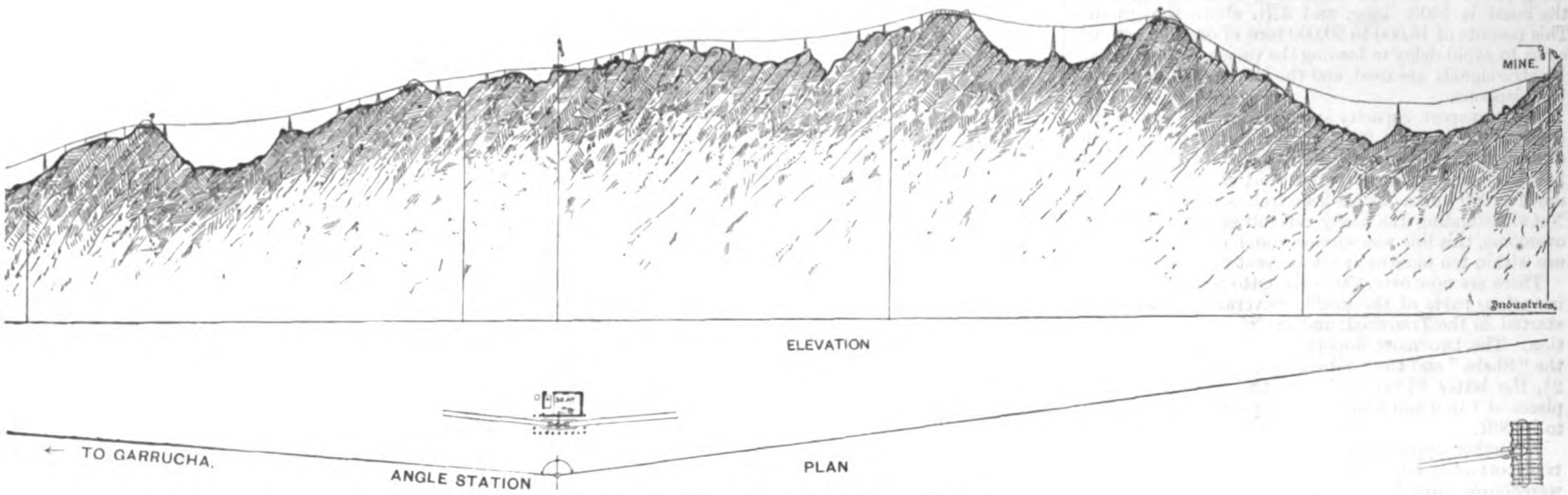


FIG. 17.—PROFILE AND PLAN OF PART OF LINE.

THE GARRUCHA AERIAL ROPEWAY.

(*Concluded from page 578.*)

As these lines cannot be worked round curves it is necessary, provided the ropeway cannot be carried in a straight line from end to end, to insert angle stations. Figs. 14, 15, and 16 represent a longitudinal section, a sectional plan, and a transverse section, of one of these angle stations at Puerto del Coronel, the chief power station of the line. When the buckets arriving from Bedar reach the shunt rail at the angle station they are automatically disengaged from the hauling rope as above described, switched on to the shunt rails, and run round by hand on to the carrying rope of the next section of the line, where they are again attached to the hauling rope and sent off in the direction of Garrucha. To avoid a violent impact of the knot and the coupling, the shunter gets a bell signal when a knot is approaching, and he pushes off the bucket at about the same rate as the hauling rope is travelling. If the line is not required to work at its full capacity the empty buckets can be docked at the stations, sidings being provided on to which the buckets are shunted out of the way.

This line is divided into four sections, a 30 horse-power engine driving the two steeper sections, a 70 horse-power the other sections. In Figs. 14 and 15 is also shown the method of taking up the slack of the hauling rope and keeping the same taut by means of balance weights. The carrying ropes are weighted at their ends in a similar manner.

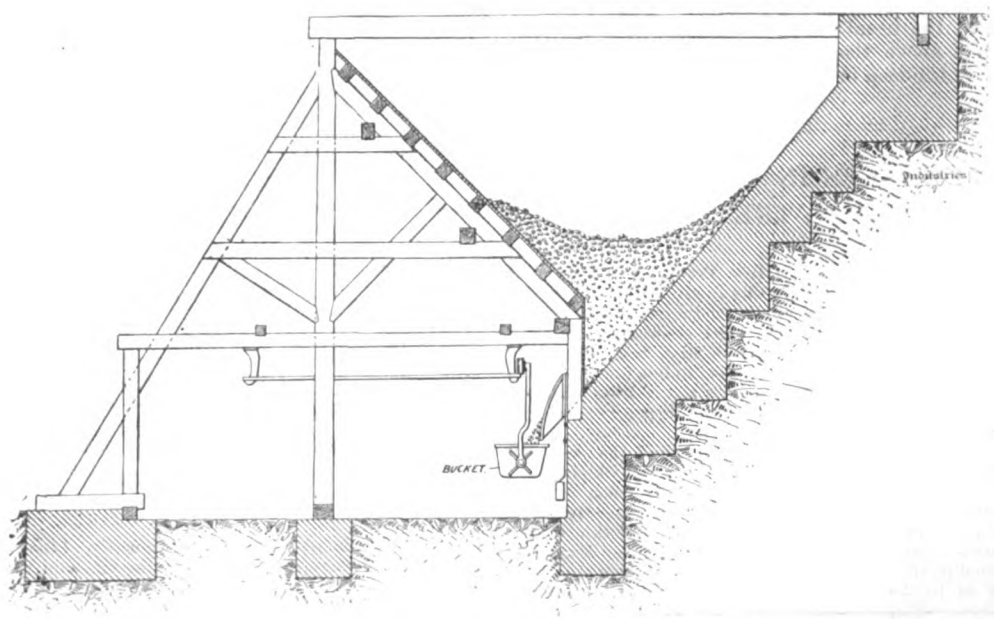


FIG. 18.—SECTION OF ORE BIN.

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Fig. 19, on page 612, gives a view of the loading station. The trucks from the mine are run down a gravity incline to the ropeway station, and the contents tipped into bins or hoppers of a capacity of 800 tons. Fig. 18 gives a section of one of these bins, showing the buckets suspended from the shunt or hanging rail and the spouts for filling them. From the profile of the line (Fig. 17) it will be seen that after leaving the loading station at Serena, which is situated some 905ft. above the sea level, the line crosses a number of deep valleys, one upwards of half a mile wide and 330ft. deep, and traverses several mountain ridges (the highest being no less than 1,174ft. above the sea level), to the village of Pinar de Bedar, where, at an elevation of 951ft., the first engine house and angle station is situated. From here the line goes off at an angle to the right, and again passes over several valleys and ridges, with a gradual descent to a second angle station at an elevation of 370ft. It then bears to the left, passing over more or less hilly country, to the second engine house, near Puerto del Coronel, situated at an elevation of 147ft. From here it again turns to the right, descending at a comparatively easy gradient to the unloading station on the coast, near the town of Garrucha, a view of which is given in Fig. 20 on page 612. We should here state that in Fig. 17 the horizontal scale is double that of the vertical.

The line, which can be seen from end to end from the mountain ridge between Bedar and Serena, has a very imposing effect—the 660 buckets travelling backwards and forwards at a velocity of about three miles an hour, appearing smaller and smaller, until in the distance they look only like mere specks—the ropes in the sunlight like silver threads extending to the sea shore. A spectator cannot help being struck with this system of transport when he sees how steadily and with what precision the carriers move over the deep valleys and steep ridges. The other long spans vary from 328ft. to 750ft., the average distance of the supports from one another being about 130ft. The unloading station (Fig. 20) at the coast is 150ft. long, and 32ft. above the ground. This permits of 18,000 to 20,000 tons of ore being stored, so as to avoid delay in loading the vessels as they arrive. Electric signals are used, and the stations are connected by telephone.

The transport capacity specified for this line in the original contract was 600 tons per day of 10 hours, but of late, owing to the increased demand for this ore, the line has been working a double shift of 8 hours, and as much as 900 tons a day has been transported to the coast. Notwithstanding the many difficulties that had to be overcome, this line was surveyed and erected ready for use within ten months at a total cost of £26,000.

There are now over 450 of the Otto ropeways at work in various parts of the world. Several have lately been started in the Transvaal, and are giving every satisfaction. The two most important lines out there are at the "Sheba" and the "Edwin Bray" mines, the former 2¾, the latter 3¾ miles in length, with gradients in places of 1 in 2 and 1 in 1·6, and spans of from 1,400ft. to 1,600ft.

A further application for these aerial lines is in the transport of goods, boxes, barrels, sacks, &c., between warehouses, over buildings, railways, canals, &c., where an ordinary line could not be employed. The loading and unloading is very rapid and easy, and can go on in all states of the weather. No purchase of land is necessary for the permanent way, but only the lease of a strip about 10ft. wide is required, and this, with the exception of a small area at the points of support, can be cultivated in the usual way, the buckets travelling at such a height above the ground as not to interfere in any way with the men or cattle in the fields.

ON THE CHANGES IN IRON PRODUCED BY THERMAL TREATMENT.*

In a paper "On the Changes in Iron Produced by Thermal Treatment," † read last year before this Institue at the request of Professor Roberts-Austen, I published the results of some experiments made a few years ago, which showed that in addition to the three points of change which have been observed by Osmond, there appears in very mild steel to be a fourth point, which occurs at a temperature approaching the melting point of the metal itself; and I further showed that this point of change coincides with the point of maximum tenacity.

In the discussion which ensued on the reading of the paper it was observed by M. Osmond that the change which took place at this high temperature might have been due to the fusion of iron oxide adhering to the metal, the fused oxide being subsequently absorbed by the iron. Admitting the possibility of this, other experiments were made in a similar manner, but under strongly reducing conditions, and as the results seemed to show that the suggestion as to the effect being due to oxide could not be correct, the experiments have been continued. The results obtained are not without importance, as they have shown:—(1.) That in iron containing 0·1 of carbon, the tenacity of the metal increases by hardening either in oil or in water, with the temperature at which the metal is quenched with a view to hardening, a maximum tensile strength being reached at a temperature of about 1,300° C. This temperature once exceeded, however, the tenacity of the metal diminishes, although the extensibility increases. (2.) By raising the percentage of carbon from 0·1 to 0·2, the maximum tenacity is attained, not at 1,300° C., but at a much lower temperature—about 1,000°—below the melting point of iron oxide, which, moreover, was not present. (3.) By further considerably increasing the percentage of carbon, this point of maximum tenacity apparently disappears almost entirely, the annealed metal having nearly as high a tensile strength as the same metal which has been quenched in oil from any temperature up to a bright red heat. Beyond this temperature, or when quenched in water, the hardened metal became so hard and brittle that it could not be gripped by the jaws of the testing machine. Whilst, however, the tenacity of the high carbon steel was not greatly influenced by quenching, both the hardness and the brittleness of the steel increased with the initial temperature of the metal before quenching, until at the initial temperature of about 1,400° C., obtained by heating the metal in a crucible in a wind-furnace, the iron had become so brittle that there was very little resistance to shock at all, either when hot or after hardening. The metal, even if cooled gradually in a muffle from this temperature, was also extremely brittle. It should be observed that this temperature of 1,400° was that of the incipient fusion of the steel.

The tenacity of iron would appear not to be directly connected with its degree of either hardness or brittleness. Neither is this change in the mechanical properties of the metal at high temperatures due to a "carbon change," for it is most pronounced when carbon is almost absent, the introduction of increasing percentages of carbon apparently having the effect of producing a gradual diminution in the temperature at which the change takes place. The change is not due to oxide. Is it an "iron" change? Is it due to a form of iron existing when left to itself only at temperatures approaching the melting-point of the metal, but rendered stable at lower temperatures by hardening or by the presence of carbon? Very probably other elements besides carbon have a similar effect, but in these experiments an endeavour has been made to render the results comparable by using steels of approximately the same composition, with the exception of the carbon. The following are analyses of the milder steels used:—

Steel.	C.	Mn.	Si.	S.	P.
1.....	0·13	0·284	0.004	0·069	trace.
2.....	0·12	0·546	0·011	0·089	trace.
3.....	0·20	0·350	0·012	0·160	absent.

The curves of magnetic permeability of Nos. 1 and 2 were published in the original paper, but as these results might, to some extent, have been influenced by the presence of temporary internal strains resulting from the hardening, two other series of bars of the Bessemer metal were hardened in oil and in water, placed vertically in a glass jar, and allowed to remain for a year before submitting them to examination by the Hughes magnetic balance. The results are shown in Fig. 1, and are quite concordant with those previously exhibited, except that the hardened bars, under the influence of the earth's magnetism, had become more strongly magnetic, with the result that the curves representing their direct repellant action on the magnetic needle of the balance are much more regular, and the salient points more pronounced. The dotted lines represent the bars hardened in oil, the others showing those hardened in water. The tensile test-curve is shown at foot, and is that published last year for the other bars. There are probably unobserved maxima existing between the two higher points of the curves of magnetic permeability.

The other steels were examined in the same manner as that described in the previous paper, but using a reducing atmosphere. Fig. 2 gives the curves obtained with the steel containing 0·2 per cent. of carbon.

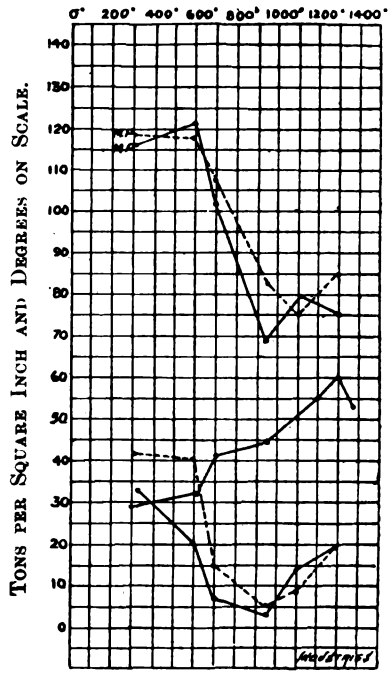


Fig. 1.—Temperatures.

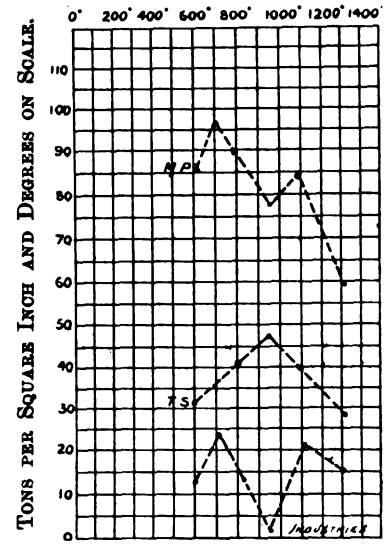


Fig. 2.—Temperatures.

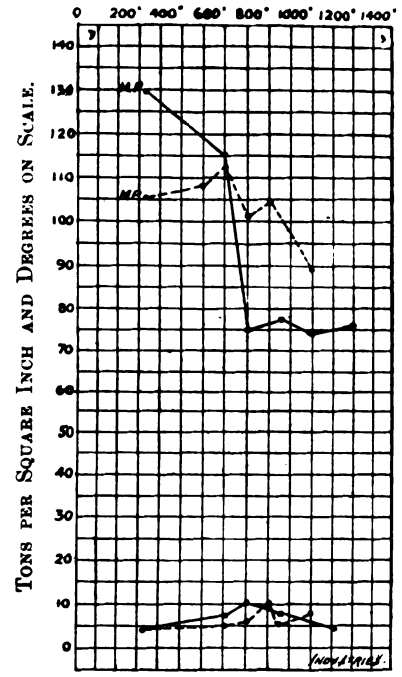


Fig. 3.—Temperatures.

These curves show (M.P.) the magnetic permeability of the bar hardened in oil, its tensile strength (T.S.), and its direct repellant action on the needle of the balance. This steel was in the form of a round rod 0·167in. in diameter. Hardened in water, the maximum strength was 65 tons, this strength being attained at the same temperature as in the case of the oil-hardened bars, and diminished again rapidly at higher temperatures. Fig. 3 gives similar results as obtained with the high carbon rod. This had a diameter of 0·231in.

I have endeavoured in these later experiments to meet the objection of M. Osmond that the change observed in very mild steel at about 1,300° is due to the formation and fusion of iron oxide. The experiments which are now described were conducted under conditions which prevented the formation of oxide, and while the bars, in the earlier experiments criticised by M. Osmond, showed scale, they were now free from it. Again, in the 0·2 steel, the maximum tensile strength was reached below the melting-point of the oxide, even had it been formed, which was not the case. M. Osmond further suggests that the change is closely connected with the structure of the metal. This seems not at all improbable. It does not appear, however, to be directly connected with a change in the mode of association of the carbon, as the carbon changes have taken place long before the maximum tenacity has been reached in mild steel. Neither does it appear to be due to the sudden development of crystallisation observed by Brinell, for if this were the case, instead of a gradual rise in the tensile strength to a maximum, followed by a gradual fall, accompanied, at least at first, by increased extensibility, a sudden and considerable diminution in the tenacity and extensibility might be expected. Whether this increased tensile strength is entirely or only partly a direct consequence of the strains produced in the metal by the act of quenching is again an open question, but it is evident that by quenching from a high temperature a change of some kind is produced in the iron under treatment, and that the extent of this change is dependent on the temperature and on the chemical composition of the metal.

In view of the abnormal results obtained on hardening the high carbon steel previously referred to, I hesitate to publish details, but prefer to reserve this question to a later date when I hope to be in a position to give the results of other and more complete experiments which are now in progress.

* Paper read by Mr. E. J. Ball, Ph.D., before the Iron and Steel Institute, on the 7th ult.

† *Journal of the Iron and Steel Institute*, 1890, No. 1, page 85.

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THE ROYAL NAVAL EXHIBITION.

MESSRS. G. E. BELLIS & CO.'S EXHIBITS.

The accompanying illustration (Fig. 1) refers to a set of compound centrifugal pumping machinery exhibited by Messrs. Bellis & Co., in the Camperdown Gallery. The exhibit represents one of the four sets that the firm are supplying for H.M.S. "Resolution" and "Revenge." The pumps, as fitted in each ship, are capable of lifting 2,200 tons of water per hour when running at 250 revolutions per minute, and though their primary duty is to supply the main condensers with circulating water, they are so constructed as to allow of their being utilised for pumping from the bilges in cases of emergency.

The engines, as shown by the illustration, are of the tandem type, a piston valve controlling the admission and emission ports of the high-pressure cylinder, while an ordinary flat valve is employed in conjunction with the low-pressure cylinder; these valves, mounted on the same spindle, being actuated by an ordinary eccentric. The high-pressure cylinders and valve chests lift off bodily by simply disconnecting and breaking the faced joints of each, thus admitting of easy and thorough examination of the high-pressure piston, cylinder, valve, &c.; and as the guides are cast in one with the bottom cover of the low-pressure cylinder, it is only necessary to remove one set of nuts to get at the interior of this cylinder and the bottom side of its piston. Ample provision is made for lubrication by means of the sight feed arrangements shown. Every part may be oiled round by hand in the usual way, or the small funnels fitted at the top of each pipe may be fed from the can should the drop-by-drop valves shown become choked.

Fig. 2 shows this firm's Navy-type compound single valve engine fitted to one of Latimer Clark, Muirhead, & Co.'s "Westminster" compound shunt-wound dynamos. In this engine a single valve, of the long piston type, placed between the two cylinders and driven by a single eccentric and rod, controls the steam and exhaust ports of both the high and low pressure cylinders, and is in turn controlled by the centrifugal governor bolted on to the crank cheek and adjustable to any designed point of cut-off before starting. As the single valve controls both cylinders, the cut-off in each is, of course, simultaneously coincident, and that the type of governor fitted is well adapted for its purpose is evidenced by the fact that one of these engines when tested for speed variation, only rose from 320 to 323 revolutions per minute, when its full load was suddenly thrown off. As in the previously described pumping engines, all parts are open and readily got at, the lower cylinder covers and guides are cast in one, and ample provision is made for lubrication, a sight-feed lubricator being fitted to each of the crank shaft bearings.

The engine and dynamo, shown in Fig. 2, when running at 320 revolutions per minute, give an output of 400 amperes at a pressure of 80 volts, and supply current simultaneously to two of the search lights in the grounds, each taking 100 amperes, and to upwards of 100 16 c.p. incandescent lamps in the Camperdown Gallery, and these latter are not perceptibly affected by the instant switching out of one or both of the "searchers." The makers have supplied similar sets to the one illustrated to Her Majesty's ships.

The firm also show on this stand a somewhat smaller set of direct-coupled compound engine and dynamo, which differs from the one just described in that the valves placed at the back of the cylinders are driven by a swinging link gear deriving its motion from the high-pressure connecting rod. Sets similar to this have been fitted on H.M.S. "Nile," "Royal Oak," and other ships. When tested, twelve hours daily for fourteen days, with full load on, to satisfy Admiralty requirements, it was found that one pint of oil sufficed for twelve hours' lubrication.

Messrs. Belliss also exhibit one of their triple air compressors, many of which have been supplied by them to the British and foreign navies. In the one now referred to the three cylinders and valve chests, cast all in one piece, are placed below the pumps and above the cranks, the whole being carried by four turned steel columns. One of these compressors was tested for three hours with full load on, and frequently gauged to ascertain if there was any defection of the pumps, but no defect was observable. Each cylinder and pump may be disconnected independently, thus allowing of No. 1 cylinder being used to drive No. 2, or 3, pump, and so on. When running at 350 revolutions per minute, and with a steam pressure of 100lb., a reservoir having a capacity of 10 cubic feet was charged up to 1,800lb. on the square inch in 19 minutes.

The double air compressor and air reservoir in the Armstrong Gallery were supplied by this firm, and are used daily in working the 6in. 5-ton hydro-pneumatic disappearing gun, for actuating the rammers shown near the 110-ton gun, and charging torpedoes in the Camperdown Gallery. In all types of their compressors Messrs. Belliss place the highest pressure pumps innermost, the two lower pressure pumps, and the cooling coils, being placed outermost, so as to confine any fragments of metal that would otherwise fly in the event of the highest pressure pump bursting. The double type of compressor stands on a base of 2ft. by 2ft. 9in., and the reservoirs on one of 2ft. 6in. by 6ft. 6in., and assuming the latter to be charged up to 1,800lb. on the square inch, their joint capacity is equal to the charging of one service (Whitehead) torpedo with air at 1,500lb. per square inch every four and a half minutes.

In a recent issue we described Messrs. Maudslay's and the General Engine and Boiler Company's exhibits, and stated that these two firms were the only exhibitors of air compressors. We regret that we overlooked Messrs. Bellis' compressing machinery in publishing our former notice, and are pleased to see that they make such a good show of this class of machinery

THE ROYAL NAVAL EXHIBITION.

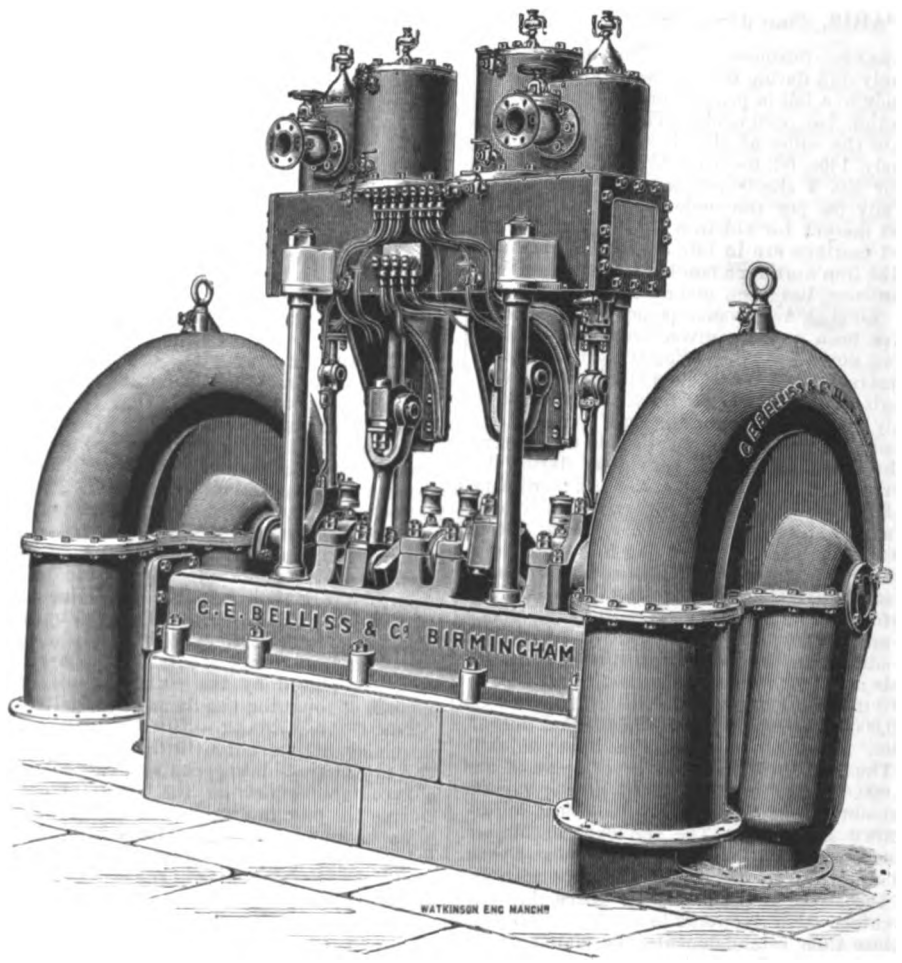


Fig. 1.

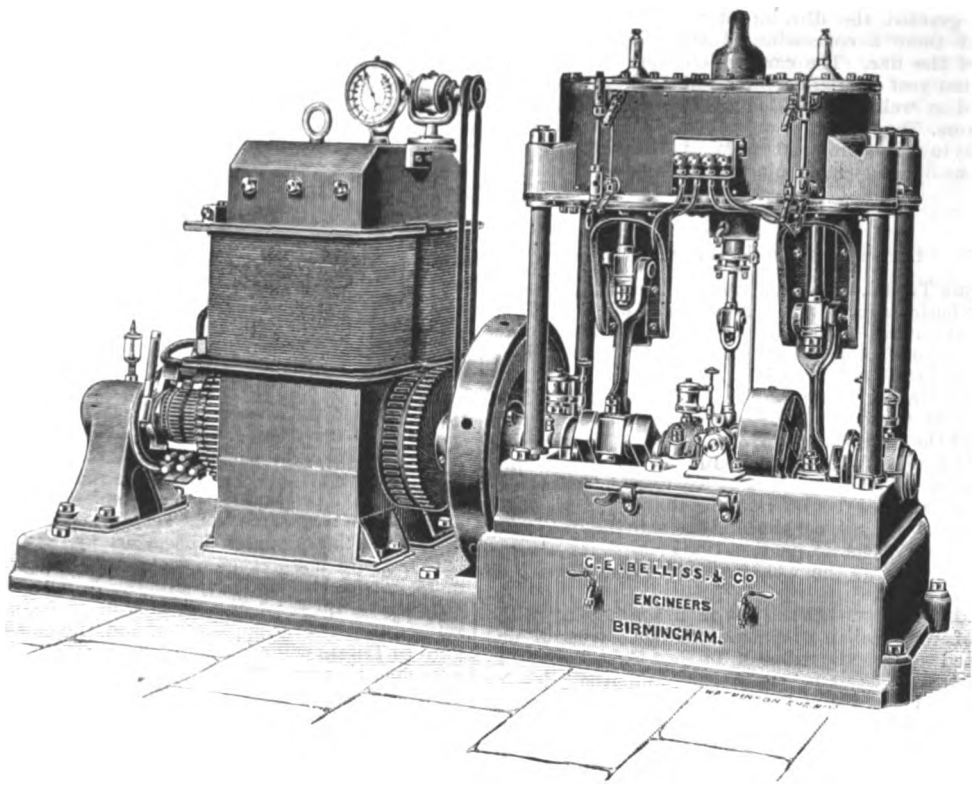


Fig. 2.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 23rd June, 1891.

The Iron Market.—Business on the Paris market has been comparatively dull during the past week and there is a decided tendency to a fall in prices, but up to the present no general reduction has been made. The prices fixed by the Syndicate are the same as they have been for some time past—namely, 140s. 6d. for bars, 152s. 6d. for joists, and 168s. 6d. for No. 2 sheets per ton—but business is transacted at fully 5s. per ton under these quotations. There is a good market for old iron rails at from 83s. to 85s. per ton, and castings are in fair demand at 112s. 6d. A contract for the iron work for a landing stage at Pauillac, the port of Bordeaux, has been given to La Société des Etablissements Eiffel. As a consequence of the large orders that have been recently given for railway rolling stock there is just now a good deal of activity in the pneumatic brake constructors' shops, those of the Westinghouse Company at Paris being particularly busy. In the North prices, especially those of joists, are inclined to rise; bars are easily disposed of at from 120s. 6d. to 124s. 6d. per ton.

Copper.—The official quotations for copper during the past week were:—Best Chilian bars, £58 5s.; ordinary Chilian bars, £56 5*s.*; Chilian ore in cakes and ingots, £59 5s. 6d.; and best selected, £60 5s. per ton. It is rumoured that another syndicate is being formed to force up the price of copper bars to about £60 per ton, and hold them at this quotation. The moment seems to be a fairly propitious one for such an enterprise, as most of the stocks on hand have undergone a diminution since the failure of the French syndicate in 1889, and there has been a good demand for this metal for some months past.

The Flax Spinning Industry in France.—In 1850 there were 250,000 spindles; in 1860, 502,692; and in 1867, 705,350 spindles. Since then the number has been gradually decreasing. Thus, in 1875, the number of spindles had fallen to 686,000, in 1879 to 500,000, and at the present moment it is doubtful whether there are 400,000 at work.

Dyers' Strike at Lyons.—The employés of Messrs. Pierron & Bouchard, dyers at Villeurbanne, near Lyons, have gone out on strike by reason of a dispute with the foreman. If the strike is prolonged for three days the owners of seventeen other dyeworks in the neighbourhood threaten to close their establishments, the claims of the men being considered unjustifiable. This action on the part of the employers would throw about 2,000 workmen out of work.

Electric Tramways.—A tramway laid down by the Decauville Company a short time since on trial at Bourg has proved such a success that the municipality of this town has granted the director of the electric lighting department there a concession of thirty years for the working of the line. The cars, which were run for the first time last year on trial in the Champs-Elysées, at Paris, are lighted as well as propelled by electricity stored in accumulators. The track is of only 23½in. gauge, and curves of 16 yards in radius are practicable. It is said that these cars have no difficulty in running up grades of 1 in 80.

BERLIN, 22nd June, 1891.

The Iron Trade.—The iron trade in general, and especially the business in rails, is in an unfavourable condition. In the recent award of contracts invited by the Baden State Railways unsatisfactory prices were quoted. Messrs. Hope & Co. offered steel rails at £6 1s. 5d. per ton, the Bochum Union and Messrs. Krupp at £6 2s. 5d. per ton. Iron sleepers were offered by the Horder Union at £6 4s. 10d. per ton, by the Gutehoffnung Works at £6 4s. 11d. per ton, and by the Hösch Works, at £6 5s. 1d. per ton. The quotation made by a Belgian works was £6 12s. 2d., which was in excess of all the other offers. The Röhrig Rolling Mills in Brunswick are asking the Mid-German Rolling Mills Union to allow them to quote a lower price for a large quantity of work, as the work will otherwise be lost to them.

The Coal Trade.—At the last monthly meeting of the owners of Westphalian coal mines and coke ovens it was determined to raise the price of furnace coke for use in German steel works by 1s. per ton, and to fix the price for Coppée coke for export at 12s. 9d., and for furnace coke at 13s. 9d. per ton. Members of the union are to be allowed to export coke at the lowest price quoted for German firms. The Rhenish Westphalian coal market is steady, as is shown by numerous inquiries for coal for future delivery. The forwarding of coals in Southern Germany and on the Rhine has been interrupted by the recent unfavourable weather.

The Petroleum Industry.—The yearly report of the Harburg Chamber of Commerce contains the following interesting information with reference to the monopoly of the German petroleum trade. The business of Messrs. W. A. Riedemann, who possessed a store of petroleum, has been taken over by the German-American Petroleum Company. During the year 1890, 64,053 tons of refined petroleum were imported in nineteen shiploads, and 421,451 barrels of petroleum were despatched to Berlin, Breslau, and the chief towns on the Elbe. Two steam elevators were erected, and were capable of raising 6,000 empty barrels daily. The whole of the works are lighted by electricity, for which purpose a dynamo, driven by a 14 h.p. steam engine, produces a current of 167 amperes at 110 volts. Up to the present time 8 arc lamps and 81 incandescent lamps have been used. On January 1st the petroleum stores of Messrs. Sanders & Co. also became the property of the German-American Petroleum Company, so that the latter company now has the whole trade under its control. The Harburg petroleum business is already considerably greater than that of Hamburg. In the past year 686,452 barrels of petroleum were imported into Hamburg, and 811,513 barrels were imported into Harburg. The export from Hamburg amounted to 661,479 barrels, and from Harburg to 837,831 barrels. The action of the German-American Petroleum Company will, perhaps, increase the use of Russian oil. It may also account for the deep borings now being undertaken in Germany.

VIENNA, 22nd June, 1891.

The Iron Market.—The condition of the iron market has not shown any important change during the past week, and purchases do not exceed what is necessary to supply immediate wants. Prices of all sorts of iron, with the exception of rolled iron, have remained unchanged. Quotations for rolled iron show a firmer tendency, and iron and machine works are all fully employed. The Brünn Machine Works have just completed some large orders, and are now constructing two engines of 1,000 h.p. each, which have been ordered by the English syndicate of the Aussig Sugar Refineries. At a general meeting of the "Poldihütte" Crucible Works it was recently determined to increase the share capital from £75,000 to £140,625 by the issue of 3,500 new shares, in order to extend the works, and increase the manufacture of rolling stock.—Some large orders for iron have been placed by the authorities of Carlsbad for the purpose of repairing the damage caused by the floods.

The Coal Market.—The coal market continues to be extremely active, notwithstanding the advanced season. The export trade is especially brisk, and this fact has had a favourable effect on the prices of coal mine shares. During the past few weeks the prices of coal mine shares have shown an important rise, which, in the case of the Salgó-Tarján Company, has amounted to nearly 40 per cent., whilst the shares of most of the other coal mines have risen from 20 to 30 per cent.

Electrical Engineering.—The management of the Budapest City Railway has been seeking permission for some time past to supply electrical power to private persons for industrial purposes. The chief city engineer is of opinion that the supply of electrical power would be very advantageous in the carrying on of small industries. He states, moreover, that the electrical central station of the City Railway Company, formerly belonging to Messrs. Siemens & Halske, is quite sufficient for the working of the railway and for supplying power to private works. This would be the case even if the railway were to be further developed, since the central station can be enlarged. The cable system is now being enlarged, and the distribution of power will shortly be set in operation. The Budapest City Railway will soon receive an extension, as some lines which run to the suburbs and to places of pleasure resort, about 4½ miles beyond the town, are to be amalgamated with the city line.—The Carlsbad Board of Works is actively engaged in considering the project of an electrical tramway, which would be of great service to the numerous visitors at that health resort.

The Free Harbours of Trieste and Fiume.—On the 1st of July next the tolls of the "free harbours" of Trieste and Fiume are to be abolished, and free traffic between these districts and the other parts of the kingdom will commence on August 1st. The sole remaining imposition of tolls in the kingdom will thus disappear. The inhabitants of these two towns have some difficulty in reconciling themselves to the new state of affairs, and the parliamentary representatives of Trieste and a deputation from that city have petitioned the Government for a postponement of the new regulation. They allege that the warehouses, which are rendered necessary by the freeing of the harbours, are not yet completed, and that some of the more important machinery is still wanting. The Marquis von Bacqueherst, the Minister of Trade, has, however, refused to grant the application, and the new law with regard to Trieste will come into force on July 1st. It seems probable, therefore, that Fiume, which has petitioned the Hungarian Government for a postponement of one year, will also fail to obtain its request.

BRUSSELS, 23rd June, 1891.

The Iron Market.—In the iron market the high price of fuel, and especially of coke, has seriously affected business. Little business has been done, with the exception of small sales at reduced prices. Some contracts for railway sidings have been awarded to Messrs. Noulet & Co., and contracts for railway crossings to the Société de l'Est de Marchienne. There is a good business in iron sheets, and the demand for both angles and joists is brisk. At Charleroi prices generally seem to follow the price of pig iron, which shows a firmer tendency, but at Liége the bad news in reference to the English market has seriously affected the demand. Red short iron is quoted at £1 18s. 5d., and Luxembourg iron at £1 18s. It is reported that an Italian firm has made a contract with some Belgian works for the construction of an industrial railway of about fifty miles in length.

The Coal Market.—The market continues firm, notwithstanding the arrival of foreign coal, and stocks are very low. After the award of contracts by the Belgian Government on the 17th inst. an attempt was made to raise prices, but without success. The price of coke continues high, and new ovens are likely to be started owing to the ready sale. Coke is quoted at 14s. 9d. to 15s.; coal nuts from £1 0s. 9d. to £1 1s. 7d., with a tendency to rise; small close-burning coal at 7s. 2d.; small steam coal at 9s. 7d.; coal nuts for furnaces at 11s. 2d.; household coals at 15s.; screened at 17s. 7d.

Electric Lighting in Belgium—Some statistics have just been published by M. Wybauw which show the actual state of electric lighting in Belgium. At Brussels 1,200 incandescent lamps are supplied by the station of the Tudor Company, 600 lamps supplied by the Montagne station at the Herbes Portagères, the installation of M. Vlierboom, 800 lamps in the Rue des Bouchers, 200 lamps in the Rue du Coude, and 600 lamps in the Place des Nations and the Rue Zérézo. At Ghent 1,000 lamps are supplied by the Station du Marais, and at Charleroi 1,500 lamps are supplied by the central station of M. Dulait. Altogether there are at Brussels 9,600 incandescent lamps and 545 arc lamps, at Antwerp 1,480 incandescent lamps and 240 arc lamps, at Ghent 4,930 incandescent lamps and 220 arc lamps, at Liége 2,010 incandescent lamps and 384 arc lamps, and at Verviers 2,430 incandescent lamps and 665 arc lamps.

Belgian Commercial Society.—This society was started a long time ago for the purpose of encouraging trade between Belgium and distant countries. Of Belgium exports, 80 per cent. are sent to the four countries which are close to Belgium, 10 per cent. to other countries of Europe, 5 per cent. to North and South America, and only 5 per cent. to the rest of the globe. There are very few Belgian firms which are concerned entirely in the export trade. The new society, which has been started with a capital of £40,000, will carry out its objects by buying and selling directly, or by the establishment of agencies. It will seek information as to the undertaking of new works, such as railway, gas, and water works. It will make inquiries as to the most advantageous conditions for sale, and will try to establish relations between producer and consumer. It may possibly happen that the action of the society will be disadvantageous to certain industries, but a circular is to be issued by the Bourse des Métaux asking Belgian manufacturers to subscribe the capital of the new society.

DÜSSELDORF, 23rd June, 1891.

The Iron and Steel Market.—The condition of the market is generally quiet. The price of pig iron shows a weaker tendency. An important event of the past week was the placing of contracts for rails to the amount of 3,505 tons by the Royal Railway management. Two contracts for 755 tons and for 420 tons were offered by the "Königs und Laurahütte," and by the Upper Silesian Railway Supply Company at £6 4s. 4d. per ton. The remainder was tendered by the Georgs-Marien Works of Osnabrück at £5 19s. 6d. per ton delivered at Osnabrück. These offers were made by Messrs. Pintscher, of Altona, on behalf of an English works, the whole quantity being offered at £6 4s. 4d. delivered at Breslau. The other offers, inclusive of freight, were at £6 11s. 3d. to £6 11s. 9d., delivered at Breslau. Messrs. Pintscher have not disclosed the name of the English works, and it seems doubtful whether the contract will be awarded to them, notwithstanding that they quote a cheaper price, as German railways only obtain their rails from firms of some standing. Foundry and machine works are generally well employed, especially those which are engaged in the manufacture of large mining plant.

The Coal Market.—The despatch of coal from the Ruhr district is more active than it has been during the past season or in former years; 11,000 double waggons of 10 tons each are being despatched daily, and a deficiency of railway waggons is again being felt. On the 19th inst. there was a demand for 11,242 waggons, whilst only 10,775 waggons were forthcoming. Consumers feel some apprehension as to the supply of coal in the autumn, as there is always an increased demand for waggons on the part of farmers and sugar works during that season. It is feared that many industries will suffer inconvenience on this account.

Union of Gas and Water Engineers.—At a general meeting of this Union held at Strasburg during the past week the condition of the German coal districts came under discussion. Mr. Grassmann, assessor of mines, estimated that there were 565 million cubic metres of coal in the Saarbrück region, which would amount to 14 milliards of tons of coal. The present yearly output amounts to 6 million tons, so that the supply will last for 2,339 years. Dr. Brookmann spoke of the Ruhr district, in which 130,000 workmen are employed, with a yearly output of 630 million tons; 165 mines are now in operation in that district, of which 25 produce gas coal, 70 bituminous coal, and 70 poorer sorts of coal.

An English Cotton Mill in Germany.—An English company has been formed at Gladbach, Rhenish Prussia, under the title of the Rhenish Cotton Spinning Mills, Limited. The capital of the company is £80,000, and its head office is in London.

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AMSTERDAM, 22nd June, 1891.

Steamship Companies.—The report of the Board of Directors to the shareholders of the Zeeland Steam Navigation Company in Flushing for the year 1890 is not of such a favourable nature as they could wish. The gross receipts have increased from £118,819 to £121,209, but the working expenses also have from £91,305 to £98,333, chiefly in consequence of the higher price of fuel. The net receipts fell from £27,522 to £22,877. Deducting debenture interest and other payments, there only remains a balance of £8,679, which has been placed to the credit of the depreciation account. The steamers of the company in 1890 performed 730 journeys, half of which were in the day service, carrying 76,333 passengers, against 74,198 in 1889; and 44,698 tons of goods, against 44,698 the year before. The company received £25,000 on account of the carriage of letters, and £200 on account of the carriage of parcels. 1,231 tons of postal matter were carried.

State Railways.—The report for 1890, presented by the Board of Directors to the shareholders, is one of the most important in the history of the company which works these railways. The convention between the Government and the company underwent an important modification and extension by the purchase of the Dutch-Rhenish Railway system, the Leyden-Woerden Railway, and the steam tramway from Ede to Wageningen by the State, and their transfer to the State Railways Company. The system worked by the latter was thereby increased by 158 miles of railway and 7½ miles of tramway. The company also acquired the Central Railway shares, which were in the possession of the Dutch-Rhenish Railway. Deducting the mileage of railroads which were transferred to the Holland Railway Company, the system of the State Railways now comprises 986 miles of railway and 7¼ miles of tramway. The total receipts in 1890 were £1,242,354, the working expenses amounting to 52·74 per cent. Deducting various charges, there remains an available balance of £92,338, out of which the State Railways Company is entitled to a sum of £67,698, enabling the Board of Directors to distribute a dividend of 5¾ per cent. on the share capital of £1,083,300. This, in 1890, was increased to £1,500,000, whilst the shareholders authorised the issue of £500,000 in debentures.

Telegraphs.—The Minister of the Colonies has granted a concession to the Eastern Extension, Australasia, and China Telegraph Company, Ld., for laying down a telegraph cable from Labœan-Deli, on the East Coast of Sumatra, to Penang, which cable must be open for traffic in June, 1891, in such a manner that a through communication be established with the Government cables at Labœan-Deli, Batavia, and Banjœwangi. The company further agrees to pay the Government a certain royalty on all messages transmitted over the Government cables.

STOCKHOLM, 20th June, 1891.

The Gellivora-Lulea Railway.—The purchase by the Swedish Government of the Swedish section of the Swedish-Norwegian Railway having been finally completed, Swedish officials have recently visited parts of the line in order to inspect it before finally taking it over.

Workmen's Share in Profits.—The new Atlas Engineering Company in Stockholm has decided to give its workmen a share of the company's profits. For the present year 20 per cent. of the profits is to be distributed amongst the company's men and officials. The following conditions must be complied with:—The men must have served for at least one year, they must have borne a good character, and must have completed their twenty-first year. One-third is paid at once, and the remaining two-thirds go to a fund for payment after twenty-five years' service, or when the fifty-fifth year of age is completed.

The Motala Engineering Company.—This company has for several years past been in a very unsatisfactory state, in spite of no apparent lack of orders, and notwithstanding the assistance rendered in various ways by the Swedish Government by means of large contracts and loans. Things have now come to such a pass that, unless a reconstruction of the company be arranged, a catastrophe seems impending. At a meeting in Stockholm a few days ago a plan was discussed which would involve a further Government loan of £33,330, in accordance with which a number of creditors would take shares in the new company in lieu of their claims. The old share capital would have to be considered as lost. No definite decision was arrived at, but another meeting is to be held shortly in order to settle the matter.

CHRISTIANIA, 20th June, 1891.

New Railways.—The latest proposals of the Government in respect to new railways, which embrace the North Railway, the Eidanger-Brevik Railway, and the Bergen Railway, have been referred to a committee. Of these the first and the last are most important lines. The Government is against the partial combination of the North with the Bergen Railway, which is not thought likely to prove satisfactory. The two most likely routes for the North Railway are through Christiania, Haklon, and Gjövik, and through Grorud, Hakedal, and Gjövik, the calculated cost being respectively £577,550, of which £75,000 would be spent on the extension of Christiania Railway Station, and £454,776. From a financial point of view the authorities see no objection to the construction, with Government aid, of a railway to Gjövik at a calculated cost of £583,300, of which 20 per cent. is expected to be forthcoming from local grants. The Government, in consequence, proposes the building of a Christiania-Gjövik Line, at a cost of about £583,300, along the following route:—Christiania, Maridalen, Grun, Tingelstad, and Gjövik. The Bergen Railway is calculated to cost about £1,944,000. The Department is in favour of an inland line, as being preferable from both a national and a military point of view. With regard to the southern portion of this line, the Humledale line of route is recommended.

COPENHAGEN, 20th June, 1891.

The Danish Sugar Manufactories.—The large Danish Sugar Manufactories, which have works in different parts of the country, have had a surplus on last year's working of £66,215, which, with a balance carried over from last year, makes a total of £69,531. From this amount £13,885 is deducted for interest, and £1,930 for salaries, leaving an available sum of £53,726. Of this the shareholders get in the first instance 5 per cent., or £25,819; 15 per cent. of the balance is added to the reserve and renewal fund, amounting to £3,670. The board get in tontine £491, and the managers £1,229, the company's servants and men £737, and the ten-yearly beet growers £1,864. Further, £13,888 are added to the reserve and renewal fund, and the shareholders get an additional 1 per cent., or £5,163.

The Copenhagen Free Harbour.—The works on the new free harbour at Copenhagen have now been commenced in earnest. A great deal of pile-driving is going on, for the purpose of partitioning off a large area, which will afterwards be pumped dry, and then excavated to the proper depth. This will do away with the small harbours for boats in that locality, but accommodation will in the meantime be provided for these somewhat nearer the town.

MADRID, 22nd June, 1891.

The Madrid Gas Company.—English gas engineers may find a difficulty in understanding how a gas company which sells gas at 9s. per thousand feet, and coke at 45s. per ton, is unable to offer its shareholders a larger dividend than 3¼ per cent. There is no place, perhaps, where gas lighting is more used than in Madrid. The explanation of this anomaly is that the Madrid Gas Company pays in interest to its debenture holders eight times as large a sum as it is required to invest in the undertaking. The results for the present year are likely to be even more unfavourable than those of the year 1890, as many persons now prefer to use the electric light instead of gas, even at the high price of 1s. 3d. per unit.

The Port of Bilbao.—Considerable progress has been made with the large works which are being carried out at the mouth of the Nervion, and which will make the port suitable for all sizes of vessels in any state of the weather. The works will not be completed before five or six years, but access to the port will be facilitated within a shorter period. Much advantage is expected to arise from the execution of the works in the outer port, in view of the fact that an iron industry may be established at Santander. It is perhaps rather difficult to see how this advantage will be gained, as vessels of more than 3,000 tons can even now enter the port of Bilbao.

Daimiel and Talavera Railway.—The Senate has passed a law, according to which the Government may grant a concession for a railway from Daimiel to Talavera. The line could be easily constructed, but the traffic would be very small. The object of making the line is probably to secure a good position for the coming railway war in Spain. The northern system of railways will try to connect its lines with the south of Spain and the port of Valencia, and the proposed line would form a part of this extension. Unless the two large companies enter into some arrangement many lines of the same character as the proposed line will be constructed by the one company in order to show its capability of injuring the traffic of the other.

ROME, 22nd June, 1891.

Italian Lignites.—In their natural condition these lignites contain from 17 to 40 per cent. of moisture, and after having been dried in the open air they still have from 10 to 25 per cent. of moisture; they have from 5 to 15 per cent. of ashes, and often contain over 5 per cent. of sulphur. The method of utilising the lignite proposed by Mr. Sapori consists in a dry distillation of the lignite in retorts similar to those used for the production of gas. A part of the gas produced is used for heating the retorts, and producing coke in addition to the tar (brai) and ammoniacal liquors. The gas thus produced gives, it is stated, a heating power of 8,000 calories, and the coke remaining in the retorts has a heating power of 7,000 calories. From the distillation of 1,243lb. of "lignite xiloide" in four hours, Mr. Sapori had a return of 31·15 per cent. of gas, and 33·38 per cent. of coke. The gas, notwithstanding its incomplete purification, gave a light equal to that of gas produced from coal. The lignite gas was found to have a heating power which was capable of getting up steam in the boiler of a locomotive containing 700 litres of water in forty-five minutes. It is able to melt glass, bronze, pig iron, and iron ingots, in a short space of time. The coke obtained from the distillation had no smell, and was suitable for industrial and household purposes. Mr. Sapori completed his experiments by manufacturing briquettes with the lignite coke, mixed with tar obtained from the distillation of the same lignite. The Mediterranean Railway Company has made several experiments with this special fuel, the last being the one recently made on the line from Rome to Frascati. In consequence of these experiments many manufacturers have come to the conclusion that it will be no longer necessary to import fuel and other products from abroad. It is, however, necessary to look carefully into the matter both from a scientific and from a practical point of view, in order to ascertain how much truth there is in this statement. From investigations made by the Royal Commission of Mines, it appears that the lignite coal mines which have been found in Italy up to the present time could not give a regular output of more than 700,000 tons at the utmost. From a geological study of the districts where other workable lignite coal mines are usually found, it appears that the total annual production could never reach 1,000,000 tons under the most favourable hypothesis. In Italy there is an annual consumption of 5,000,000 tons of fuel, so that even if the lignite had an equal heating power to the good qualities of the coal now imported from abroad, it would be able to supply only one-fifth part of the requirements of Italian industries.

NEW YORK, 13th June, 1891.

The Hudson River Bridge.—The New York and New Jersey Bridge Company held its annual meeting on the 2nd inst. The report of the Executive Committee states that the charters of both States have been confirmed by special Acts of Congress. The two North River Bridge Companies propose to amalgamate and to begin work on both sides of the Hudson simultaneously early in September. Propositions have been made by several large iron manufacturers who are prepared to sign a contract to complete the entire work within thirty months of the time of beginning. The construction of this bridge will enable all the trains from Philadelphia and, therefore, from the South and West also, to run directly into New York City. Much time has hitherto been lost in crossing the Hudson River from Jersey City to New York in ferry boats.

Rapid Transit for New York City.—The Commissioners appointed to devise some plan to meet the pressing need for improved rapid transit have recommended the construction of an underground railway along Broadway. It would take several years to construct this railway. The cost is estimated at £8,000,000, on which the interest at 4 per cent. would be £320,000 a year, which would have to be earned in addition to the working expenses. This would require a yearly traffic of 23,000,000 persons. The four elevated railway lines carry 600,000,000 passengers a year.

New 12in. Steel Gun.—The first 12in. steel gun made in the United States has been completed at the Watervliet Arsenal, Troy, N.Y., and shipped to the Sandy Hook proving ground for testing. The gun weighs 52 tons. It is 36·66ft. long, and the length of its bore is 34ft. Its charge is 440lb. of powder, and its projectile weighs 1,000lb. The powder pressure which will be exerted on its interior when the gun is fired is 16·5 tons to the square inch. The initial velocity of the projectile will be 1,940ft. per second, the muzzle energy 26,000 foot tons. The tube and jacket forgings for this gun were purchased at Le Creusot, France, and the remaining forgings were obtained from the Midvale (Pa.) Steel Works. This is the largest steel gun built in this country, and the test, which will shortly take place, is being looked forward to with great interest.

PHILADELPHIA, 12th June, 1891.

A Large Casting.—Probably the largest casting ever transported by the Pennsylvania Railroad Company arrived at Johnstown on the 23rd ult., and was consigned to the Cambria Iron Company. It was a half-section of a fly-wheel, and weighed 90,000lb. The special car in which it was transported from Philadelphia was borrowed by the Pennsylvania Railroad Company for that purpose from the Baldwin Locomotive Works, the company having no car with a capacity above 80,000lb. The wheel is in halves for bolting together, and when complete is 25ft. in diameter, with a rim 18in. thick and 28in. wide. It is for the new 26in. billet mill now being erected by the Cambria Iron Company. The engine which will drive this wheel is a compound condensing one of 3,000 h.p., and is being built by the Southwark Foundry and Machine Company, of Philadelphia, which firm also made the fly-wheel.

Telegraphic Cable to Hawaii.—The Secretary of the Navy has selected the "Thetis" to be the vessel used in making a preliminary survey of the proposed telegraphic cable from San Francisco to Honolulu, and the work will probably be begun about July 1st. It has been decided to use the system of sounding devised by the hydrographer of the Navy Department, which consists in taking soundings at alternate intervals of two and ten miles, unless indications of shoals are found, in which case the soundings will be taken at one-quarter mile intervals until the exact character of the shoal is determined.

The Haskell Gun.—The contract for making the steel forgings for the Haskell multi-charge gun has been awarded to the Bethlehem Iron Company, and the contract for finishing the gun to the Reading Iron Company. The total sum appropriated for this purpose is £11,000.

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THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

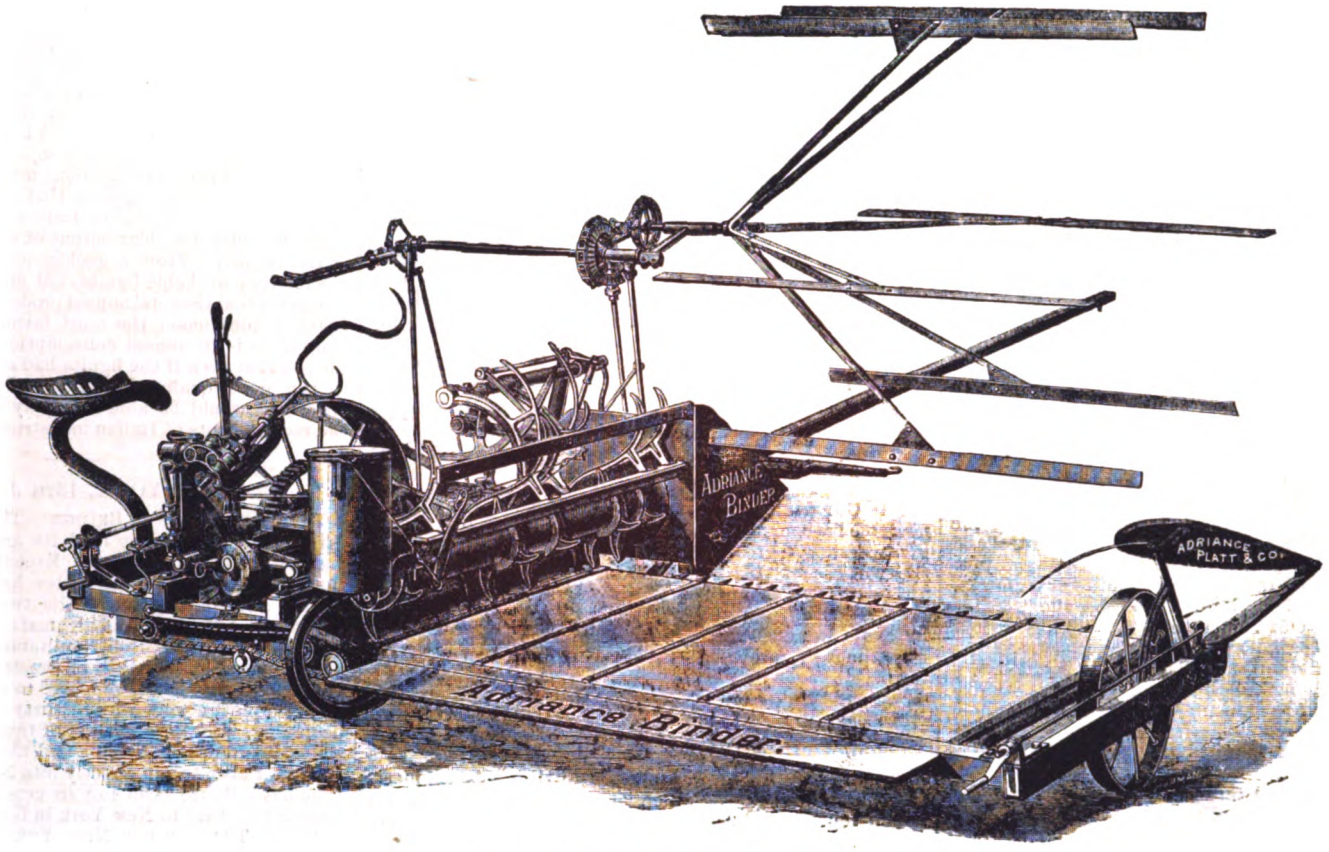


FIG. 1.—THE "ADRIANCE" BINDER.

THE ROYAL AGRICULTURAL SOCIETY'S SHOW AT DONCASTER.

THE fifty-second annual country meeting of the Royal Agricultural Show was opened to the public on the 20th inst. Last year the show was held amidst picturesque scenery; this year, although the scenery is lacking, the show is a decided success. The number of implements exhibited is larger than in any year since 1884, with the exception of 1889, when the show was held at Windsor. The amount of space allotted to implements is 12,743ft., exclusive of open ground space, as compared with 9,078ft. at Plymouth last year, 15,602ft. at Windsor in 1889, 10,743ft. at Nottingham in 1888, and 8,217ft. at Newcastle in 1887. The site of the present show covers from 80 to 90 acres.

All the larger makers of implements are of course to be found strongly represented, but with their standard types, they apparently being satisfied to continue the manufacture of well-established machines. But several smaller makers show what they call "new implements," these being mostly improvements in detail of a well-marked type or the adaptation of an existing type to new work. Of absolute novelties we only saw two, one being the "Darby Digger," and the other, the compressed air sheep shearer exhibited by the Australian Shearer Company, Limited, of 81, York Street, Sydney, N.S.W., the English agents being Messrs. R. Hornsby & Sons, Limited, Grantham. Three of these shearers were exhibited, and practical demonstrations of the manner and the speed with which they operate were given during the show. At one of these we witnessed a sheep sheared in eight minutes, but the inventor states that five minutes per sheep can be easily managed. The implement in question is worked by compressed air instead of belting or gearing as is usual in power-worked sheep shearing machines. The dimensions over all of the shearer do not exceed 10in. by 3in. by 2in., and it can be easily held in the hand. The machine consists of a reciprocating double-pistoned engine, having a suitable air valve which controls its action, the piston working a lever pivoted in the centre of the machine at one end and the other end working the cutter, which is made with several teeth. The speed of the cutter is stated to be 3,000 strokes per minute. The invention is of Australian origin, but the machines are being manufactured in this country by Mr. C. G. Bonehill, Belmont Gunworks, Birmingham. The air pressure employed to work the machine is 25lb. per square inch; the compressed air is obtained in the usual manner by a steam engine and compressed air pump forcing the air into a wrought-iron reservoir, from whence it is led by overhead pipes to the shearing room. A flexible indiarubber pipe is attached to the main feed pipe at distances suitable for each shearer, and to the independent flexible pipe is fixed the new shearer, a small stop valve being interposed between the machine and the main pipe.

The "Darby Digger," shown by Messrs. T. C. Darby & J. E. Steevenson, Chelmsford, is a steam digger and cultivator of 10 h.p. It is the result of continued experiment and simplification of the Darby digger, exhibited some four years ago at the Smithfield Show. In the present machine hydraulic power has been introduced for steering and for putting pressure on the digging prongs. The leading feature of the machine is that the piston rods are coupled up directly to the digger crank shaft, gearing and fly-wheel being dispensed with. To regulate the fineness of the ground dug, fixed coulters are placed immediately behind the digging forks, and where the land is clean enough the seed may be drilled at the same time by means of a drill attached to the rear of the machine. To increase the bearing surface of the machine when passing over soft ground, rollers are bolted to the hind wheels to increase their width. The total weight of the machine is eight tons.

Messrs. J. & H. Keyworth & Co., Liverpool, show several American harvesters and binders, amongst which we noticed the "Adriance" binder, illustrated in Fig. 1. This machine has been tested for a few years on American work, and is now being introduced into this country. The features aimed at are lightness, with strength, simplicity, and elegance, and the balancing of all moving parts. The peculiar and limited elevation of the grain and the rear discharge of the bundle are novel. The action of the machine is as follows:—The grain, when cut, is reeled on to a moving canvas apron and carried to the lifting mechanism in the usual way. The grain is then conveyed to a series of revolving sprockets and a revolving butter disc located in the rear of the inner divider; by them it is carried upwards through a throatway on to curved ways or feeder scrolls, which serve to support the grain and also to clear the sprockets and prevent any winding of grain. Above the sprockets the feeder scrolls and the upper compressor form the grain receptacle, in which the grain remains until enough for a bundle has accumulated. The highest elevation of the grain is only 15in. The bundle is made when sufficient grain accumulates in the receptacle to raise the trip or bundle sizer; this puts the binder mechanism in motion, and the needle, which is in position above the receptacle, descends, enclosing the grain within the cord, and, at the same time, moves toward the binder deck which is on the opposite side of the feeder throat from the grain receptacle. The needle does not require to be forced through a mass of packed grain, but one of the sloped sprockets is timed to act with the needle and leave a clear way for the point. This sprocket carries the bundle to the binding deck, where it is compressed by a side compressor, which relieves the needle from strain. The tie is made at a time when both the needle and the discharge fork are relieved from work and returning to position, and while another bundle is gathering in the receptacle. The return of the needle to its first position is not, as in other binders, over the track of downward movement, but over a different course. Every motion of the needle and swinging binding arm is controlled by one crank. The discharge fork, pivoted at the rear corner of the binder frame, acts at the moment when the needle has enclosed grain for a new bundle, and lifts the bound bundle from the deck, turns it completely over endwise, and discharges it gently on the butts in the rear of the machine, but entirely out of the way of the next round.

Messrs. Ransomes, Sims, & Jefferies, Ipswich, have a large collection of exhibits, amongst which is one of their 6 h.p. traction engines, with wrought-iron driving wheels, and with compensating motion on the driving shaft; a 6 h.p. and an 8 h.p. portable engine of the same type, each having steam-jacketed cylinders. The wrought-iron brackets which carry the crank shaft are firmly riveted to the boiler, and the bearings of the crank shaft have both vertical and lateral adjustments for taking up the wear. The governor is connected to a double-beat piston valve. The boiler is large for the size of engine, and large wearing surfaces are given to all bearings. In addition, this firm shows a 10 h.p. compound under-type engine, with the cylinders steam jacketed; a 20 h.p. long-stroke stationary expansion engine; a vertical engine, with boiler combined, of 5 h.p.; and two 54in. steam thrashing machines. Ploughs, rakes, and haymakers also form an important feature in Messrs. Ransomes' exhibits.

Messrs. John Fowler & Co., Leeds, exhibit a fine collection of their heavy engines and ploughs, comprising a 6 h.p. nominal traction engine, an 8 h.p. ditto; a 12 h.p. compound ploughing engine, fitted with winding drum and coiling gear for the double-engine system of steam cultivation; a five-furrow balance plough, with anti-balance gear, which prevents the implement from jumping out of its work at whatever depth it is ploughing; a 12in. single-cylinder horizontal engine, fitted with Hartnell's patent automatic expansion gear. The "Oliver" plough is a magnificent specimen of agricultural machinery. This plough is specially made for deep work, and is largely used in the vine districts of France and

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Spain, where deep ploughing for planting vines and trees is required. This plough is constructed of exceptional strength in all parts, and is capable of cutting a furrow 24in. wide and 30in. deep. A second plough of smaller size is placed in front of the large plough to divide the work. An 8 h.p. compound semi-portable engine is employed in driving Messrs. Bradley & Craven's brick machinery. A 10-ton steam road-roller, and an assortment of Messrs. Fowler & Co.'s light railway plant are also on view at their stand.

The Weardale Iron and Coal Company, Limited, Durham, have a very fine display of their manufactures. In addition to the samples of the various sizes and sections of iron and steel made by this company, specimens of the materials after being worked are to be seen.

Petroleum and gas engines are represented by a number of different makers. Messrs. Crossley Brothers, Limited, Manchester, have a good show, including a 14 h.p. "Otto" horizontal, capable of indicating up to 33 h.p. This engine is fitted with all the latest improvements, including Crossley's new patent tube and patent lining valve, and also a patent self-starter. A 4 h.p. gas engine is shown working with common petroleum oil, and is stated to be capable of indicating up to 9½ h.p. The oil used in this engine has a flashing point of 110°, and is supplied by the American Oil Company; the consumption is 0·8 pint per brake horse-power per hour. Messrs. Weyman & Co., Limited, Guildford, show their "Trusty" gas engine, a description of which was given in *Industries*, Vol. IX., page 568. Messrs. Wells Bros., Sandiacre, show the "Premier" gas engine, with a special drop governor in two sizes.

Messrs. Priestman Bros., Hull, exhibit four of their oil engines, ranging from 2 h.p. up to 18 h.p. Mr. John Robson, Shipley, Yorkshire, shows two sizes of his gas engines—a 4 h.p. and a 1 h.p. The engine rests on its own bed, and therefore requires no special foundation; the working parts are few, and the bushes are of phosphor-bronze.

Messrs. Page & Co., Bedford, show a variety of implements, including ploughs, scufflers, harrows, drills, and mills. Amongst the latter we illustrate one, Fig. 2,

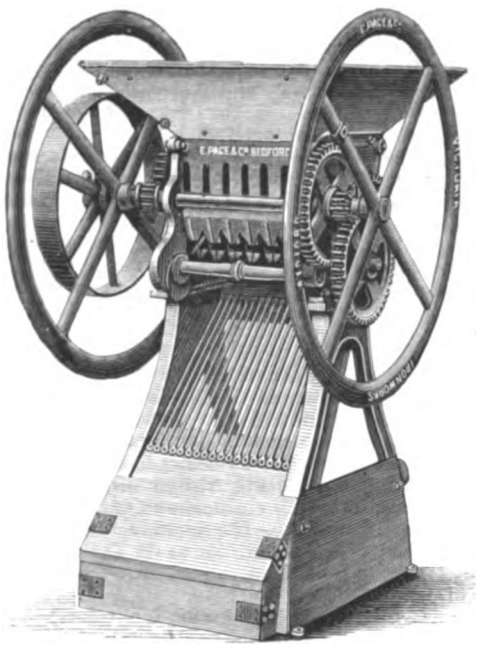


Fig. 2.

adapted to the breaking of coke for smiths' fires, greenhouses, and domestic purposes. This coke breaker is fitted with two pairs of rollers. Two men, by manual power, can break a ton of gas coke in about half an hour. A screen, fitted to the machine, enables the broken coke to be sifted from the dust, and the rollers are capable of adjustment so as to break four different sizes.

(To be continued.)

SHIPBUILDING NOTES.

The New South Wales Government have ordered from Messrs. Wm. Simons & Co., Renfrew, a powerful twin-screw hopper dredger, which will be fitted with the builder's patent sand pumping apparatus, similar to that supplied by them in connection with the dredging operations on the Mersey bar. This vessel will be constructed under the direction of Sir John Coode, K.C.M.G., of Westminster.

On the 9th inst. Messrs. Edwd. Withy & Co. launched from their shipbuilding works at Hartlepool the large steel screw steamer "Sydenham," built to the order of Mr. R. B. Stoker, London. This vessel is over 300ft. in length, and is built throughout of Siemens-Martin steel. She is built to the highest class of Bureau Veritas International Register. To make the vessel as far as possible unsinkable, the main and fore holds are divided by an iron water-tight bulkhead efficiently stiffened by iron grain divisions, and on the web-frame system, with cellular double bottom subdivided into water-tight compartments. The engines, which are of the triple-expansion type, have been constructed by Messrs. T. Richardson & Sons, Hartlepool, and there are two large single-ended boilers, constructed for a working pressure of 160lb.

On the 9th inst. the "Sir William Hartley," a new dredger for the European Commission of the Danube, built and engined by the Naval Construction Company, left Barrow for Sulina. Previously she had been thoroughly tested, with satisfactory results.

On the 10th inst. Messrs. Wm. Simons & Co. launched from their yard the "Mazatlan," a steel screw passenger steamer, built for the Mexican trade. The vessel has been constructed of Siemens-Martin steel to Lloyd's highest class, and is of the following dimensions:—Length, 150ft.; breadth, 22ft.; depth, 11ft. The vessel is lighted throughout with electricity. The engines, which were also made by the builders, are of the inverted triple-expansion type, with cylinders of 16in., 35in., 41in. in diameter, and a stroke of 30in. The boiler, which is constructed of mild steel, has a working pressure of 160lb. per square inch. It is provided with one of Kirkaldy's feed-water heaters. The propeller shafting is of Messrs. Vickers, Sons & Co.'s steel, and the propeller is of manganese bronze.

Notices of Meetings.

THIS WEEK.

Royal Institution.—Friday, June 26th, at 9 p.m. Faraday Commemoration Lecture by Professor Dewar, F.R.S.

Physical Society.—Friday, June 26th, at 5 p.m. Papers to be read: "The Construction of Non-Inductive Resistances," by Professor W. E. Ayrton, F.R.S., and Mr. T. Mather; "The Influence of Surface-Loading on the Flexure of Beams," by Mr. C. A. Carus-Wilson; "On Pocket Electrometers," by Mr. C. V. Boys, F.R.S.; "On Electrification due to the Contact of Gases with Liquids," by Mr. J. Enright, B.Sc.

PRICES CURRENT, 24th June, 1891.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 15 0	.....	6 5 0	f.o.t. wks.
,, Angles	5 10 0	.....	6 0 0	,,
,, Plates	5 12 6	.....	6 2 6	,,
Staffordshire Bars	6 10 0	.....	7 0 0	London.
,, Angles	6 12 6	.....	7 2 6	,,
Crown Sheets	7 0 0	.....	7 10 0	,,
,, Hoops	7 0 0	.....	7 10 0	,,
"Siemens-Martin" Steel Boiler Plates			7 5 0	,,
,, Ship and Girder			6 10 0	,,

PIG IRON.

Middlesbro' Warrants, No. 3.	42/-	Cash.
Scotch Warrants, m/n	47/3	,,
Hematite Warrants, m/n	51/6	,,

Stocks in Stores. Scotch	514,321—Dec.	for week	648 Tons.
Middlesbro'	134,425—Inc.	,,	2,081 ,,
Hematite	134,510—Dec.	,,	3,471 ,,

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	62/-	.....	57/-	f.o.b. Glasgow.
Gartsherrie	58/6	.....	55/-	,, ,,
Langloan	61/-	.....	56/6	,, ,,
Summerlee	58/6	.....	54/6	,, ,,
Glengarnock	59/-	.....	51/-	,, ,,
G.M.B. ex store	47/6	.....	47/6	,, ,,

METALS.

Spelter: Ordinary	£24	10	0	to	24	15	0
Copper: British Cakes and Ingots	59	10	0	,,	60	10	0
,, Chili Bars, G.O.B.'s	56	7	6	,,	56	15	0
,, Other sorts, G.M.B.'s (equal to Chili Bars)	56	7	6	,,	56	15	0
,, Manufactured (strong)	67	0	0	,,	68	0	0
Lead: Common Pig	13	7	6	,,	13	10	0
,, English Sheet	14	2	6	,,	14	5	0
Tin: Straits	93	5	0	,,	93	15	0
,, Australian	93	0	0	,,	94	0	0
,, English Ingots	97	5	0		.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: During the past week values of raw copper have still further improved, and the market continues firm. Large transactions are reported in Chili bars recently, and quotations are about 10s. higher per ton on the week. To-day's prices are £56 7s. 6d. to £56 15s. cash. Manufactured firm, at £67 to £68, "strong."

Tin continues very steady, and prices are the same as in our last report.

Lead: Quiet; values a shade firmer.

Spelter continues to advance, and is likely to be dearer, as stocks are everywhere small and the consumption increasing.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	62/-	..... 55/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	7/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	5½	to	0	0	6¼
,, ,, Liquid	gal.	0	1	0	—	.....		
,, Citric	lb.	0	1	7½	—	.....		
,, Oxalic	,,	0	0	3½	—	.....		
,, Sulphuric	ton	1	15	0	—	.....		
,, Tartaric	lb.	0	1	3	—	.....		
Alum: Lump (powder 10/- ex.)	ton	5	12	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
,, Muriate (Grey)	ton	23	0	0	—	.....		
,, ,, (White)	,,	30	0	0	—	.....		
,, Sulphate	,,	11	0	0	—	11	2	6
,, Liquor	lb.	0	0	3	—	.....		
Antimony	ton	75	0	0	—	.....		
Bleaching Powder	,,	6	12	6	—	.....		
Bisulphide of Carbon	,,	13	0	0	—	.....		
Borax	,,	29	0	0	—	.....		
Benzole (90 %)	gal.	0	3	9	—	.....		
,, (50/90 %)	,,	0	2	9	—	.....		
Copper Sulphate	ton	15	10	0	—	.....		
Copperas	,,	2	0	0	—	.....		
Kieserit	,,	.....			—	.....		
Lead: Nitrate	,,	21	0	0	—	.....		
,, White Sugar	,,	26	0	0	—	.....		
,, Brown ,,	,,	19	10	0	—	.....		
Potash: Bichromate	lb.	0	0	3¾	—	.....		
,, Caustic	ton	21	10	0	—	.....		
,, Carbonate	,,	20	0	0	—	.....		
,, Chlorate	lb.	0	0	5½	—	.....		
,, Prussiate (Yellow)	,,	0	0	10½	—	.....		
,, Sulphate (Basis 90 %)	ton	4	0	0	—	.....		
Precipitate: Red	lb.	0	3	4	—	.....		
,, White	,,	0	3	0	—	.....		
Salts: Epsom {Bags	ton	3	0	0	—	.....		
{Casks	,,	3	15	0	—	.....		
,, Glauber	,,	1	10	0	—	.....		
Sulphur: Sublimed Flowers	,,	10	10	0	—	.....		
,, Recovered		7	0	0	—	.....		
Soda: Ash	deg.	0	0	1 1/16	—	0	0	1⅝
,, Caustic (White 70%)	ton	10	17	6	—	.....		
,, ,, {60%}	,,	9	12	6	—	.....		
,, ,, {Cream 60%}	,,	9	7	6	—	.....		
,, Crystals	,,	3	2	6	—	3	3	0
,, Bicarbonate	,,	6	10	0	—	.....		
,, Hyposulphite	,,	7	5	0	—	.....		
Solvent Naphtha	gal.	0	1	5	—	.....		
Tartar, Cream of	cwt.	4	19	0	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Sulphate of copper has again receded a little, under pressure of second hand parcels for spot delivery; quotations for forward delivery remain firm. Sulphate of ammonia is still neglected. Carbonate and muriate of ammonia are in fair demand. Yellow prussiate of potash is steady, but the inquiry is rather easier. Bichromates of soda and potash have more attention, sales being made for early delivery only. Acetates of lead are firm. Nitrate of lead very dull.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	34	0	0
,, Ceylon	,,	29	0	0
Cottonseed	,,	20	15	0
Cod	,,	24	10	0
Lard	,,	34	10	0
Linseed	,,	21	15	0
Olive, Spanish	,,	45	0	0
Palm, Lagos	,,	24	10	0
Rapeseed: English	,,	28	5	0
Seal: Pale	,,	25	0	0
,, Brown	,,	.....		
Sperm	,,	50	0	0
Whale	,,	22	0	0
Turpentine	per cwt.	1	9	0
Coal	per gal.	.....		
Petroleum (Refined)	,,	0	0	5½
Spirit	,,	0	0	7¾

We have received from Messrs. Alexander Shanks & Son, of 110, Cannon Street, London, E.C., and Arbroath, N.B., a copy of their weekly catalogue, which contains a very complete list of engines and boilers for land and marine purposes, pumps of various descriptions, and grab diggers, made by this firm. The marine engines comprise triple-expansion and compound types of various sizes, fitted according to Lloyd's requirements.

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HOME INDUSTRIES.

LONDON, 25th June, 1891.

The Money Market.—The money market has gradually become very weak. There is practically no demand for accommodation, and bills are so scarce that, even at rates which are barely remunerative, the discount houses cannot get business enough to employ the funds at their disposal. In the Stock Exchange the Settlement, which began on the 24th inst., has afforded a good excuse for lack of business. But, apart from this excuse, there is no life in the market, the cheapness of money having failed to stimulate speculation, while investment purchases are made only cautiously and on a very small scale. Distrust is playing havoc with business. Not only is it rampant in each individual market, but London distrusts Paris, and New York has doubts about London. The only department in which there has been any activity this week is in silver securities, but doubts concerning the origin and permanency of the renewed "boom" in silver have checked the rise. Foreign stocks have been firm, but this has been due to manipulation in Paris in order to influence the price of foreign stocks at the Settlement here. Home railways continue lifeless and dull. American railways move spasmodically, the uncertainty and nervousness of Wall Street making any sustained movement impossible. Miscellaneous, industrial, and mining securities receive little attention in general, though particular stocks are subject to some purely professional speculation.

Great Northern Telegraph Company.—The monthly traffic returns of this company show that the receipts during the month of May were £26,000. The receipts from January 1st to May 31st, 1891, were £114,000, whilst for the corresponding months of 1890 and 1889 they were £105,800 and £106,800 respectively.

Postage of Newspapers.—On the 23rd inst. a deputation, consisting of a large number of newspaper proprietors, waited on the Postmaster-General at the House of Commons in order to lay before him certain statements with reference to the transmission of newspapers and periodicals through the Post Office. Mr. Henniker Heaton, M.P., introduced the deputation, and stated that the revenue of the Post Office had increased by £1,500,000 during the past six years. The Chancellor of the Exchequer received £400,000 more from the Post Office than in 1885. He asked that all newspapers and periodicals published at intervals of thirty-one days, instead of seven days according to the present regulations, should be treated as newspapers. He also advocated that the present regulation as to the amount of current news should be revised. In the United States periodicals which appeared only four times a year could be sent as newspapers, provided they contained information of public interest, and were not designed primarily for advertising. Newspapers could be sent to India from France at a third less cost than from England. Mr. Heaton asked that the maximum weight should be extended to 8oz., as newspapers were now often mutilated in order to reduce the weight below 4oz. Mr. W. T. Stead said that his magazine could be sent from New York to San Francisco for ½d., whereas the English Post Office charged 2½d. for its transmission in England. The postage to Australia on a 6d. magazine amounted to 1s. Mr. Arnold Foster said that only about 5 per cent. of the magazines distributed by his firm passed through the Post Office, the remainder being, at present, sent by railway and parcels conveyance. In America the postage of *Harper* was ½d., whereas the postage of the *Quiver* in England was 2d. Mr. Gill showed how the revenue of the Post Office was increased by the large number of letters sent in reply to advertisements. Mr. Leng, M.P., spoke against the giving of too much discretionary power to the Treasury. The Postmaster-General, in reply, referred to the Post Office Acts Amendment Bill, which was now before Parliament. The clause of that Bill which fixed the maximum weight of a newspaper at 1lb. he considered to be very liberal. There was only one journal in the United Kingdom which exceeded that weight. The Treasury warrant was always open to the criticism of Parliament. A clause had been inserted which enabled supplements to be distributed without the date being affixed. Instructions had been given to the English delegates to the Vienna Conference to see whether greater uniformity could not be obtained in the rates for the postage of newspapers for the Colonies.

Royal Meteorological Society.—At a meeting of this Society held on the 17th inst., Mr. Baldwin Latham, M.Inst.C.E., President, being in the chair, Mr. A. J. Hands gave an account of a curious case of damage by lightning to a church at Needwood, Staffordshire, on April 5th, 1891. The church was provided with a lightning conductor, but the author thought that when the lightning struck the conductor a spark passed from it to some metal which was close to it, and so caused damage to the building. Mr. W. Ellis read a paper, "On the Mean Temperature of the Air at the Royal Observatory, Greenwich, as deduced from the Photographic Records for the Forty Years from 1849 to 1888," and also gave some account of the way in which, at different times, Greenwich mean temperatures have been formed. Mr. Ellis also read a paper, "On the Comparison of Thermometrical Observations made in a Stevenson Screen with corresponding Observations made on the Revolving Stand at the Royal Observatory, Greenwich" From this it appears that the maximum temperature in the Stevenson screen is lower than that of the revolving stand, especially in summer, and the minimum temperature higher, whilst the readings of the dry and wet bulb thermometers on both the screen and the stand, as taken at stated hours, agree very closely together. Mr. W. F. Stanley exhibited and described his "phonometer," which is really a new form of chronograph designed for the purpose of ascertaining the distance of a gun from observations of the flash and report of its discharge, by the difference of time that light and sound take in reaching the observer. The instrument can also be used for measuring the distance of lightning by timing the interval between the flash and report of the thunder. A paper was also read by Mr. A. B. MacDowall, on "Some Suggestions Bearing on Weather Prediction."

MANCHESTER, 25th June, 1891.

River Pollution.—The Bill for the formation of a Joint Board for dealing with the question of the pollution of the streams in Lancashire and Cheshire has now practically been accepted. A committee of twenty-four members is to be elected by the County Councils of Lancashire and Cheshire, and the Councils of Manchester, Salford, Bolton, Bury, Oldham, Rochdale, and Southport. The Ribble is to be dealt with by a committee of sixteen members, and in each case the whole of the powers conferred by the Rivers Pollution Act are to be vested in the committee, the expenses of the necessary prosecution being defrayed from a fund to which contributions *pro ratâ* are to be made by the various bodies represented. The Corporation of Manchester has had a survey made of the streams affecting the city, with a view of ascertaining what manufactories were polluting those streams, and what steps were being taken to prevent pollution. The great difficulty in the way of private firms is that of obtaining a simple but effective apparatus which should be capable of dealing with the necessary volume of liquor in a short time. There is an opportunity for makers of filters who can treat works effluents rapidly and effectually. At present precipitation in tanks appears to be the only course open to them.

Health of Factory Workers.—Some light is thrown upon the result upon workers in textile factories of their working conditions by a report recently issued by the Medical Officer of Health for Blackburn. The deaths from various diseases included 253 weavers and 124 spinners and cardroom workers. 11·4 per cent. of the weavers, 6·4 per cent. of the spinners, and 2·3 per cent. of labourers die from phthisis and lung diseases. The report states that the three factors having the chief influence on the health of workmen are the temperature, the vitiated state of the atmosphere arising from respiratory impurity, and the humidity.

The Arts and Crafts Exhibition.—This very successful Exhibition was closed on the 20th inst., after having been open for eighty-one days, during which time the visitors numbered 242,268. A number of awards for exhibits have been made, and it is proposed to hold a similar exhibition at a future date.

The Ship Canal.—On the 19th inst. water was admitted into the canal cutting at Ellesmere Port, thus marking the approaching completion of the work. A depth of water of 26ft. now exists between Ellesmere Port and Eastham, a distance of 3½ miles, and, although the canal is not yet excavated to its full depth, the remainder of the work will be carried out by dredging. The water was admitted by a cutting in the embankment, the opening of the lock gates and formation of a deep sea channel having yet to be carried out. In all there are five dredgers at the disposal of the engineer, which can be put to work speedily. It is anticipated that the canal will be filled with water as far as the mouth of the Weaver during the month of July.

The Linen and Jute Trades.—The results of business this week have been somewhat disappointing both in the light and heavy descriptions of goods. Home trade is somewhat restricted owing to the near approach of stock-taking. One of the most important outlets of trade for Manchester firms is South America, but there has probably been no time when shipments to that country were so small as at present. A very great drawback to business with Brazil is the high price of the necessaries of life in that country. Prints from this district have advanced from 350 milreis to about 500 milreis per yard, and prices of cheap hosiery have increased in still greater proportion. In consequence of this there is no disposition amongst importers to operate, and the same remark applies to trade with the Argentine and with Chili. French spun flax yarns do not meet with such an extensive sale in this country as was the case several years ago. According to the statements of sellers, this falling off is due to a decline in the production of the Lille district, which at one time was a very formidable competitor with England. In the local warehouses stocks are not very large, and buyers do not seem anxious to operate.

GLASGOW, 25th June, 1891.

Engineering.—The steel works of the Calderbank Steel and Coal Company, situated at Calderbank, about three miles from Coatbridge, are now rapidly approaching completion, and will, it is anticipated, be in full operation by the beginning of August. The works are designed for an output of 50,000 tons of finished steel per annum, and are fully equipped with the newest type of plant, of exceptional strength and power. The company was inaugurated exactly twelve months ago, with a capital of £250,000, and a strong local directorate. The general manager is Mr. J. W. Waites. —The new works of the Lanarkshire Steel Company are now in active operation, attention at present being devoted to the manufacture of angles and bars. The plant comprises three Siemens-Martin furnaces of the latest type. The works are situated at the Flemington Station on the main line of the Caledonian Railway, where ample siding accommodation has been provided. A minor strike has occurred at the Blochairn Works of the Steel Company of Scotland. The dispute has been about wages, but only a small section of the workmen has been involved.—The Admiralty contract for the supply of platform weighing machines for five years has been secured by Messrs. Alexander Wood & Sons, Stockwell Street, Glasgow. No loose weights will be employed. Under this contract all the Government Dockyards will be supplied.

The Late Mr. James Young.—On the 18th inst. there died at his residence, Skelmorlie, in his eighty-second year, Mr. James Young, railway contractor. Mr. Young's first practical experience was in the early days of Scotch railways, when he acted as overseer of navvies on the Glasgow and Gamkirk Railway, which now forms part of the Caledonian system. For some years thereafter he was engaged as a general contractor, and did a large amount of useful work as a maker of roads and a builder of dykes. As the railway system developed he gradually obtained contracts of considerable importance. His first independent contract was the Calderbank section of the Monkland Railway, on the completion of which he was engaged for several years for the same company on contracts in the neighbourhood of Bathgate. He then entered into partnership with the late Mr. Robert Ward, in conjunction with whom he carried out two important contracts for the Caledonian Railway Company on what is known as the Rutherglen and Coatbridge branch. After this he constructed the Milngavie Railway and the eastern section of the Wemyss Bay Line from Port Glasgow to Ravenscraig, between 1860 and 1863. In 1866 to 1869 Mr. Young successfully carried out the western section of the Greenock and Ayrshire Railway, which passes through West Greenock and gives access to the Prince's Pier of the Glasgow and South-Western Railway Company. At the same time he carried out the Greenock Waterworks, including the large Gryffe reservoir, from which the town is supplied. His partnership with Mr. Ward being dissolved, he took into partnership his son, Mr. James Young, Jun. The most important contracts carried out by the firm were the Glasgow, Bothwell, Hamilton, and Coatbridge Railway, the North Monkland Railway, the Yoker and Clydebank Railway, the St. Andrews and Anstruther Railway, and lastly, the western section of the Glasgow City and District Railway from West Campbell Street to Stobcross. Mr. Young introduced into Scotland the American steam-navvy, which is now in extensive use. Mr. Young retired from business on the completion of the Glasgow City and District Railway in 1886.

Scottish Railways.—The Fortwilliam section of the West Highland Railway, extending from Fortwilliam to Treig, has been completed, and on the 18th inst. a train was run for twenty miles, the whole length of the section. The other sections of the railway are being pushed on rapidly.

Visit of French Railway Officials to Glasgow.—Thirty railway officials of the French railways, who are just now making a tour in this country, visited Glasgow this week. They were met by local railway officials, and conducted over the City and District Railway on the North British line, and subsequently visited several of the shipbuilding yards, including Fairfield and Clydebank.

Chemical Industry.—The manufacture of bichrome carried on under the Alkali Union at the Eglinton Chemical Works, Irvine, has been suspended on account of the low price of bichrome.

Minerals.—The pig iron market is absolutely quiescent, there being very little business, although there is a brisk demand for forward delivery for Cannel coal. The export trade is dull at the present moment.

Gold Extraction.—The results of a number of trials of the Macarthur-Forrest process worked by the Cassel Company at the Johannesburg gold fields were so satisfactory that at the beginning of this year the process was adopted for systematic work. It is reported that this has resulted in a considerable addition to the product, there being a large quantity of refractory ores in that region. Mr. Macarthur, of the Cassel Company, is now in South Africa. Mr. Pollok, of the Pollok Patents Company, is on his way to Queensland.

(From our own Correspondents.)

LIVERPOOL, 24th June, 1891.

The Liverpool Water Supply.—The long-promised supply of the Vyrnwy water has not yet reached the Liverpool mains, and it was stated at the meeting of the Water Committee yesterday that the present supply, instead of being made continuous, would most probably have to be further restricted. There appears to be some difficulty with the temporary pipe line which was laid a short time ago, and admittance to the precincts of the Prescot reservoir, into which the supply has to flow, is strictly forbidden. An unfortunate accident is also reported to have happened to the permanent works under the Mersey, the water of the river having burst in near the shield and flooded the tunnel. The arbitration case to

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decide the claim of the original contractors for the construction of the tunnel—Messrs. Monk & Newell—against the Corporation of Liverpool for wrong determination of the contract and for damages is now being heard before Sir John Coode, with Mr. Meadows White, Q.C., as legal assessor, at the Westminster Palace Hotel, considerable interest being evinced in the evidence and the probable result.

SHEFFIELD, 24th June 1891.

The Iron and Steel Market.—Iron and steel works continue to be fairly employed, although there is no decided pressure of work. Orders for railway material are scarcely sufficient to keep the machinery going, and some of the older firms are looking forward to a period of slackness in the near future. Messrs. Ashbury's Railway Carriage Company are busily employed with goods waggons and passenger carriages for English and Irish railways. The substitution of iron axles for steel upon the Indian railways has not yet had any perceptible effect upon business in this town. Sheffield steel manufacturers are strongly of opinion that this step is decidedly retrogressive. There is no improvement to report in marine engineering. Orders for shafts and castings are almost completed, and there is little prospect of new orders for some time to come.

Engineers.—The Yorkshire Engine Company, of Sheffield, has just completed the roller path for one of the Manchester Ship Canal swing bridges. This is of cast iron in sections, each of which was machined separately, and with such accuracy that when bolted up the path was perfect and the joints imperceptible. This firm is also bringing out an improved form of coal cutting machine, which is capable of cutting in either direction, and is worked by compressed air or steam.

Agricultural Implements.—There is a brisk inquiry for agricultural implements, and makers of castings and forgings here are employed to the full extent of their capacity.

Cutlery.—Firms engaged in trade with America are very slack, and are not employed more than two or three days in each week. The home and colonial trade in edge tools is very fair.

Rawdon Sewerage.—The Rawdon Local Board have instructed Mr. W. H. Radford, of Nottingham, to prepare a scheme for sewerage and sewage disposal for the whole of the areas under their control. The population of the district is 3,500, and part of it is a residential district for Leeds and Bradford merchants.

CARDIFF, 24th June, 1891.

The Iron and Steel Trades.—The prospects in the steel trade are anything but cheerful. Makers have been turning their attention to rails, but orders are very scarce. Steel tin bars find no outlet now on account of the stoppage of the tinplate works. In the pig iron market there is a fair amount of business. Iron ore has been sold at 13s. c.i.f. Cardiff and Newport, 50 per cent. basis.

The Coal and Coke Trade.—The steam coal market is not quite so brisk this week on account of a falling off in the arrivals of tonnage. There is, however, a good deal of tonnage being chartered for loading during the next two weeks, and it is expected that prices will become firmer. Some cargoes of coal ready for delivery have been sold at a little less than the market price. Best quality is quoted at 15s. to 15s. 3d.; second, at 13s. 9d. to 14s. 6d.; third, at 13s. to 13s. 6d.; and fourth, at 12s. 6d. to 12s. 9d. Small steam, 5s. 3d. to 5s. 6d. Coke is in limited request. House coal is dull on account of the warm weather. The question of new docks is still much discussed in commercial circles. In many quarters it is felt that the time has arrived for the formation of a Harbour Trust, of which mention was made a few weeks ago. The Barry Dock and Railway Company intend to construct a new low-water entrance with a depth of 10ft. below the level of the dock. The coal shipments at Barry Dock for the half-year will certainly amount to more than 2,000,000 tons, an increase of 400,000 tons on the same period of last year.

BARROW-IN-FURNESS, 24th June, 1891.

Hematite.—There is a quiet trade in hematite qualities of pig iron, although prices show an improvement. Warrant iron is selling at 51s. 3d. per ton net cash, and makers are asking 53s. for parcels of Bessemer mixed numbers net f.o.b. The consumption is still greater than the output, with the consequence that stocks are being slowly reduced. Forty-one furnaces are still blowing and thirty-six are idle. There is less consumption of Bessemer qualities of pig iron, and little trade in forge and foundry qualities, while spiegeleisen, which is smelted at some of the works, is not in large request, although 20 per cent. qualities can be bought at 95s. per ton.

Steel.—A quieter tone is again noticeable in the steel trade. There is less business in Bessemer rails, although two of the largest makers in the district have sold largely for future delivery, but the rest of the makers are unfavourably situated. Heavy rails are at £4 7s. 6d. per ton, light rails at £5 10s., and colliery sections at £6 15s. per ton. In steel shipbuilding material there is not much business, nor is the demand in any sense equal to the capacity of production. It is hoped that the shipbuilding department of trade, as well as the business in steel blooms, slabs, and billets, will improve. Tinplate bars are, however, very quiet. The business in hoops and heavy steel castings is brisk, and there is every chance of a considerable development of this industry in the early future.

Iron Ore.—Little business is being done in iron ore. A cargo of native hematite was shipped last week from Barrow to New York, which contrasts with the importation of a cargo of Bilbao ore this week to this district where there is very little demand for local qualities of the raw material. Local ores are at 9s. 6d. to 9s. 9d. per ton net at mines.

Shipping.—A better tone has lately been noticeable in the shipping trade, but although the tonnage of metal exports are exceeding those of the corresponding period of last year, the aggregate tonnage of exports up to the middle of the present month is below that in the corresponding period of last year.

MIDDLESBROUGH, 24th June, 1891.

Pig Iron.—The iron trade is still in an unsatisfactory state. At the weekly market held on 'Change yesterday, there was a good attendance, but little business was done. No. 3 Cleveland G.M.B. was a little stiffer in sympathy with warrants. The general quotations for No. 3 makers' iron was 41s. per ton, and that price was paid by those who wanted it for immediate shipment, but iron for early delivery was quoted at 40s. 6d. by some firms, and at 40s. for August delivery. Middlesbrough warrants are—sellers, 42s. 4d., and buyers, 42s. 3d. per ton. The deliveries to Scotland of No. 4 foundry and forge iron are in fair quantities, though the difference in price between these qualities and No. 3 would have been thought to lead to a better demand. No. 4 foundry is quoted at 38s. 6d., and grey forge at 37s. 6d., but the latter can be got from sellers at 37s., which is 4s. instead of the usual 1s. below the usual price of No. 3. East Coast hematite is quoted at 50s. 6d. per ton for mixed numbers. There is still a large amount of iron going into the public stores to make warrants, and on the 22nd inst. the stock in Connal's was 133,983 tons, an increase for the month of 8,414 tons. It is probable that the stocks will not be much decreased this month, as in consequence of the approaching stocktaking local deliveries will be kept as low as possible until the end of the month.

Manufactured Iron and Steel.—There is little to report in connection with the finished iron and steel industries; indeed, it may be presumed that prices have now reached their lowest, for, though work has been irregular and orders scarce for the past few weeks, quotations have not altered. They are as follow:—Common bars, £5 12s. 6d.; best bars, £6 2s. 6d.; iron ship plates, £5 10s.; steel ship plates, £6; iron angles, £5 7s. 6d.; steel angles, £5 15s., all less 2½ per cent. for cash on the 10th of the month following delivery and f.o.t. at makers' works. Heavy steel rails are from £4 5s. to £4 7s. 6d. net at works.

Shipments.—The shipments of pig iron appear to be falling off for the latter part of the month, and during last week only amounted to 15,877 tons, as against 20,336 tons for the corresponding week of last year. The total shipments for June up to the 22nd inst. were 56,607 tons, against 58,927 tons during the corresponding period of May, and 56,018 tons up to June 22nd, 1890.

SUNDERLAND, 24th June, 1891.

Shipbuilding.—Thirty-nine vessels, of 84,058 tonnage, have been constructed during the present year. This amount shows a decrease of seven vessels, of 13,742 tons, when compared with the corresponding period of the year 1890. Messrs. William Doxford & Sons, Pallion, take the first place with five vessels, of 13,148 tons, three of which were "Clan Line" steamers, and the remainder very large sailing vessels. Messrs. Short Bros., Pallion, are second, with an output of six steamers, of 11,416 tons; and Messrs. J. L. Thompson & Sons, North Sands, are third, with four steamships, of 9,180 tons. Mr. James Laing, Deptford, has launched three steamers, of 9,138 tons; Messrs. W. Pickersgill & Sons, Southwick, two steamers and one sailing ship, of 6,790 aggregate tonnage; the Sunderland Shipbuilding Company, Ld., South Dock, two steamers, of 6,370 tons; Messrs. J. Blumer & Co., North Dock, three steamers, of 5,850 tons; Messrs. Osbourne, Graham, & Co., three steamers, of 5,672 tons; Messrs. Robert Thompson & Sons, Southwick, four steamers, of 5,488 tons; Messrs. Bartram, Haswell, & Co., South Dock, two steamers, of 5,113 tons; Messrs. J. Priestman & Co., Southwick, two steamers, of 3,743 tons; and Messrs. S. P. Austin & Son, one steamer and one sailing vessel, aggregating 2,150 tons. The Strand Slipway Company have not launched any vessel during this period.

River Wear Commissioners.—The report for last month was fairly satisfactory, although neither as to coal shipments or gross revenue was it equal to that of the previous month. From the river and docks 332,986 tons of coal were shipped, as compared with 325,784 tons in the month of May, 1890. The total revenue for the month was £11,364 10s. 11d., as against £11,182 4s. 7d. in May, 1890, an increase of £182 6s. 4d.

The Engineering Trade.—Much satisfaction is felt that the dispute at Jarrow has been settled, and that the local employers have been enabled to reinstate those members of the Amalgamated Society of Engineers who had been discharged. There are still some matters in dispute amongst seagoing engineers, as the conference held here on the 8th inst. had no definite result. On the 20th inst. the counter proposals of the shipowners were considered at a meeting of all the engineering societies, and steps are being taken to have a second conference with the employers.

NEWCASTLE, 24th June, 1891.

The Coal Trade.—At a meeting of coal owners and representatives of the Northumberland miners, held in Newcastle on the 20th inst., the claim of the miners for an advance of 10 per cent. on the wages rates was discussed, and at the close, the coalowners declared their inability under present circumstances to concede any advance whatever. This decision will, of course, be the subject of further discussion in the miners' lodges, but it is probable that in view of the general tendency to a decrease of business the claim will be withdrawn. The shipments of coal and coke at Tyne Dock during the week ending the 20th inst. amounted to 122,889 tons, being an increase as compared with the shipments in the corresponding week last year of 2,680 tons.

The Race Week Holidays.—In accordance with custom the whole of the industrial establishments in the district are closed this week, owing to the holding of the annual race meeting at Gosforth. This is the longest holiday period observed in this district throughout the year, and managers of works usually take advantage of it to carry out such repairs as may be needed to the plant and machinery under their charge. The stoppages of work through holidays and labour disputes that have taken place this year have exercised a most detrimental effect on business, and it is to be hoped that in the remaining six months there will be few or none of these interruptions.

Shipbuilding.—Messrs. Armstrong, Mitchell, & Co. launched from their Low Walker Yard on the 20th inst. a large twin-screw passenger steamer of 11,000 tons displacement, ordered by Messrs. McIver, of Liverpool. The vessel, which is named the "Ruthenia," is intended to be the first of a new line of steamers to trade between this country and Australia. Messrs. Wigham Richardson & Co. have also launched a twin-screw passenger steamer named the "Pelotas." This vessel is intended for the Brazilian coasting service. It is reported on apparently good authority that a few orders have been received since the beginning of the month. It is to be hoped that the report will turn out to be well founded, for empty building berths are becoming numerous, and an accession of work is needed.

Engineering.—The works of Messrs. R. Stephenson & Co., South Street, continue to be kept well employed on locomotive orders, and Messrs. Black, Hawthorn, & Co. are also well supplied with work of the same description. The tendency of business at the Elswick Ordnance Works is still towards dulness, and within the past week or two a further number of hands have been discharged. There have been ordered from Messrs. Tangye, of Birmingham, through the firm's Newcastle agency, four 22in. centrifugal pumping engines and three duplex pumps, for use in connection with the new pontoon dock which is being constructed by Messrs. M. S. Swan & Hunter for the Wallsend Pontoon Company, Ld.

The Fitters and Plumbers' Dispute.—This unseemly quarrel has at last been ended, or at all events a truce has been declared, and full work will once more be resumed after the race holidays. The trouble will no doubt arise again unless some effective steps are taken to prevent such needless stoppages, and it is to be hoped that action will be taken before another crisis of this sort occurs.

BELFAST, 24th June, 1891.

Shipbuilding and Engineering.—These trades are now in a better condition than they have been for a long time past. All the stocks are full, and there are enough orders to keep them so for some time to come. A large number of vessels of heavy tonnage are lying at the finishing berths for the purpose of repairs. Several contracts of this sort have had to be sublet to English firms, owing to pressure of work here. Messrs. Harland & Wolff are working day and night in almost all their departments. The York Street Flax Spinning Company are following the example of Messrs. William Barbour & Sons, of Hilden, and are fitting their York Road Mill with triple-expansion engines, which have been ordered from Messrs. Hick, Hargreaves, & Co., of Bolton.

The Linen Trade.—The tone of the market is at present very steady, although sales have not been large. The demand for yarns, however, still continues good. The growing crop of flax is generally good, but more rain is desirable.

Electric Lighting in Armagh.—Messrs. Ernest Scott & Mountain, Ld., of Newcastle-on-Tyne, have secured the contract for the electric lighting of the Armagh Spinning Company's mills in Armagh. The installation will consist of a "Tyne" compound dynamo and 380 incandescent lamps

The Society of Chemical Industry.—The annual meeting of the Society of Chemical Industry will be held at Dublin on the 8th, 9th, and 10th of July. During the meeting visits will be made to several of the works and distilleries, &c., in the district, among which we may mention Messrs. Power & Son's distillery and Messrs. A. Guinness, Son, & Co.'s brewery.

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THE GARRUCHA AERIAL ROPEWAY.

(*For description see page* 603.)

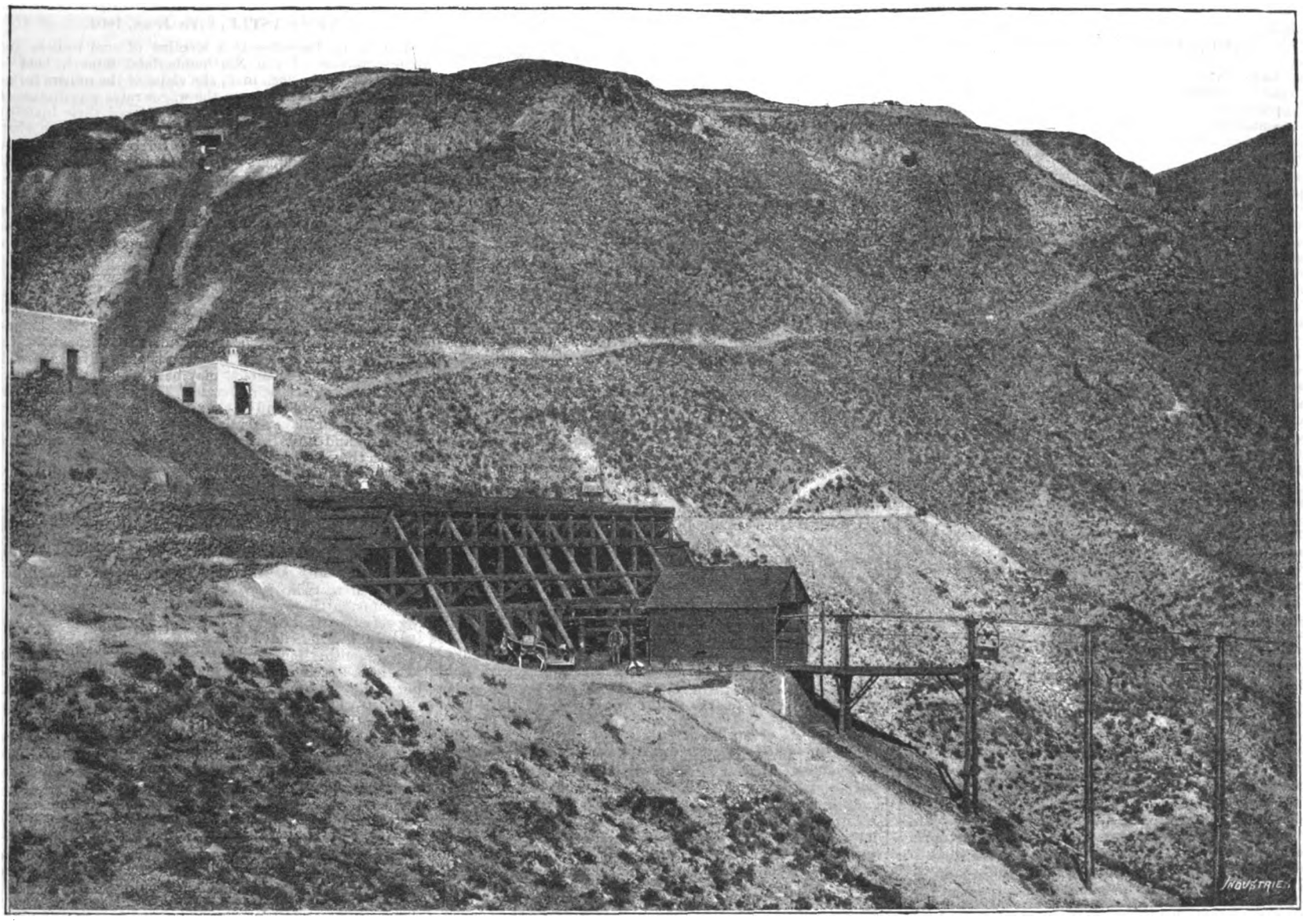


FIG. 19.—LOADING STATION AT FOOT OF GRAVITY INCLINE.

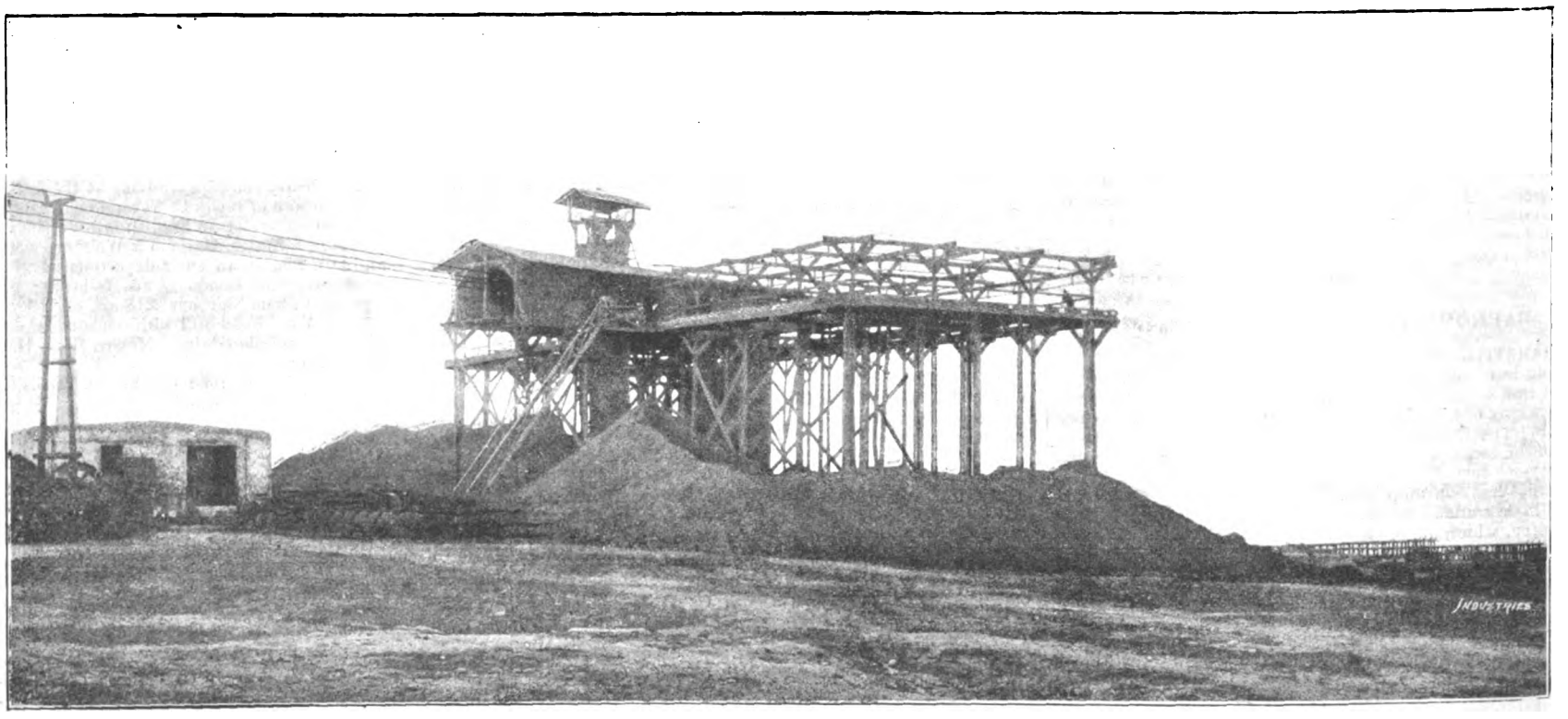


FIG. 20.—UNLOADING STATION AT THE COAST NEAR GARRUCHA.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week. Small advertisements can, however, be accepted up to 6 o'clock on Thursday.

All accounts are payable to GEO. CAWLEY, *358, Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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93, Hope-street, Glasgow.

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(Mr. G. N. Hennessy is Sole Agent for Ireland.)

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

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To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 26TH JUNE, 1891.

REPORT OF THE BULKHEADS COMMITTEE.

THE Report of the Committee appointed by the Board of Trade more than a year ago to consider the questions relating to bulkheads in ships has just been issued, and is, on the whole, one of the most important documents which has appeared in connection with the practice of shipbuilding for a very considerable time. It is published at a very opportune time, when the subject of safety and speed at sea is being discussed, and when ships are being designed which are to surpass in size and speed any of those at present running. Those who study the document will, in the first place, wish to know the names of its authors, for the position of these in their profession will, to a very large extent, determine the weight which is to be attached to their recommendations. Such a Report will have authority in so far as it is the result of special investigation, combined with general knowledge and experience. The Chairman of the Committee was Sir Edward Harland, M.P., and he had as his colleagues the late Professor Jenkins, of Glasgow University; Dr. Alexander Kirk, senior partner of Messrs. Robert Napier & Sons; Mr. Royden, M.P.; Mr. James Laing, of Sunderland; and Mr. James G. S. Anderson, of London; and we think that these gentlemen form a judicious combination of practical experience, theoretical ability, and commercial knowledge which ought to command confidence. The Committee were asked to report on the following matters:—(1) As to the manner in which ships shall be subdivided, so that they may float in moderate weather with any two compartments in free connection with the sea, and what rule there should be as to the proportion of freeboard of the water-tight deck next above that to which such bulkheads are attached as shall be sufficient to enable the ship to float. (2) As to the description of ship to which such proportions should apply as regards size and design. (3) Upon the construction of water-tight bulkheads, with a view to their resisting the strains which come upon them. (4) In what manner the surveyors of the Board of Trade can best determine the sufficiency of such bulkheads. (5) Under what restrictions may passage ways be permitted through such bulkheads. (6) Whether a transverse compartment, divided into two by a longitudinal bulkhead, should be treated as one or two compartments. (7) What particulars, drawings, and calculations should be furnished by the owners of ships to the Board of Trade when they desire to take advantage of the provisions of the Merchant Shipping Act, 1888, which gives exemption from carrying the full number of boats and rafts which otherwise would be required. (8) Whether, independently of the requirements of the preceding paragraphs, the Committee have any recommendations to make with reference to bulkheads, which would, in their opinion, contribute to the safety of life at sea. The Committee carried out their work very carefully, and did not content themselves with writing a report as the result of their own personal work and experience. They not only took the evidence of other experts, but had recourse to experiments of a crucial character. Large tanks were fitted up in their offices at Whitehall, so that the Committee might be in a position to elucidate any difficult point which might arise. The results of their observations are embodied in a series of curves and tables, which must be of immense value, as they relate to almost every description of craft and cargo. The Committee also submit a series of suggestions, by the adoption of which the advantages of the efficient subdivision of vessels by means of bulkheads may be secured.

We must refer our readers to the Report for details of the investigations and of the replies which the Committee have given to the various questions which were placed before them, as our space will only allow us to notice a few of its chief points. With regard to the first question, the Committee think that vessels may be considered able to float in moderate weather with any two adjoining compartments in free connection with the sea, if fitted with efficient transverse water-tight bulkheads, so spaced that, when two such compartments are laid open to the sea, the uppermost water-tight deck to which all the bulkheads extend, and which they call the "bulkhead deck," is not brought nearer to the water surface than a certain limit. This limit is indicated by a line drawn round the side of the vessel, at a distance amidships of $\frac{3}{100}$ths of the depth at side at that place below the bulkhead deck, and gradually approaching it towards the ends, where it may be $\frac{3}{200}$ths of the same depth below it. This line they call the "margin of safety line." Vessels in which the bulkheads do not extend to a continuous deck require a modification of the "margin of safety line," which is specially described in an appendix to the Report. The arrangement of plane transverse bulkheads necessary to satisfy the above condition may be determined with the aid of the curves and tables which are given in the appendix, or by separate calculations in accordance with the assumptions made in that appendix. These curves and tables show the maximum spacing of such bulkheads permissible in vessels of various descriptions and under various conditions, at any point in the length measured along the loadline from the fore-side of the stem to the afterside of the sternpost, in connection with any given freeboard measured from the bulkhead deck. The freeboard to be used is not necessarily that required under the Merchant Shipping Act, 1890, but may be any freeboard which, on the application of the shipowner, may be registered by the Board of Trade. Such freeboard the Committee call the "bulkhead freeboard," and the corresponding loadline the "bulkhead loadline." The tables were so arranged that the Committee did not consider it necessary to frame rules with regard to the proportion of freeboard in relation to the size of the vessel. The tables were prepared for vessels carrying cargoes such as coal, but curves have been prepared for cargoes of a low density. From these curves similar curves may be approximately deduced for cargoes of intermediate density. From an examination of the curve for an iron cargo it is obvious that, to require such a spacing of bulkheads in sea-going cargo vessels as would fulfil the conditions of the question of the Board of Trade under all circumstances of loading, would cause the holds to be too short for general trade. The Committee say that, after much consideration, they recommend that the arrangement of bulkheads in all the vessels specified in the different

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grades should be fixed on the assumption that the vessels contain cargo, such as coal, occupying 47 cubic feet to the ton, sufficient, with the full complement of bunker coals on board, to immerse them to the bulkhead loadline, and so distributed as a whole that they may float on an even keel. Such cargo they have assumed to admit water to 40 cubic feet in every 100 cubic feet of the space which it occupies.

The first question is the most important of the eight put to the Committee, and they have devoted considerable space to its discussion. With regard to the second question, they reply that although all vessels, whatever their length, can be subdivided so as to be able to float in moderate weather with any two adjoining compartments in free connection with the sea, yet if small vessels were subdivided to that extent their holds would be so reduced in length as to impair their value for commercial purposes. As we have already indicated, the Committee, having regard to the exigencies of trade, recommend that vessels should be classed in six grades, and be fitted with bulkheads in the manner mentioned in the appendix. These grades include all the ordinary types of vessels. In reply to Question 3, the Committee supply a table of scantlings, and, if the bulkheads forming water-tight compartments be constructed according to these, they may be considered of sufficient strength to withstand the strains to which they are likely to be subjected. They point out, however, that such bulkheads should be efficiently secured to the outside plating by means of frames or angle-irons, and also to the deck to which they extend. They also answer Question 4 by stating that the surveyors of the Board of Trade may accept the designs and scantlings contemplated in the tables as sufficient, but other modes of construction may be allowed, provided that the Board of Trade is satisfied that the strength would not be less than it would be if they were constructed to the above-mentioned scantlings. With regard to Question 5, the Committee recommend that any passage ways through such bulkheads should be subject to very strict conditions—which they enumerate—and which, if adhered to, should prevent any danger therefrom. They think that a compartment subdivided by one or more longitudinal bulkheads should be treated as one compartment only, unless the Board of Trade has been satisfied that the divisions have been made thoroughly efficient, and provided that the stability of the vessel would not be seriously affected by one part of it being filled. Owners desiring to take advantage of any of any of the exceptions made in the Merchant Shipping Act in favour of efficiently subdivided vessels, should furnish the Board of Trade with the following particulars and drawings: (*a*) Longitudinal elevation in section, showing the sheer, the bulkheads, and the decks proposed; (*b*) plan and elevation of each bulkhead; (*c*) proposed bulkhead, freeboard, and corresponding loadline; also position of the side-lights. The Committee have nothing very important to suggest under the last question put by the Board of Trade, thus showing that the previous ones had been very carefully drawn up. They, however, make a few recommendations of a more or less general nature. Altogether the Report of the Committee gives evidence of having been thought out and drawn up with great care, and we commend it to the attention of shipowners and shipbuilders.

THE NORWOOD JUNCTION RAILWAY ACCIDENT.

In our last issue we gave a brief abstract of Major-General Hutchinson's report on the bridge accident at Norwood Junction. The facts disclosed in this report are by no means calculated to inspire confidence in the minds of the travelling public. We learn that as far back as 1876 "two identical girders at different parts of the same bridge were broken by an engine getting off the rails, and they (the Brighton Company) were then recommended to substitute stronger girders in their place, a recommendation to which unfortunately no attention was paid, or the present serious accident would have been prevented."

Surely in such cases as these, where the safety of hundreds of passengers at one time is at stake, the Board of Trade should have power to enforce its recommendations. Otherwise one is tempted to doubt their utility. For all practical purposes the previous admonition of the Board of Trade might just as well never have been given, since it has required a second accident, involving damage to property and passengers, to induce the railway company to carry out the necessary reforms. From the engineer's point of view, our first feeling, on reading the details of the dimensions and condition of the girder and the loads to which it was subject, was one of astonishment that it had lasted so long—viz., thirty-one years—in spite of excessive loads and a flaw reducing by 25 per cent. its nominal sectional area.

According to Major-General Hutchinson, the span of the bridge is 26¼ft., "and the engine which drew the express train," to which the accident happened, "would give a moving load equivalent to about 12·33 tons at the centre of each girder, and the permanent load being equivalent to about three tons at the same point, the girder, according to Board of Trade rules (first issued in 1859), should have had a breaking weight of"—

$$\begin{aligned} 6 \times 12{\cdot}33 \text{ tons} &= 73{\cdot}98 \text{ tons} \\ 3 \times 3 \quad \text{,,} &= 9 \quad \text{,,} \\ &\overline{\quad\quad} \\ &82{\cdot}98 \text{ tons} \end{aligned}$$

Major-General Hutchinson states that the "calculated breaking weight of the girder, according to the usual rule, would be, supposing the metal sound, about 71 tons." "But the existence of the flaw would reduce this by at least one-fourth, or leave the breaking weight not exceeding about 53 tons."

Now admitting this to be correct, the nominal factor of safety would be $\frac{53}{15{\cdot}33} = 3{\cdot}45$ referred to the total load, moving and permanent; but as, on a short bridge with high train speeds, the moving load is approximately suddenly applied, the real factor of safety would be considerably smaller, without taking into account shocks or jarring. It seems, therefore, extremely improbable that the girder was really as weak as represented, otherwise it could not possibly have lasted for so long a period. Moreover, the relative reduction of strength represented by the flaw was probably much greater than that due merely to the diminished sectional area.

Taking all these points into account, we are led to suspect that the girder was in fact much stronger than estimated by Major-General Hutchinson, and a closer examination of the figures given in his report confirms us in this view. The depth of the broken girder is given as 27in., the width of the bottom flange 20in., its thickness at the outside and centre respectively 1⅛in. and 1¼in., and the thickness of the web 1½in. to 1¾in. Now, if we neglect the additional transverse strength due to the web, and calculate the strength of the girder in the same manner that the strength of deep wrought-iron girders is generally treated, taking the effective depth at 25½in. we find the total tensile stress on the lower flange from the equation—

$$\tfrac{1}{2} \times 15{\cdot}33 \times 13{\cdot}375 \times 12 = 25{\cdot}5 \times \text{total stress},$$

whence Total stress = 48·25 tons.

The sectional area of the lower flange is $20 \times 1\frac{5}{8} = 32{\cdot}5$ square inches, and therefore the tensile stress per square inch $\frac{48{\cdot}25}{32{\cdot}5} = 1{\cdot}484$ tons. If we assume the ultimate tensile strength of the cast iron to be 8 tons per square inch, we have an average factor of safety $\frac{8}{1{\cdot}484} = 5.39$, and the breaking weight would thus be $15{\cdot}33 \times 5{\cdot}39 = 82{\cdot}64$ tons. According to the "usual rule," Major-General Hutchinson estimates this breaking weight at 71 tons (assuming the metal to be sound). It is not stated in the report what this usual rule is, but the method we have adopted of calculating the strength of the girder gives a result which is much below the true value, and is yet considerably in excess of that obtained by Major-General Hutchinson. As is well known, the transverse strength of solid cast-iron beams is very much greater than that which is based on the assumption that the ultimate stress in the extreme fibre, if the usual formula for solid beams applies, is limited by the ultimate *tensile* strength of the material. Besides this, the strength of the web has not been taken into account in our calculation, and this alone would add at least 8 per cent. to the preceding estimate (82·64 tons). Having regard to all these considerations, the breaking weight of a sound girder of the dimensions in question might very well have been 120 instead of 71 tons, or, allowing a reduction of 25 per cent. for the flaw, 90 tons instead of 53 tons. Even thus the factor of safety would be less than 6, which, for cast iron subject to repeated and suddenly applied loads, with occasional shocks, is too low. The engine, moreover, which caused the final catastrophe was not the heaviest passing over the bridge, for we read that the London and North-Western locomotives brought a load of 14·3 tons on the centre of each girder.

Cast iron, from its character, is quite unsuitable as a material for the construction of girder bridges, not merely because it may contain flaws externally invisible, but chiefly on account of the fact that it has no true elasticity and a very slight extensibility. Consequently, when it fails, the collapse is sudden, and no warning is given. Since August, 1883, the use of cast-iron girders, except in an arched form, has been prohibited by the Board of Trade for under-bridges on *new lines*. We suppose because it is an old line the London, Brighton, and South Coast Railway Company consider themselves justified in still retaining five cast-iron under-bridges on their main route between London and Brighton. If cast-iron girders are dangerous on new lines they must be still more so on old lines, and to allow their continued existence on the latter when they have long been prohibited on the former is an illogical blunder on the part of the Board of Trade, and unpardonable negligence on the part of the railway company. It is an aggravation, too, of the offence, that "no inspection of the bottom flanges of the girders from below had taken place since the bridge had been refloored about ten years ago." This neglect is explained, but not excused, by the circumstance that "the bridge was covered underneath with corrugated iron plates." To have removed these for the purpose of inspection, would—we suppose—have entailed undue trouble and expense. Yet the damage done to the train alone is estimated in the official report at £1,850. As it happens, the flaw which accelerated the collapse of the girder "was invisible to even careful inspection after the girder had been placed in position," but this does not absolve the company from the duty of regular inspection.

Altogether the chief lesson to be learned from the unfortunate occurrence is, that official prohibitions and recommendations are of little use unless the authority by which they are promulgated has the power and will to enforce them. This suggests, by the bye, the subject of continuous brakes; but that is another matter, into which we cannot now enter. Let us hope, however, that it may not be forced upon our attention by some further "shocking railway accident" of another kind.

THE ALKALI WORKS REPORT.

Mr. Fletcher's annual report to the Local Government Board and the Secretary for Scotland is always interesting reading, and the report for the year 1890 is at the present time of especial interest, as it is the first official report issued since the establishment of the Alkali Union. The Chief Inspector points out that it may be expected that any improvement, introduced and found to succeed at any of the works, will be rapidly extended to all, and that among the managers a wholesome emulation will be developed, tending much to raise the general standard of efficiency. He wisely abstains from expressing any opinion as to the working of the Alkali Union from a commercial point of view, but if his expectation of greater efficiency at all the works is realised, the Union will thus be beneficial to the industry in this country. Rivalry in trade, however, has in many manufactures brought about the same result, and it is difficult to realise that a monopoly, as far as England is concerned, will tend to raise the efficiency in the way which Mr. Fletcher expects. The history of the sulphuretted hydrogen difficulty in connection with the Chance-Claus recovery process, which has been alluded to from time to time, shows that the nuisance complained of has been much greater than was at first imagined. The eagerness with which nearly all the alkali manufacturers adopted the new process must have suddenly burdened the Union with a considerable amount of labour in remedying the evil which existed through the faulty plant of the vendors. In Widnes alone we read that eight manufacturers almost simultaneously commenced working the new process, and altogether fifteen large works started within a few months of one another, with plant costing in the aggregate £500,000. The loss of sulphur at first amounted to as much as 10 grains per cubic foot, and was nearly 20 per cent. of the total quantity of sulphur produced by the process. The efforts of the Newcastle Chemical Company to combat the nuisance have proved unsuccessful owing to the valves of the pumps suffering from the strain caused by the great volume of gases which had to be pumped through the deep columns of "slurry" or semi-fluid tank waste. The British Alkali Company have passed their gases over the pyrites burners, and have thus entirely obviated the

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nuisance, but such a procedure diminishes the production of acid in the chamber to the extent of 10 per cent., and necessitates an additional consumption of nitre. It is hoped, however, that the gain of sulphur will be found to compensate for these items of loss, and thus demonstrate the value of this method of treatment.

The Hargreaves process also lends itself to the utilisation of the sulphur-charged waste gases, but many works found that it was more advantageous at the time to erect special furnaces in which complete combustion of the sulphuretted hydrogen to sulphurous acid was effected, this acid gas being afterwards allowed to pass away through the chimney of the works. Dr. Affleck, the special inspector at Widnes, reports that none of the noxious sulphuretted hydrogen now escapes. The public, however, should be informed that at the works at which these furnaces are in use, notwithstanding the enormous dilution of the gases with air, the total amount of sulphur passing into the atmosphere remains the same. From a sanitary point of view, we doubt if sulphurous acid is at all preferable to sulphuretted hydrogen. We hope in the report for the current year statistics will be collected by means of which the acidity of the gases escaping in each district from sulphuric acid chambers, chimneys, and from manure works may be compared.

The total amount of salt consumed in the Leblanc soda process in 1890 was 598,684 tons, which shows a slight increase over the amount, 580,827 tons, for 1889, but has not yet reached the large amount of 613,718 tons consumed in 1888. The ammonia-soda process, on the other hand, consumed 252,260 tons last year, which is a far larger quantity of salt than in any previous year, the consumption being 219,279 tons in 1889 and 212,181 tons in 1888.

With regard to rival processes, the report states that the method devised by Messrs. Parnell and Simpson, of which so much had been expected, has now been abandoned, whilst that devised by Messrs. Haddock and Leith is favourably commented upon by Dr. Affleck. Mr. Gossage, of Widnes, and Mr. James Simpson, of Liverpool, are also both busily engaged upon commercial trials of their new processes, in neither of which is lime required, nor is any tank waste produced. In concluding this part of his report, Mr. Fletcher alludes to the electrolytic processes, and shows that "every improvement in the steam engine or other motor, or any advance in the construction of the dynamo, brings nearer the day when the splitting up of the salt may be accomplished as a simple act of electrolysis."

The smoke abatement question is also briefly discussed in the report, which contains many suggestive remarks thereon, and we commend a careful reading of this portion of the report to those of our readers who are interested in this question.

TELEGRAPHIC COMMUNICATION WITH LIGHTHOUSES.

We mentioned some time ago that the subject of the importance of telegraphic communication with lighthouses had been discussed before the Associated Chambers of Commerce, and that it was resolved to present a memorial to the President of the Board of Trade, setting forth that, inasmuch as a sacrifice of life and property takes place yearly on the coasts of the United Kingdom owing to the absence of prompt information of ships being in distress or wrecked, it is desirable that a system of telegraphic and telephonic communication be established between coastguard and lifeboat stations, lighthouses and lightships, and the general telegraphic system.

A few days ago a deputation waited on the President of the Board of Trade to present the memorial, and to urge upon him the necessity for attention being paid to the various matters mentioned in it. Colonel Hill, M.P., who introduced the deputation, pointed out that it was well known that from time to time there were disastrous wrecks around our coasts, attended with a lamentable loss of life and property, which might have been prevented if assistance could have been rendered with promptitude. In the majority of cases that assistance could have been obtained, for it existed in nearly all our ports in the shape of steam tugs and lifeboats at various stations, rocket apparatus, and other means. What was required was some means of letting those various stations know the necessity that existed for their help. There should, he urged, be telegraph and telephonic communications with the general system of the country, and the arrangements could be utilised, not only for the purposes of the mercantile marine, but also in time of war when they would be most valuable to the naval and military authorities. The Associated Chambers of Commerce had prepared a list showing where communication with the telegraphic system of the country was most needed. The places given in the list were: St. Agnes, Scilly, Start, St. Alban's Head, Dungeness, North Foreland, Cape Clear, Flamborough Head, Rattray Point, South Stack, St. Anne's, and Lundy Island. The expense had been estimated at £100,000, and Colonel Hill believed that even the expenditure of a very much larger sum than that would be justified if the present lamentable loss of life could be prevented. He pointed out that the expenditure would not be altogether unprofitable, because he was quite sure that some revenue—it was impossible to say how much—would be derived in consequence of the increased means of communication and intelligence that would be afforded.

After various other members of the deputation had spoken in support of the deputation, the President replied that, while he could not assent to their request at once, he was very favourably disposed towards it, and was willing to arrange for experiments being made to ascertain the difficulties connected with the question and the best methods of overcoming them.

This is possibly all that can be expected in the meantime. It is to be regretted, however, that the question of the expense connected with the arrangements and the experiments was not faced in a more liberal spirit. When any class or set of individuals receive special benefits it is only right that they should be expected to pay for them, but arrangements which are national should be paid for out of the national Exchequer. The President of the Board of Trade practically shirked the question, and hinted that the expense of the experiments ought to be paid out of the Mercantile Marine Fund, but as that fund has for some time been practically in a state of bankruptcy, the suggestion practically means that they should be paid for out of the pockets of the shipowners. Some years ago all tolls were taken off the public roads, and, if such a measure was expedient, then it is equally expedient to take steps which will add to the safety of our merchant shipping and to the strength of our army and navy. It is of the utmost importance that our military and naval authorities should have the earliest possible intelligence in the event of war, and also the means of communicating with all outlying points, and thus be able to arrange for the most effective disposition of their forces. We hope, therefore, that these authorities will unite with the Board of Trade, and come to an arrangement which will not only meet all their requirements, but also at the same time add to the safety of our mercantile marine.

DECIMAL WEIGHTS AND MEASURES.

For several years the "decimal question" has been quietly slumbering, but the development of foreign competition and other causes are now forcing renewed attention to it. The subject is certainly one of great importance, and it may be well to give a short statement of the present position of the matter.

If our coinage, weights, and measures were decimal, fractions could be added, subtracted, multiplied, and divided in the same way as whole numbers, and compound arithmetic would be superseded. From an educational point of view the advantage of such a change would be immense, and during the past year many of the leading School Boards petitioned the Education Department in favour of decimals being taught on completion of the four simple rules. Chiefly in consequence of this, the New Code (1891) provides that: "The scholars in Standards V., VI. and VII. should know the principles of the metric system, and be able to explain the advantages to be gained from uniformity in the method of forming multiples and sub-multiples of the unit." It is no-doubt an important step to familiarise the rising generation with the metric system, always supposing that the weights and measures of this system are to be generally used. If the metric system is not to be adopted the question will naturally be asked, Why should our overworked teachers and scholars have this additional burden cast upon them? The educational gain will be great if we adopt the metric system, instead of our odds and ends of incongruous and perplexing weights and measures; but the gain will be greater still if we also have a decimal coinage. As a question of practical politics it will not do to attempt too much, and there appears to be a general agreement among the advocates of the proposed reform that the weights and measures should be dealt with first, and the coinage afterwards. This opinion is strengthened by the fact that the last Royal Commission on Decimal Coinage reported in 1857 that it was undesirable to change the coinage "while our weights and measures remain as at present, and so long as the principle on which their simplification ought to be founded is undetermined."

Various proposals have been made for decimalising some of our existing weights and measures, but the Select Committee of 1862 (on Weights and Measures) pointed out that "it would involve almost as much difficulty to create a special decimal system of our own, as simply to adopt the metric system in common with other nations. And if we did so create a special national system we should, in all likelihood, have to change it again in a few years, as the commerce and intercourse between nations increased, into an international one." The Weights and Measures Act, 1878, has led the way by providing for the verification of metric weights and measures used for purposes other than trade, and sets forth the equivalents in imperial weights and measures. More recently the Board of Trade Standards Department has obtained metric standards of the highest scientific precision.

Many persons think the metric system simple, rational, and good, but fear trouble if we adopt the French names usually associated with this system. The French metric tables are no doubt complete and symmetrical, but in the ordinary affairs of domestic and commercial life barely a third of these names are used, even in France. In the elementary schools of Germany only nine names are taught for the metric weights and measures. If nine names are sufficient for Germany, there is no reason why we should have more.

The Select Committee of 1862 reported very strongly in favour of the adoption of the metric system, and it is urged that, good as their reasons then were, the need for the change is now very much greater, and it could be effected more easily than thirty years ago. Since then elementary education has been made compulsory, and is controlled by the representatives of ratepayers, under Government supervision. The School Boards wish for the change, and we have seen that experience in other leading countries has shown that the French metric tables, formerly proposed, can be greatly simplified. Apart from these considerations, there is the important fact that, excluding our own dependencies, the United States, and Russia, all the civilised countries of the world (with an aggregate population of nearly 330 millions) have now adopted the metric weights and measures. Put in another way, nearly 60 per cent. of our imports (excluding British possessions), and over 70 per cent. of our exports, come from and go to countries which have adopted the metric weights and measures. Not only is this so, but the foreign makers who compete with us come chiefly from countries where the metric system is used exclusively. Thus, while our foreign customers are troubled and perplexed with our absurd weights and measures, our competitors are able to offer them goods and machines in terms of the only weights and measures with which our customers and competitors are familiar.

Our Chambers of Commerce are all in favour of the proposed change; and when a joint deputation of the London Chamber of Commerce and the Decimal Association waited on the Chancellor of the Exchequer the other day, he admitted that the change would be an improvement, and that on theoretical grounds it was right. He did not even discuss the question on its merits, and merely referred to the difficulties of effecting the change. On this point the experience of other countries is reassuring, and the best example is probably that of Germany. In that country four years were allowed within which to effect the change, but as a matter of fact it was over practically in a few weeks. There certainly appears to be a *primâ facie* case for adopting the metric weights and measures without further delay, and it seems desirable that a Select Committee should be appointed to consider the question in all its bearings, and especially in the light of our present requirements. Over 150 Members of the present Parliament signed a petition for further inquiry by a Royal Commission or Select Committee, and many other Members are known to be in favour of such a course. The Education Department has already ordered that the metric system shall be taught in the primary schools; the Chancellor of the Exchequer has just stated that the Government will not oppose the appointment of a Select Committee; and it now remains for the pressure of public opinion to make itself felt through the usual channels.

We may say that we are indebted to the Decimal Association for some of the information we have now given; and if any of our readers desire further information on any point they will do well to write direct to its London Office, Botolph House, Eastcheap, E.C.

PROPOSED NEW RAILWAYS IN DUMBARTONSHIRE.

It seems as if Dumbartonshire were to have a large addition to its railway facilities, for the Caledonian and the North British Companies have each been successful in passing their schemes through the ordeal of Select Committees of the House of Commons. The schemes are, to a certain extent, competing, but the former is by far the more important of the two. The proposed schemes of the North British Company are designed merely to give

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access to some works in Dumbartonshire, and to improve the North British communications in the Vale of Leven. The Caledonian scheme, however, is much more extensive, and continues the present line from Stobcross Docks, through Partick and Whiteinch, two populous suburbs of Glasgow, which were previously without adequate railway communication. Passing along the river side, at such a distance as not to interfere with the shipbuilding yards, but rather to serve them, it goes on by Bowling and Dumbarton to Lock Lomond, and finds its terminus on the Ross estate, at a distance of 26 miles from Stobcross. The only serious objection which was taken to it was that it would prevent the development of the line which already goes to Yoker and Clydebank, but the advantages of a direct connection with the Lanarkshire coal and iron districts were too great to be put aside in the interests of a local line. One interesting feature in the plan is the formation of a loop line which will serve to connect a large suburban district with the centre of Glasgow. The Glasgow Central Railway is now being constructed from the Central Station to Kelvinside, and it is proposed to bring it round in a circle to Stobcross, and on that part of the line to have an omnibus service of trains, which will enable a large number of people in business to live conveniently in a suburban district. The Caledonian Company seems disposed to meet all opposition in a conciliatory spirit, and we hope that this will cause that opposition to be so modified that the Bill will pass the House of Lords without much difficulty.

Letters to the Editor.

THE STEAMSHIP OF THE FUTURE.

To the Editor of "Industries."

Sir,—May I be permitted to suggest that speed is not everything in crossing the Atlantic. Other things being equal, I would rather cross quickly, but the temptation of making quick passages leads the skippers to run at dangerous speeds through fogs. During a fog the engines are signalled to go at "half speed," but this is a complete delusion. The last few miles an hour of a large steamer absorb a great deal of power. The result is that a very considerable reduction of engine power produces a very slight reduction of speed. The throb and tremble vanish, and you feel as if you were on board a sailing ship in a gentle breeze, but, on counting the revolutions of the engine, you find them running considerably over fifty. Everybody on board feels as if the steamer were progressing most circumspectly, whereas she is shooting along at over 15 knots. I have none of the instincts of a sportsman, and I do not care to risk my life by gliding quickly through a fog merely to escape a dull Sunday on board by securing a still duller one in New York.

Yours, &c.,
Liverpool, 22nd June, 1891. Engine.

IMPROVED COMMUNICATION WITH THE EAST.

To the Editor of "Industries."

Sir,—Referring to your notices of the quick passage made by the new steamer, the "Empress of India," between Yokohama and Vancouver, and the effect which the improved line of communication would have on the mails and traffic for the East, I have been informed by a friend, who was a passenger in her, that the new steamer and the new route have at once become very popular, and that every berth was occupied during the first voyage. The shortness of the time occupied is of course a great recommendation to business men whose holiday is short, or whose engagements are pressing. It has not yet been reduced to three weeks between Yokohama and London, but the mails shipped by the "Empress of India" were delivered in London twenty-seven days after leaving Yokohama. The comfort and arrangements of the steamer were everything that could be desired, while little or no trouble was given to the passengers at the points of connection on their journey. The railway part of the journey is much more enjoyable than that across the States, the scenery being very much finer, and the inconvenience and discomfort of the alkali plains, and the general monotony of the Western States of the Union after crossing the Mississippi, are avoided. Moreover, Britons have the satisfaction and pleasure, which in themselves are no mere matters of sentiment, of travelling the whole way under their own flag.

It is well that you should direct the attention of your readers to such matters, for they very often have more substantial results on industry and trade than matters relating to scientific or technical details.

Yours, &c.,
London, 22nd June, 1891. Far East.

TRUSTS.

To the Editor of "Industries."

Sir,—You have done excellent service in directing your readers to some of those broader aspects of industrial subjects which are too apt to be overlooked by the ordinary man of business and by the practical politician. The article in your issue of the 22nd ult. on "Trusts" was very much to the point, and will help to moderate the impression made by Mr. Plimsoll, who is always enthusiastic—some might say, hysterical—on all the subjects which he takes up. It cannot be doubted that trusts, or other similar combinations, economise both labour and money; the question for us to consider is whether the power which large combinations of capital at present possess is one which ought to be in the hands of private individuals for their own selfish ends. Free competition is at an end in many cases, and it looks as if the whole fabric of economic science will require to be placed on a new basis. We have certainly reason to modify our belief in the possibility of universal happiness and leisure flowing from the mechanical increase of our total production under a *régime* of unrestricted individual or capitalistic competition for its products.

When the Factory Acts were first proposed, the economists were, almost to a man, hostile to what they called restrictive legislation, and so, of course, were the capitalists. But, as the Duke of Argyll has remarked in his able book on "The Reign of Law," this opposition was not in the main due either to selfishness or indifference. False intellectual conceptions—false views both of principle and fact—were its real foundation. Some of the ablest men in Parliament, who were wholly unaffected by any bias of personal interest, declared that nothing would induce them to interfere with the labour which they called "free." Had not the working classes a right to employ their children as they pleased? Who, they argued, were better judges than fathers and mothers of the capacities of their children? But the pale faces of the little children, stunted and outworn, were sufficient arguments to enable the promoters of the Factory Acts to carry them in spite of all opposition, and in defiance of what were alleged to be inevitable economical principles.

Similar considerations for the welfare of the community to those which influenced the Legislature in passing the Factory Acts, would justify legislation to restrain capitalists, "rings," and trusts. Whether the fear of this, combined with the wish to conciliate the public by showing that, on the whole, they are a benefit to the people at large, may, as you think, be trusted to keep the trust question in check for some time to come, can only be found out from experience, but, in any case, it is well that the attention of our legislators and of the public should be directed to it.

Yours, &c.,
Newcastle, 23rd June, 1891. Liberty.

THE USE AND ABUSE OF MATHEMATICS.

To the Editor of "Industries."

Sir,—I have followed the discussion which has appeared in your journal on "The Use and Abuse of Mathematics" with much interest and with considerable profit. Your last correspondent on the subject, "Engineering Demonstrator," sagely remarks that, after reading the letters which have appeared on the subject, his belief has been strengthened that the value of an opinion depends, to a very large extent, upon the man who gives it. The majority of people arrive at this conclusion at a very early stage in their career, and that without any lengthened correspondence. The correspondence, I understand, was started for the purpose of ascertaining the place which mathematics should take in the training of engineers, and from that some of your correspondents have wandered considerably.

John Scott Russell, who was an accomplished mathematician as well as a distinguished engineer, said that "for a mere philosopher and for a practical mechanic, the science of physics must be taught in quite a different way. Certain elementary principles are, no doubt, the same for all men and all circumstances, but that is only the purest and most abstract science. To the man of science, the science itself is the end and aim; to the technical man, science is the mere tool and instrument, and what he wants to know is not the mere science only, but the means of shaping it to his end, and the best way of using it so as to achieve his purpose." This seems to me to express very clearly the position which mathematics ought to take in the training of engineers. In a letter to you on this subject one writer quoted an opinion of Professor Kennedy, to the effect that "he had no hesitation in saying that a man's knowledge of mathematics ends exactly where his ability to work problems ends; everything beyond that is useless, so far as his profession goes, and is even liable to have, in certain cases, disastrous consequences." Your correspondent, "Engineering Demonstrator," says that Professor Kennedy now ranks as a chief among consulting engineers, and that he has upon his staff at least one man who was among the first twenty in a recent mathematical tripos at Cambridge. He, no doubt, knows that Professor Kennedy had no special mathematical training, and that his mathematical knowledge has grown with his engineering experience; in fact, that the problems to which he applied his mathematics were not those artificial ones which are to be found in books, but the actual problems of engineering practice, and as he has risen in his profession so has his knowledge of mathematics extended. It has thus been real and thorough, as his position as a consulting engineer now shows.

Few engineers ever require much beyond elementary geometry, algebra, and trigonometry, and their applications. A stage higher would include the elements of analytical geometry and of the calculus. In the latter, however, almost all that engineers ever want can be done by the aid of elementary arithmetic, or by graphic or mechanical methods. In fact, in every department the problems should, if possible, be solved by analytical, graphic, and mechanical methods, which should thus be made to check and illustrate each other, and render their meanings plain to the students. In every department of engineering the same methods should be adopted. In the lecture rooms the students should get the theory of their work, in the drawing office they should learn to delineate principles and results graphically, while in the laboratory they should conduct experiments to illustrate or test these principles or results. If this were done they would soon find the real use of mathematics, and they would avoid the worst abuse, which, as your correspondent points out, consists in not using mathematics at all.

Yours, &c.,
Bombay, 5th June, 1891. Scrutator.

PNEUMATIC GUNS AND PROJECTILES.

The Americans have recently paid considerable attention to the pneumatic propulsion of shells and projectiles, as they have perceived the great advantage in case of war of being able to throw dynamite or other high explosives into an enemy's position whether at land or sea. The outcome of this has been the Zalinski pneumatic gun, for which a special vessel—the "Vesuvius"—has been constructed. This powerful weapon is, after all, however, a costly machine, each gun requiring a number of mechanical contrivances, more or less easily put out of order, and necessitating a motor of some kind, and air-compressing machinery. The barrel of the Zalinski gun is of very great length, and, while there is no doubt that in certain situations and under special conditions it would prove a powerful auxiliary against an enemy's fleet, it is practically useless in the field.

It therefore has been left for Mr. J. Elton Bott, of Manchester, to invent and perfect a pneumatic shell which seems equally adaptable for naval, field, or siege guns, and that with only a slight alteration of the gun breech and firing mechanism of ordinary guns. This pneumatic shell would appear to have the merit of being both simple in construction and efficient in action. It is carried in the ordinary tumbril of a field piece, and is perfectly safe, as it is simply a strong metallic cartridge containing the impelling charge of compressed air or gas at the rear of the chamber containing the explosive. When required to be used it is inserted in the breech of a gun in the usual manner, as in a quick-firing gun, when a simple turn of a lever instantaneously releases the air or gas, and the shell or projectile, which contains, in the forward chamber, a charge of dynamite or other high explosive, is sent with deadly effect in the required direction. In this operation no smoke is made, there is practically no noise, and the gun works perfectly cool and clean.

If the "Blanco Encalada," for example, had been equipped with a few small pneumatic guns, or guns adapted for firing the pneumatic shells invented by Mr. Bott—and made by Messrs. J. Elton Bott & Co., Limited, Cornwall Street, Openshaw, Manchester, the Chilian ironclad would have been able to fight practically noiselessly, and absolutely without smoke or heating of the gun barrels, while showering deadly missiles against the torpedo boat flotilla.

Extensive preparations are being made for the manufacture of pneumatic guns and shells by Messrs. J. Elton Bott & Co., as the inventor, after perfecting—at his own expense—both his gun and shell, has been fortunate enough to secure the co-operation of a number of prominent gentlemen, and, with their assistance, a series of tests were made before several Government officials on the estate of Mr. Geo. H. Cammell, of Hathersage, near Sheffield, the results being very satisfactory. The guns and some of the shells fired at the Hathersage tests are now at Cornwall Works, previous to being sent to the Royal Naval Exhibition. Messrs. J. Elton Bott & Co., are now constructing a large pneumatic gun for naval purposes, with a service of pneumatic shells. This gun when finished is intended for the naval service, and will be a very powerful weapon.

The following is an extract from the patent specification of the inventor, and will explain the nature of the invention:—

The invention "consists in providing a rear chamber to shells and other projectiles, which rear or auxiliary chamber is filled with compressed air or gas at a high-pressure. . . . . The rear or auxiliary chamber in each shell or projectile is constructed so that a proper charge of compressed air or gas is introduced through an orifice in its base, preferably in the manner in which carbonic acid gas is introduced into bottles of soda water, so that when such rear or auxiliary chamber is filled with air or gases at a pressure equal to that of the compressing machine, a lead, leather, rubber, or other suitable form of valve or plug, falls and closes the said orifice, thus enabling the shell or projectile so charged with compressed air or gas to be removed from the machine when it is ready for use in cannon, mortars, guns, and rocket apparatus. It is intended to load the shell or projectile in the ordinary manner with its explosive charge, which can be exploded either by contact or by the usual forms of fuses. The method of using the improved self-propelling shell or projectile is as follows:—After placing the shell or projectile in the muzzle or breechloading weapon from which it is to be expelled, a pin in the breech of the weapon is operated so as to force back or cut away the retaining valve or plug of the shell or projectile, when the compressed air or gas is immediately released, and by impinging upon the breech of the weapon causes the shell or projectile to be rapidly ejected from the muzzle of the weapon, thus dispensing with the usual gunpowder cartridge."

Mr. J. Elton Bott has also invented a novel method of constructing artillery, according to which the pneumatic gun now on exhibition at his works was made. If successful when applied to large guns, it will partially revolutionise the manufacture of ordnance, as by this method all the dangers of unequal shrinkage are avoided

Books Received.

Annual Report of the Gordon College, Geelong, Victoria, for 1890.

Telephones. Their Construction and Fitting. By F. C. Allsop. London: E. & F. N. Spon.

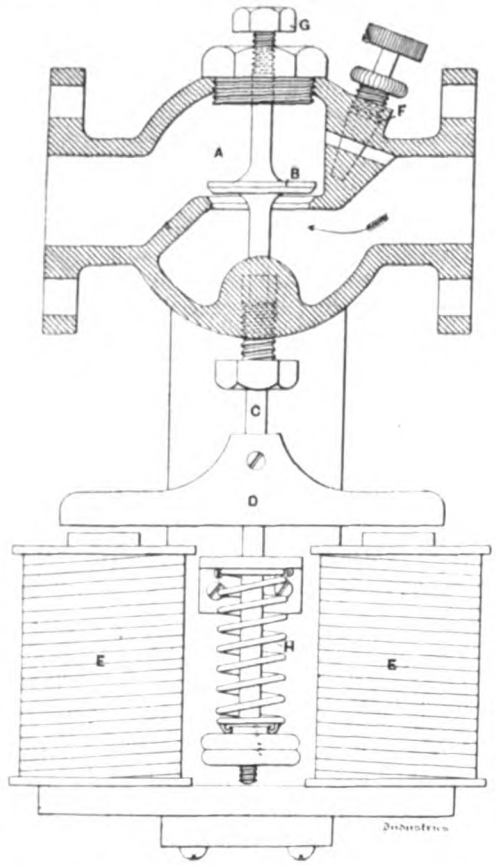
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AN IMPROVED UNSINKABLE SELF-RIGHTING BOAT.

THE accompanying illustrations, Figs. 1 and 2, represent a steel boat in elevation and plan respectively, which is being introduced by Mr. W. Wells, of 50, Commercial Street, Leith, and which is claimed to be absolutely unsinkable and instantaneously self-righting. The fore and aft sections of the boat are constructed in the form of hollow cones, and are thoroughly air and water-tight. These are slightly flattened and laid horizontally, and, owing to their peculiar form, impart strength and rigidity to the boat as a whole. The inventor claims that these boats are eminently suitable for pleasure purposes of every description, as they maintain their buoyancy when filled to the gunwale with water; and even if turned bottom upwards they instantly right themselves. These boats would appear to be especially suitable as an addition to the life-saving equipment of vessels, as, in case of emergency, they could be thrown overboard without the formality necessary with boat-lowering gear in use with ordinary punts or dinghies, and would instantly right themselves. The boats are put together in sections, and can be disjointed for transportation, and, it is stated, that should both the water-tight compartments be pierced below the water line, the boats would still remain buoyant. The boats are exceedingly light, one 12ft. long and 3ft. beam, with oars, masts, and sail, only weighing 3 cwt. We are informed that these boats have successfully undergone severe tests in the Firth of Forth.

ELECTRO-MAGNETIC GAS CONTROLLER.

THE accompanying illustration represents a part sectional elevation of an apparatus invented by Mr. J. M'Laren, 7, George IV. Bridge, Edinburgh, and intended for use in buildings lighted electrically, but where gas is also laid on in case of failure of the former light. The apparatus will automatically turn up the gas in case of failure of the electric light, and in the event of the latter coming on again will immediately lower the gas, thereby avoiding considerable inconvenience and effecting a great saving in gas. The construction of the controller is such as to require very little description, and is entirely self-



contained. The globe valve A shown in the upper portion of the illustration is fitted in the gas main, and is provided with a disc valve B with prolonged stem C, on which is fitted an armature D. The lower portion of the apparatus consists of a pair of electromagnets E, connected to the electric light mains, which, when the current is on, attract the armature and maintain the valve in its closed position. Should, however, the electric current in the mains fail, the armature will be released, and with it the valve, owing to the action of the spring H, thereby allowing a flow of gas to the burners. The small by-pass valve F is provided to allow a small quantity of gas to pass when the main valve is closed, so as to keep up a pilot light in the burners. The main valve is also capable of adjustment by means of a set screw G.

AN IMPROVED UNSINKABLE SELF-RIGHTING BOAT.

CONSTRUCTED BY MR. WILLIAM WELLS, ENGINEER, LEITH.

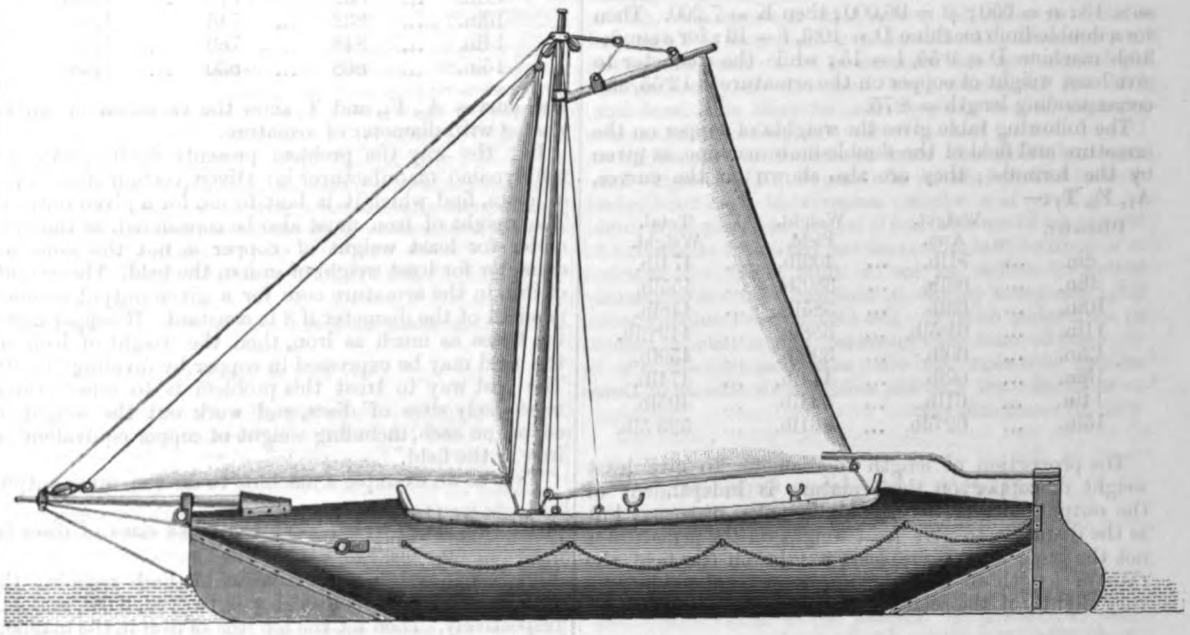


FIG. 1.—ELEVATION.

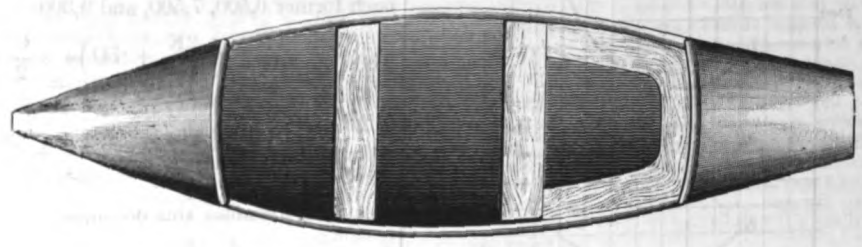


FIG. 2.—PLAN.

THE RELATION BETWEEN WEIGHT OF COPPER AND DIAMETER IN GRAMME MACHINES.

By R. B. ROGERS.

THE weight of copper on an armature is equal to the mean length of a turn in inches multiplied by the number of turns multiplied by the sectional area of the copper multiplied by ·32lb. The weight on each former is equal to the mean length of a turn multiplied by the ampere turns multiplied by ·32lb. and divided by the current density. This must be multiplied by the number of formers to give the total weight of copper on the field. Then total $W = ml$ (arm.) $\times n \times a \times \cdot32 +$

$$\frac{ml\text{ (field)} \times AT \times \cdot32 \times \text{number of formers}}{c.d.}.$$

The mean length of a turn on a two-pole Gramme armature is equal to twice the length of the core plus twice the radial depth of core plus an allowance for the commutator connections and the depth of the winding. If the radial depth is ·2D, the mean length may be taken as $2l + \cdot7D$. The number of turns is a function of the diameter and the current, and may be written mD, where m is a coefficient depending on C. The area is equal to the current in each bar divided by the current density. For rectangular magnets, with breadth measured parallel to the spindle equal to the length of core, the thickness would be about ·28D and depth of winding ·21D for a double-limb field of the Crompton type, and the mean length may be written $2l + 1\cdot4D$. For a single-limb field with magnets double the thickness, and the same depth of winding, this would be $2l + 1\cdot96D$. The ampere turns increase as the diameter increases, and if the air space increases as the diameter, the ampere turns may be written aD, where a is a number which may be taken as constant for machines of similar proportions but different diameters. Then, if x = current density in armature and y = current density in field,

$$W\text{ (total)} = \frac{(2l + \cdot7D)m\text{D}\frac{C}{2} \times \cdot32}{x} + \frac{(2l + 1\cdot4D)a\text{D} \times \cdot32 \times 4}{y}$$

for a double-limb Gramme field.

If the output of a machine and induction per square inch are fixed, nA = constant where A is the total area of both sides of the core. If β = induction per square inch, N = revs. per minute. $Ea \times 10^8 = n\text{A}\frac{N}{60}\beta$;

$$n\text{A} = m\text{D} \times l \times \cdot4\text{D} = \text{K} = \frac{Ea \times 10^8 \times 60}{N \times \beta}\ ;\ l = \frac{\text{K}}{\cdot4m\text{D}^2}.$$

Substituting this value of l, the equation becomes

$$\frac{\cdot8\text{KC}}{x\text{D}} + \frac{\cdot112m\text{D}^2\text{C}}{x} + \frac{6\cdot4a\text{K}}{m\text{D}y} + \frac{1\cdot79a\text{D}^2}{y}.$$

If W is to be a minimum, then

$$\frac{d\text{W}}{d\text{D}} = o = -\frac{\cdot8\text{KC}}{x\text{D}^2} + \frac{\cdot224m\text{DC}}{x} - \frac{6\cdot4a\text{K}}{m\text{D}^2y} + \frac{3\cdot58a\text{D}}{y}$$

$$\text{D}^3 = \frac{\frac{\cdot8\text{KC}}{x} + \frac{6\cdot4a\text{K}}{my}}{\frac{\cdot224m\text{C}}{x} + \frac{3\cdot58a}{y}}$$

For a single-limb machine the equation becomes

$$\text{W} = \frac{(2l + \cdot7\text{D})\,m\text{D}\,\frac{\text{C}}{2} \times \cdot32}{x} + \frac{(2l + 1\cdot96\text{D})\,a\text{D} \times \cdot32 \times 2}{y}$$

or

$$\text{D}^3 = \frac{\frac{\cdot8\text{KC}}{x} + \frac{3\cdot2a\text{K}}{my}}{\frac{\cdot224m\text{C}}{x} + \frac{2\cdot5a}{y}}$$

The equation to give least weight of copper on the armature is

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$$-\frac{\cdot 8KC}{xD^2}+\frac{\cdot 224mDC}{x}=0$$

$$D^3=\frac{3\cdot 56K}{m}$$

Substituting $\cdot 4lmD^2$ for K in this last equation gives $D = 1\cdot 43l$.

Taking as an example a machine to do $\frac{110\times 220}{1{,}000}$

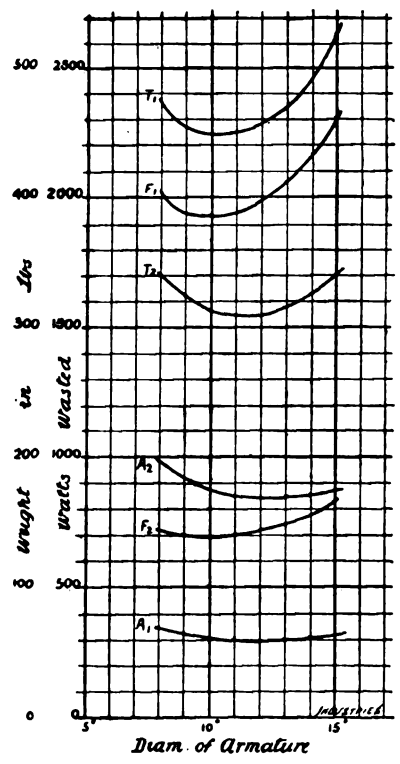
Let current density in armature = 2,500
" " field = 900

$m = 13$; $a = 650$; $\beta = 96{,}000$; then K = 7,200. Then for a double-limb machine $D = 10\cdot 3$, $l = 13$; for a single-limb machine $D = 9\cdot 55$, $l = 15$; while the diameter to give least weight of copper on the armature is 12·55, and corresponding length = 8·75.

The following table gives the weights of copper on the armature and field of the double-limb machine, as given by the formulæ; they are also shown on the curves, A_1, F_1, T_1:—

Diameter.	Weight. Arm.	Weight. Field.	Total. Weight.
8in. ...	71lb. ...	403lb. ...	474lb.
9in. ...	66lb. ...	389lb. ...	455lb.
10in. ...	63lb. ...	385lb. ...	448lb.
11in. ...	61·5lb. ...	388lb. ...	449·5lb.
12in. ...	60lb. ...	399lb. ...	459lb.
13in. ...	60lb. ...	414lb. ...	474lb.
14in. ...	61lb. ...	434lb. ...	495lb.
15in. ...	62·5lb. ...	461lb. ...	523·5lb.

The proportion of length to diameter to give least weight of copper on the armature is independent of the output, current density, and number of turns; but as the diameter to give least weight on the armature is not the same as to give least weight on the field, the ratio of length to diameter for least total weight will vary slightly if the relative weight on the armature and



field is changed—that is, if the ratio of current densities or ampere turns on the armature and field is changed; but the ratio D/l will remain nearly the same as that found above—namely, ·77 for double limb and ·64 for single limb—for any variations of current densities and ampere turns within practical limits.

The assumption made above, that the ampere turns on the field vary directly as the diameter of the disc is not strictly accurate; in practice the ampere turns do not usually increase as fast as the diameter of the disc, so that the formula gives a diameter rather too small. If the current density is fixed, the watts wasted are proportional to the weight of copper, so that the diameter which gives least weight of copper on the armature also gives least watts wasted in the armature, and the diameter which gives least copper on the field gives least watts wasted in the field; but, as the current densities in the armature and field are not the same, the diameter for least total weight of copper does not coincide with diameter for least watts wasted. The watts wasted in any copper circuit of uniform current density, if the weight is known, may be found from the formula—Watts = $(\text{c.d.})^2 \times W \times 2\cdot 22 \times 10^{-6}$, where c.d. = current density and W = weight in lbs. This assumes that the copper is at the normal temperature, 60° Fahr.; if the temperature rises the coefficient, 2·22, must be increased in proportion to the increase of resistance. The following table gives the watts wasted in armature and field in the double-limb machine taken as example above:—

Diameter.	Watts. Arm.	Watts. Field.	Watts. Total.
8in. ...	982 ...	723 ...	1,705
9in. ...	918 ...	700 ...	1,618
10in. ...	872 ...	692 ...	1,564
11in. ...	852 ...	698 ...	1,550
12in. ...	832 ...	718 ...	1,550
13in. ...	832 ...	745 ...	1,577
14in. ...	848 ...	780 ...	1,628
15in. ...	868 ...	830 ...	1,698

The curves A_2, F_2, and T_2 show the variation of watts wasted with diameter of armature.

But the way the problem presents itself usually to the dynamo manufacturer is: Given certain stock sizes of discs, find which it is best to use for a given output. The weight of iron must also be considered, as the diameter for least weight of copper is not the same as diameter for least weight of iron in the field. The weight of iron in the armature core for a given output is independent of the diameter if β is constant. If copper costs ten times as much as iron, then the weight of iron in the field may be expressed in copper by dividing by 10. The best way to treat this problem is to select three most likely sizes of discs, and work out the weight of copper on each, including weight of copper equivalent to iron in the field.

Take as an example a machine to do the same output as before, $\frac{110\times 220}{1{,}000}$. Let the stock sizes of discs be 10in., 12in., and 15in. For a double-limb machine the section of iron in the field will be $2\cdot 8l$, $3\cdot 36l$, and $4\cdot 2l$ respectively. Then let the lengths of iron in the magnets of this section be 72in., 78in., and 88in. respectively, the turns on the armature 130, 156, and 204; the A.T. on each former 6,500, 7,500, and 9,300—

$$\text{Then}\quad W=\frac{\left(\frac{2K}{\cdot 4nD}+\cdot 7D\right)n\times\frac{C}{2}\times\cdot 32}{x}+$$

$$\frac{\left(\frac{2K}{\cdot 4nD}+1\cdot 4D\right)(AT)\times\cdot 32\times 4}{y}+\frac{\cdot 28DK\times 72\times\cdot 28}{\cdot 4nD\times 10}.$$

For 10in. diameter this becomes

$$W=\frac{\left(\frac{K}{2\times 130}+7\right)130\times 110\times\cdot 32}{2{,}500}+$$

$$\frac{\left(\frac{K}{2\times 130}+14\right)6{,}500\times 1\cdot 28}{900}+\frac{2\cdot 8K\times 72\times\cdot 28}{4\times 130\times 10}=$$

$$63+386+78=527\text{lb.}$$

For 12in.,

$$W=\frac{\left(\frac{K}{\cdot 2\times 156\times 12}+\cdot 7\times 12\right)156\times 110\times\cdot 32}{2{,}500}+$$

$$\frac{\left(\frac{K}{\cdot 2\times 156\times 12}+1\cdot 4\times 12\right)7{,}500\times 1\cdot 28}{900}+$$

$$\frac{3\cdot 36K\times 78\times\cdot 28}{\cdot 4\times 156\times 12\times 10}=60+377+70=507.$$

For 15in.,

$$W=\frac{\left(\frac{K}{\cdot 2\times 204\times 15}+\cdot 7\times 15\right)204\times 110\times\cdot 32}{2{,}500}+$$

$$\frac{\left(\frac{K}{\cdot 2\times 204\times 15}+1\cdot 4\times 15\right)9{,}300\times 1\cdot 28}{900}+$$

$$\frac{4\cdot 2K\times 88\times\cdot 28}{\cdot 4\times 204\times 15\times 10}=63+430+60=553.$$

This shows that the 12in. machine will cost least in material, in armature, and field, though the 15in. is the lightest machine.

THE PHYSICAL SOCIETY.

At a meeting of this Society on the 12th inst., Professor W. G. Adams being in the chair, Professor Ayrton read a paper on "Alternate Current and Potential Difference Analogies in the Methods of Measuring Power," by himself and Dr. Sumpner. In a paper read before the Society in March last, the authors pointed out that for every method of measuring power in which readings of volts and amperes were taken, other methods in which amperes were read instead of volts, and volts

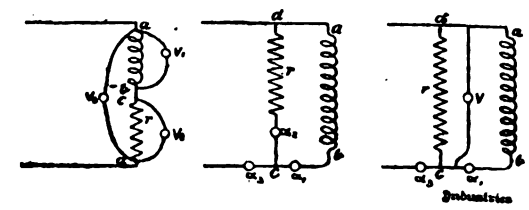


Fig. 1. Fig. 2. Fig. 3.

the non-inductive resistance r is measured by the aid of a voltmeter V across its terminals. This obviates the necessity of putting an electromagnetic instrument in what should be a non-inductive circuit. The formula for the mean watts spent in the circuit a b, Figs. 1 and 2, are respectively—

$W = 1/2r\,(V_3^2 - V^2 - V_2^2)$ and $W = r/2\,(A_3^2 - A_1^2 - A_2^2)$.

Mr. Blakesley's method of measuring power by a split dynamometer was shown to be analogous to the original electrometer method in which the difference of two readings was proportional to the power, and Blondlot and Currie's double electrometer method was shown to be the analogue of the ordinary wattmeter. The wattmeter was defective in the fact that a solenoidal coil was inserted in a nominally non-inductive circuit. The error thus introduced is, as was shown by one of the authors some years ago, expressed by the formula—

$$\frac{\text{apparent watts}}{\text{true watts}}=\frac{1+\tan\theta\tan\phi}{1+\tan^2\phi},$$

where θ is the phase angle between the current and e.m.f. in the circuit in which the power is to be measured, and ϕ the phase angle for the approximately non-inductive circuit. It is now proved that the same formula expresses the error in any of the methods where resistances not wholly non-inductive are used. As is well known, Mr. Blakesley has applied his split dynamometer to the measurement of phase differences between two currents, and an analogous method of finding the phase difference between two potential differences is described in the paper. In this method a high-resistance split dynamometer, such as suggested by Mr. Rimington for measuring power, is employed. Blondlot and Currie's double electrometer could also be used for the same purpose.

Professor S. P. Thompson inquired whether hot-wire voltmeters could be employed to measure the various potential differences without introducing error. In reply, Professor Ayrton said that, although no great error was introduced by the self-induction of these instruments, yet the fact that they required considerable current was a disadvantage, and as these currents were not always in the same phase as those in other circuits, troublesome corrections were sometimes necessary. Electrostatic instruments were preferable.

Professor Adams said he was glad to hear that the inductance of Cardew voltmeters introduced no serious error, for they were very convenient instruments to use.

Professor O. Lodge exhibited and described "A Clock for Pointing Out the Direction of the Earth's Orbital Motion in the Ether." After mentioning the various motions to which a point on the earth's surface is subjected, he pointed out that the orbital motion was the largest component, and its direction at any instant not easy to conceive. An apparatus for pointing out this direction was, therefore, convenient when dealing with problems requiring a knowledge of the motion of a point through the ether. In one of two clocks shown, one spindle representing the earth's polar axis and another the axis of the ecliptic were inclined at an angle of $23\frac{1}{2}$ degrees and coupled by a Hooke's joint. The latter axis was capable of rotating round the former. At its upper end the ecliptic axis carried a tube and a pointer, both being perpendicular to the axis and to each other. The clock keeping solar time rotated both axes, and when properly set the tube pointed in the direction of the sun, and the pointer, therefore, indicated the direction of the earth's orbital motion.

"Some Experiments with Leyden Jars" were then shown by Professor Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another when the lengths of the jar circuits were properly adjusted or tuned. The latter jar was entirely disconnected from the former and was influenced merely by electromagnetic waves emanating from the discharging circuit. Lengthening or shorten-

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ing either circuit prevented the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances. In connection with this subject Mr. Blakesley had called his attention to an observation made by Priestly many years ago, who noticed that when several jars were being charged from the same prime conductor, if one of them discharged, the others would sometimes also discharge, although they were not fully charged. This he thought might be due to the same kind of influence which he had just shown to exist. The word "resonance," he said, was often misunderstood by supposing it always had reference to sound, and as substitutes he thought that "symphoning" or "symphonic" might be allowable.

The next experiment was to show that wires might be tuned to respond to the oscillation of a jar discharge just as a string could be tuned to respond to a tuning fork. A thin stretched wire was connected to the knob of a jar and another parallel one to its outer coating, and by varying the length of an independent discharging circuit a glow was caused to appear along the remote halves of the stretched wires at each discharge. Each of the wires thus acted like a stopped organ pipe, the remote ends being the nodes at which the variations of pressure are greatest. By using long wires he had observed a glow on portions of them, with the intermediate parts dark. This corresponded with the first harmonic, and by measuring the distance between two nodes he had determined the wave length of the oscillations. The length so found did not agree very closely with the calculated length, and the discrepancy he thought was due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow even when the distance from the outside to the inside coating was about 8in. During this experiment he pointed out that the noise of the spark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings, so as to obtain "A" sparks and "B" sparks. By putting on a long "alternative path" as a shunt to the B spark gap, and increasing that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, but the experimental proof had not been completed.

He next described some experiments on the screening of electromagnetic radiation, in which a Hertz resonator was surrounded by different materials. He had found no trace of opacity in insulators, but the thinnest film of metal procurable completely screened the resonator. Cardboard rubbed with plumbago also acted like a nearly perfect screen. In connection with resonators, he exhibited what he called a "graduated electric eye," or an electric harp, made by his assistant, Mr. Robinson, in which strips of tin foil of different lengths are attached to a glass plate, and have spark gaps at each end which separate them from other pieces of foil. One or other of the strips would respond according to the frequency of the electromagnetic radiation falling upon it.

Mr. Blakesley asked whether the tuning of the resonant jars needed readjustment when the distance between their circuits was varied, for, according to theory, the mutual induction should diminish the self-induction of the primary, and cause its oscillations to be more rapid. If this was true, the method might be used for getting rapid oscillations. He also inquired whether the glow would appear in the same position on the two stretched wires if their ends were joined.

Dr. Sumpner wished to know how the resistances, inductances, and capacities of the circuits and jars were determined, and whether any evidence of irregular distribution of the charges on the tin foil had been noted. With reference to the overflowing of a jar caused by using a certain length of discharging circuit, he asked whether the overflow did not prove the existence of a higher potential than that which originally existed between the coatings of the jar, and, if so, where did the excess energy come from?

Dr. Thompson asked if it would be possible to make a wire circuit analogous to an open organ pipe by putting sheets of metal on the ends of the wires.

Dr. Lodge, in reply, said Mr. Blakesley's suggestion was an important one, but he had not observed that any change in the adjustment was necessitated by varying the distance between the resonating circuits. Neither had he noticed any glow on wires joined to form a single loop, but this might be possible if the wires were long enough to give harmonics. In answer to Dr. Sumpner, he said that the capacities were difficult to determine, for with such rapid oscillations the coatings were virtually enlarged. Lord Rayleigh had shown how to calculate the inductances, and the resistances he had practically measured by his alternative path experiments. The overflow of jars, he thought, was caused by the charges in some way concentrating on the edges of the foil, thus causing a kind of flood tide at which the overflow occurred.

The President asked Dr. Lodge what his views were as to the cause of the opacity of ebonite to light. Was it due to a selective absorption, which cut off only the rays to which the eye was sensitive, or was the ordinary explanation that it contained impurities which were conducting, and hence acted as screens, likely to be correct? Another possible explanation was that the motion of the ether particles may be in three dimensions, and light be due to the projection of this motion on a plane perpendicular to the ray, whilst electromagnetic induction might be due to the other component. Dr. Lodge said he believed that ebonite was not opaque because of conducting particles being present, and was inclined to think that it acted more like ground glass, in which the opacity was due to internal reflections. Such a substance would only be opaque to vibrations whose wave length were comparable with the size of the particles.

A note "On the Construction of Non-inductive Resistances," by Professor W. E. Ayrton, F.R.S., and Mr. T. Mather, was postponed until next meeting.

SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

The last meeting of the session was held on the 19th inst., when a paper was read by Mr. R. Le Neve Foster, entitled "Chemical Manufacturers and Smoke." The author said he wished to bring under discussion the present state of the law with respect to smoke, as chemical manufacturers in East Manchester were being much harassed by the municipal authorities. The cotton industry was predominant in and around Manchester, and where this industry existed it was highly important that all the chemicals used by the bleacher, dyer, and calico printer should be produced in the same locality. It must, therefore, be concluded that chemical works in that neighbourhood were a necessity, but although most people were under the impression that they must necessarily be injurious and noxious, he asserted that the majority of these works were conducted with a great amount of care. Inasmuch as they provided a means of employment for the population, they were a blessing rather than a curse to the neighbourhood in which they were situated. Chemical works had recently been attacked for the emission of black smoke, and, as chairman of the newly formed Chemical Manufacturers' Association, he had, therefore, represented to the city authorities the special conditions under which these works had to be carried on. But although he had been led to expect otherwise, no attention had been paid to his suggestions. The Association did not view the smoke question in any spirit of antagonism to the Corporation or to the Noxious Vapours Abatement Association, but wished to compel its members to do all in their power to minimise the emission of smoke. All manufacturers who wished to join the Association were obliged to prove that they had adopted the best known means of consuming their smoke consistent with the effective carrying on of their works. It was, he believed, maintained by the city authorities, that no matter how perfect their furnaces were, still, if black smoke was emitted, the saving clauses of the smoke section of the Public Health Act, 1875, did not apply. This view had recently been upheld by the Court of Appeal, but, if legally correct, it was neither an equitable nor a commonsense rendering of what was evidently intended. To his mind the evident intention of the Legislature was to protect works of such a nature as made the consumption of smoke impracticable. They all knew that in chemical works it was impossible at times to prevent the emission of black smoke, and that manufacturers could not comply with the regulation of the smoke inspectors that black smoke should not issue for a longer period than one minute in each half-hour. Intermittent firing, as in the case of retorts, cylinders, pots, and stills, could not possibly be done in such a smokeless manner as the firing of an ordinary steam boiler. This was what the Legislature had in view when the saving clause to section 91, sub-section 7, of the Public Health Act was introduced. If a prosecution could be maintained simply for the emission of black smoke, without regard to the nature of the manufacture, the conclusion was evident that the majority of the chemical works must be closed and these industries be transferred to other countries. With regard to the inspectors' standards, he maintained that the true criterion was the quantity of smoke in relation to the coal consumed. It was not to the personal advantage of any manufacturer to create a nuisance. Moreover, it was a remarkable fact that the district where the bulk of the works were situated had the lowest death-rate in the neighbourhood, and this proved that smoke abatement was of less vital importance than other sanitary reforms. In conclusion, he would urge upon the Corporation the necessity of treating chemical manufactures in the spirit evidently intended by the Legislature, by applying the saving clause to section 91, sub-section 7, of the Public Health Act, 1875, with respect to the emission of smoke.

A somewhat lengthy discussion followed, all the speakers agreeing with Mr. Foster in condemning the smoke prosecutions.

Mr. Grimshaw said that where such a large quantity of coal was burnt as was the case in Manchester, a certain amount of smoke must necessarily be produced. He believed that it would very shortly be proved to demonstration that factories were not the chief producers of black smoke.

Dr. Dreyfus read abstracts from notes he had prepared, and showed that, if not one of the pleasantest, the neighbourhood of chemical works was one of the healthiest places to live in. In the course of his remarks he contended that in the case of the rectification of oil of vitriol in glass pans it was impossible to prevent smoke, as one man had to look after so many small fires. The harmfulness of smoke was not to be judged by the colour, as grey smoke was really more deleterious.

Mr. W. Thomson, who followed, supported this last statement with some figures, showing the oily nature of household as compared with factory smoke.

Dr. Bailey contended that competent men should be appointed as inspectors, who would be able to report whether the emission of smoke was preventible or not. Such Acts as this and the Rivers Pollution Act were failures because they treated all trades and manufactures under the same provisions.

Mr. Davis said that he believed tall chimneys would eventually be done away with, and the injurious smoke disseminated close to the ground. This could be done by the employment of forced draught. He had proved that it was the sulphurous acid, and not the carbon, in smoke which was injurious to vegetable life, by first burning benzene and afterwards coal in a greenhouse. The solution of the smoke question was to be looked for in the use of gas, but gas could not be economically used at its present price.

Dr. Simpson, M.D., said he had been disappointed with the tone of Mr. Foster's paper, and thought that both Mr. Foster and the subsequent speakers had merely been making an elaborate apology for the production of smoke and the perpetuation of nuisances. He did not think that the enormous advance made in practical chemistry and its application to arts and manufactures should be allowed to remain without effect in diminishing the nuisances which certainly existed. The comparison of the death-rates of different districts was fallacious, as a great many factors were involved, and the manufacturers had that evening admitted that their tall chimneys carried away the smoke to other parts.

Mr. Foster, in his reply, said that Dr. Simpson was wrong in thinking that manufacturers had done nothing to abate the smoke nuisance. He had also proved, he said, that all the black smoke emitted from his works fell within a distance of a quarter of a mile.

THE WHISKY INDUSTRY.

Some important information and opinions have been brought forward in connection with the sittings of the recent Select Committee on Spirits. The whole question is interesting from many points of view. The production of the various commercial forms of alcohol is one of the great industries of the British Isles, and gives employment in districts where other manufacturing enterprises do not flourish. Whisky, using this term to include all spirit distilled from grain, is the product that most of all concerns the inhabitants of our islands, for although brandy, the spirit from wine, is consumed to some extent, the whole quantity imported—less than three million (proof) gallons per annum—is inconsiderable in comparison with the forty-one million gallons of spirit, produced mostly from grain, which is made in this country. The question, What is whisky? is, however, not easily answered. Every one knows that alcohol results from the life action of yeast upon certain saccharine matters in aqueous solution, and, of all forms of saccharine, only three are utilised in commercial fermentations. Brandy is derived from glucose, the natural sugar contained in grapes, and rum is prepared from sucrose, the sweet substance elaborated by the sugar cane. With these we have no concern at present, except to say that much of the brandy sold is free from suspicion of the vine, and that some rum is innocent of connection with the sunny lands where the cane flourishes. Whisky is made from starch, which properly should be the starch of grain.

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Some persons go so far as to say that the grain should be barley, but so strict a definition would exclude the large quantity of spirit distilled partially or wholly from oats, rice, rye, or maize, to which the term whisky is applied. When these various grains are allowed to commence germination, the albumenoid substances contained in the seed are partially converted into diastase, which has the curious property of causing starch to pass into a mixture of dextrin and maltose. The former term includes a number of bodies, but the latter is definite, and represents a sugar which, like cane sugar and glucose, is capable of being changed by yeast into ethylic alcohol. After the germination of the grain has proceeded to the requisite extent, the vital change is arrested by drying, and the result is malt. This is placed in contact with water between certain ranges of temperature in order that maltose may be produced. But the amount of diastase in malt is more than sufficient to "convert" the starch associated with it, and it is therefore the practice with many distillers to mix with the ground malt a quantity of raw grain, the starch of which is also changed into saccharine by the excess of diastase. Whisky, *par excellence*, is spirit obtained by the use of malt alone, and this is admitted to be superior to that which results when raw grain is introduced into the mash tun. There are in the United Kingdom 115 distillers using malt only, and of these 113 are in Scotland, the remaining two being in Ireland, where the use of mixed materials is the general custom. The quality of the spirit, however, depends not only upon the nature of the materials, but upon the form of apparatus used in distillation. The reason for this becomes apparent upon consideration of the chemical nature of the process of fermentation. Ethylic or common alcohol is the main result of this action, but accompanying it in small quantity are other alcohols and certain ethers, collectively known as fusel oil, and to the presence of these the odour and flavour of commercial spirits are due. These bodies come over with the ethylic alcohol from the pot still, but are almost entirely separated from the distillate when what is known as the "patent still" is employed. This form of still, regarded as a piece of scientific apparatus, is almost perfect, but the pure alcohol it produces, being practically devoid of fusel oil, is tasteless and insipid, and cannot justly receive the name of whisky.

It may surprise some who have been accustomed to hear fusel oil spoken of as a deadly poison, to be told that, on the contrary, this composite substance is, as it were, the "soul" of whisky and other spirits; and that it is scarcely to be regarded as hurtful—at all events in the proportions in which it usually exists—yet such appears to be the case according to Mr. A. H. Allen, who was a prominent witness before the recent Commission, and is one of the highest authorities on this subject. In a paper lately read before the Society of Chemical Industry, he stated that the whole theory of the banefulness of fusel oil was "trumped up about the year 1," and that people have gone on believing the statements without a jot or tittle of supporting evidence. In order to give point to a pronouncement so startling, Mr. Allen took every evening for some time part of a sample of whisky, to which was added 2 per cent. of fusel oil. The whisky, it appears, was nauseous, but its use occasioned not even the inconvenience of a headache on any occasion. This experience may be taken as disposing of the previous views, especially when it is added that experiments made by Mr. Samuels, Chief Chemist to the Inland Revenue, gave similar results. The ordinary mind, relying on the adage—that what does not poison must fatten—will doubtless require further information as to the function of fusel oil, and will be confronted with serious differences of opinion. Mr. Allen and the majority of chemists express the view that fusel oil, during the storage of whisky, becomes partially converted by oxidation into a number of desirable ethers, which impart to the matured spirit the mellowness, fragrance, and stimulating properties characteristic of old as against new whisky. Improved methods of analysis, described for the first time in the paper referred to, have made possible a discrimination between the unoxidised higher alcohols of fusel oil and the ethers also present, even from the first, and the facts and figures put forward certainly strongly support the views of those who hold the oxidation theory. Analyses of old whisky show a higher ratio of ethereal-ised—that is, oxidised—constituents of fusel oil, and the same is true of spirit prepared wholly from malt in comparison with that made from a mixture. More extensive and more systematic experiments with the new methods, however, are desirable, and such might fittingly be undertaken by a committee of chemists, working under the auspices of the whisky trade, upon larger quantities of material furnished in duty-free condition by the Excise Department of Her Majesty's Inland Revenue. The opinions of Dr. Bell, of Somerset House, are not quite in accordance with the views of Mr. Allen and those who agree with him. This chemist ascribes the ill flavour of new spirits to the presence of empyreumatic or cresotic bodies derived from partial charring of the materials in the still, and considers the admitted improvement brought about by storage in cask to be due to the removal of such substances, or their conversion into other forms. We await with much interest the further development of Dr. Bell's hypothesis, which, up to the present, can only be regarded as slender and unsupported by published facts. Possibly the two causes combined, and others, including the demonstrated influence of the oak of the cask, may all tend in the one direction of improvement, but this, however, is clear—that old whisky is better than new, being more stimulating without being more intoxicating, and pleasanter to drink. Those whose taste is for whisky, and whose pocket enables them to seek for the best, irrespective of price, may in the meantime be advised with confidence to choose a spirit made entirely from malt, and mellowed by the only legitimate method—namely, storage for several years in wood.

Notes.

ELECTRIC LIGHTING AND THE TEMPERATURE OF FACTORIES.

THE use of electric lighting in factories is evidently going to effect a great improvement in the ventilation of factories, as well as a considerable reduction of the temperature of their atmosphere. From a report by Mr. Beaumont, H.M. Inspector of Factories for Bradford, we learn that he has procured data for a comparison of the temperature in a wool-combing shed when lighted by electricity and by gas from 7 p.m. till 6 a.m. With gas the temperature rose to 109° Fahr. by midnight, while with the electric light it never rose above 96°.

ELECTRIC RAILWAYS.

IT is estimated that there are not less than 325 electric railways in the United States, England, Germany, Italy, Australia and Japan, requiring over 4,000 cars and 7,000 motors, with 2,600 miles of track, with a daily mileage of not less than 400,000 miles, and carrying 750,000,000 passengers annually. Grades of 13 and 14 per cent., distances of six miles or more from the central stations, speeds as high as from twenty-five to thirty miles per hour for single cars and trains of from two to four cars, are, according to the *Western Electrician*, features of their operation. Not less than 10,000 persons represent the number employed on these lines. Fifty millions of capital invested in the United States alone, and a present annual business not less than $8,000,000 to $10,000,000 on the part of the manufacturing and contracting electrical companies, show the present standing of the street railway works.

COAL SUPPLIES OF CALIFORNIA.

THE following table, showing how California is supplied with coal, is interesting as showing the development which is taking place in coal production in new countries, to which we have several times directed attention :—

	1888. Tons.	1889. Tons.	1890. Tons.
British Columbia	345,681	417,994	350,388
Australia.....	271,612	408,032	153,920
England and Wales	126,167	32,890	53,374
Scotland.....	10,680	12,727	1,490
Eastern States	38,118	18,950	32,701
Puget Sound	568,948	372,514	450,762
Coos Bay, &c.	81,194	87,600	74,210
Japan	13,808	1,340	13,250
Total at San Francisco...	1,456,208	1,351,947	1,130,095
At lower ports in California	211,598	11,805	123,312
Total – California ...	1,667,806	1,363,752	1,253,407

THE INDUSTRIES OF STETTIN.

THE chief industries of Stettin have only been developed to any large extent during the last fifteen or twenty years, but have in that time become many and important. Shipbuilding is very largely carried on, the banks of the deep River Oder presenting excellent facilities for the formation of docks and slips. Among the chief building yards may be mentioned those of the "Vulcan" Company, and Messrs. Müller and Holberg. There are no less than five companies engaged in the manufacture of Portland cement and other materials connected with building. A large paper and cellulose manufactory is situated near Alt-Damm, and another at Varzin. In consequence of the large cultivation of potatoes, large distilleries have been erected for the preparation of potato spirit, while sugar factories are very numerous. The soap and candle works give employment to nearly 300 men. In the district of Schlawe, 298 men are employed in the manufacture of matches. Oil mills for the extraction of oil from rape seed, cotton seed, and copra are situated near Stettin, last year's output amounting to about 30,000 tons; besides the various mills there are seven oil refineries. The manufacture of chicory is also of considerable importance. There are several large and important chemical works situated at or near Stettin. The Stettin steam flour mills are of very considerable dimensions; the amount of flour exported during 1889 was 734,700 tons, irrespective of the amount consumed in Stettin. There are several other smaller steam mills doing an equally good business in proportion to their size.

THE COLOURING MATTER OF ULTRAMARINE.

ULTRAMARINE has long been a chemical puzzle, alike in its constitution, the cause of its colour, and the vicissitudes of its manufacture, but now at least there is reason to suppose that one of these questions is in a fair way to be definitely solved. Some time ago it was suggested that the colour of ultramarine was due to the presence of an allotropic modification of the element sulphur, a substance capable of many vagaries. Mr. F. Krapp has recently pursued the former line of inquiry by investigating the so-called "black sulphur" of Magnus, which has hitherto figured in the text-books, and in them exclusively. He finds that "black sulphur" is not sulphur only, but a mixture of a certain modification of sulphur with a compound containing both sulphur and carbon. This modified form of sulphur by mere subdivision gives a blue colour to the substance used to subdivide it, and there appears to be little doubt that ultramarine simply consists of a basis of colourless silicates impregnated with blue sulphur resulting from the sodium sulphide formed in the ordinary course of manufacture. As blue sulphur in a state of isolation is unstable, and quickly passes into the yellow variety, it is easy to understand that on decomposing the colourless "base" by means of an acid the sulphur itself undergoes change, and ultramarine as a pigment ceases to exist. Mr. Krapp suggests that this same modified form of sulphur may play a part in the production of vulcanite, and that the blue colour of certain blast-furnace slags may be due to it. In any case sulphur which boils at a temperature far above 440° C., whose vapour is colourless, which oxidises to sulphur dioxide without visible combustion, and which itself is moreover blue, is a body sufficiently remarkable to warrant further research.

A NEW INSULATING MATERIAL.

A NEW insulating material bearing the name of Voltite has recently been introduced. It is composed (states the *India Rubber and Gutta Percha Trades Journal*) of a mixture of gelatine (specially made), resin oil, oxidised linseed oil, resin, and paraffin. It is cheap, and contains no sulphur. The proportions of the mixture are :—Glove glue (colle de gant), 1,000 parts; resin oil, 100 parts; oxidised linseed oil, 500 parts; colophane, 150 parts; paraffin, 250 parts. This glue is prepared by taking the refuse clippings of gloves and soaking them in cold water for one night. The next day they are strained and washed in several waters until the water is clear. In an iron boiler there are then placed 1,000 parts of water, 5 parts of carbonate of soda, and dry glove skin 250 parts. This is boiled for six consecutive hours, the water being renewed as it evaporates. The whole boiling mass is next run over a sieve, across which steam is passed to prevent the gelatine coagulating. The boiling solution is received by a wooden tub, through which a current of warm air is passed for one hour. The residue left in the sieve is boiled up with water for three hours, and, when filtered, can be used again for dissolving the glue, but this time with only 200 parts of glove skin. The gelatinous solution is put into a boiler with olein or oleic acid, used in candle manufacture, in the proportion of :—Gelatinous solution, 1,000 parts; olein, 80 parts. This is boiled for half an hour, after which 10 parts of caustic potash solution (50 parts water) is added. The boiling is maintained for an hour, so as to saponify the olein and form a soapy pulp. The glove glue being ready, resin oil, colophane, and paraffin are added, in the proportions above stated; the whole is boiled until homogeneous. This boiling generally lasts about four or five hours.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

8th June, 1891.

9653. Agthe & The Allgemeine Elektricitäts Gesellschaft ..... Couplings for wire ropes.
9660. Edler, H. ..... Machine gun.
9663. Patton, R. ..... Chain making machine.
9664. Healey, B. D. ..... Furnace reversing valves.
9666. Munroe & Hall ..... Artificial draft apparatus.
9671. American Elevator Company ..... Indicators for lifts (*Otis Brothers & Co.*).
9676. Broadfoot, J. ..... Stop valves.
9679. Johnson, J. Y. ..... Firearms (*Choles*).
9686. Longsdon, A. ..... Compound armour plates (*Authoever*).
9687. Price, W. L. ..... Armour plates.
9705. Maughan, B. W. ..... Propellers.
9706. Neat, C. G. ..... Attachment for torpedoes.
9707. Evatt, G. L. ..... Ratchet drills.
9708. Fauvel, C. J. ..... Furnace for refractory ores.
9711. Lake, H. H. ..... Vacuum pumps (*Nickerson*).

9th June, 1891.

9718. Mather & Kitchen ... Boilers.
9731. Burns, W. ..... Automatic feed for steam boilers.
9735. Southall, J. ..... Pressure boilers.
9739. Etchells, C. ..... Coilers of carding engines.
9751. Suess, W. ..... Mechanical movement.
9755. Fogg, T. ..... Automatic stop valve.
9765. Talbot, W. ..... Warp operating mechanism for cross weaving.
9766. Brosius, S. G. ..... Rotary engines.
9767. Johnson, E. C. ..... Gyratory engines.
9772. Kraiss, G. ..... Pressure reducing valves.
9774. Martin, C. D. ..... Valves for chemical liquids.
9778. Freund, E. ..... Gas holders.
9782. Klauder, C. L. ..... Dyeing machines.

10th June, 1891.

9805. Hawkins, T. ..... Vibrating engines.
9820. Hanson, R. ..... Means of facilitating the generation of steam and economising fuel.
9838. Hookham, G. ..... The manufacture of metal tubes.
9853. The American Elevator Company ..... Pressure tank systems for elevators (*Otis Brothers & Co.*).
9859. Joicey, E. R. ..... Fire-boxes for vertical boilers.
9862. Withers & Covert ..... Packing plates for vibrating, oscillating, or rotary engines.
9865. Dawson, H. T. ..... Gas engines.
9869. Horn, W. W. ..... Leather staking and stretching machine (*Baker*).
9876. Coombes & Rowe ..... Telegraph block systems of railways.
9881. McGlasson, R. ..... Steam engines and condensers.

11th June, 1891.

9883. King, H. B. ..... Flour milling machinery.
9885. Turner, W. ..... Machinery for the manufacture of horseshoes.
9890. McDermott & Angus ... Controlling gear for steam and hydraulic steering engines.
9891. Kendal, G. C. ..... Steam boilers.
9899. Alvord, C. ..... Looms.
9903. Butler, S. ..... Long-jib crane.
9926. Archambault, A. ..... Looms.
9930. De Villamil, R. ..... Screw propellers.
9931. Withers & Covert ..... Vibrating gas engines.
9933. Hunter, R. ..... Steam engines (*Hunter*).
9934. Wakefield & Thompson Apparatus for straining paper pulp.
9936. Birkin, W. A. C. G. ..... Operating the stocks of drills.
9945. Doyle, Cooke, & Garland ..... Generating and storing motive force by compressed air or gases and applying same to motive power engines.
9950. Marguet, E. ..... Calendering apparatus.

12th June, 1891.

9958. Venton & Easton ... ... Machinery for drilling holes.
9959. Oakes, Leigh, & Mellor Picking bands for looms.
9961. Gee, R. ..... Steam or hydraulic presses for pressing cloth.
9962. Giuseppe & Angelo ... Feed-water heater.
9963. Hauser & Leeman ..... Drilling machines. (5th December, 1890.)
9977. Blackburn & Wallace Fire-boxes of tubular boilers.
9978. Yates & Basford ..... Plough beams.
9979. Mitchell & Nutter ... Printing machine.
9982. Williams & Annett ... Controlling the points and signals of railways.
9987. Austin, H. K. ..... Axle boxes.
9988. Paul, M., Jun. ..... Steam boilers.
9998. Wheeler, F. G. .... Tramcar motors.
10003. Larcher, P. H. ..... Machine for cutting parallel slots.
10009. Milne, S. ..... Driving paper making machines.
10012. Liwentaal, A. ..... Producing steam by liquid fuel.
10028. Ambler, W. ..... Apparatus for purifying smoke.
10034. Craven, J. W. ..... Pug mill knives.

13th June, 1891.

10047. Bilbie & Hobson ..... Silencing boxes for exhausts of gas or oil engines.
10049. Ellwanger, J. ..... A steam engine with rotary piston.
10050. Larmuth & Howarth Rock drilling machines.
10070. Shannon, W. ..... Double-action pumps.
10086. Molas, J. ..... Hydraulic motor.
10087. Grosser, G. F. ..... Knitting machines.
10095. Webster, F. J. ..... Machines for bending metal tubes and the like (*Fowler*).
10096. Grenfell, H. H. ..... Apparatus for bending metal pipes, bars, and the like.
10097. Rochat, L. S. ..... Circular cutters for toothed wheels. (29th November, 1890.)

ELECTRICITY.

8th June, 1891.

9652. Watt, A. ..... Production of copper tubes by electrolysis.
9683. Rawlins & Walker ... Primary batteries.

9th June, 1891.

9734. Aldred, W. ..... Dynamo machines.
9762. Currie, S. C. C. ..... Storage batteries.
9780. McMahon, P. V. ..... Regulator.
9791. Greenwood, J. ..... Carbon electrodes.
9803. Engledue, W. J. ..... Galvanic batteries.

10th June, 1891.

9868. Orme, J. ..... Signalling railway trains.

11th June, 1891.

9887. Collier, A. T. ..... Telephonic transmitters.
9915. Swinburne & Holt ... Measuring instruments, safety fuses, lamps, &c.
9928. Schoth, G. A. ..... Galvanic batteries.

12th June, 1891.

9955. Holden, S. H. ..... Meter.
9956. Housman, R. H. ..... Meter.
10016. Melhuish, A. G. ..... Dynamo-electric motor.

13th June, 1891.

10082. Jablochkoff, P. ..... Voltaic batteries.
10083. Keating, H. S. ..... Cut-out.
10090. Grabau, L. ..... Electrolytic production of aluminium.

CHEMISTRY.

9th June, 1891.

9732. Rylands, D. ..... Carbonic acid gas and tubes for same.
9781. Labois, L. ..... Treatment of sulphur ores.
9786. Walker, W. ..... Method of recovering carbonic acid gas from lime kilns.

10th June, 1891.

9851. Boothy & Mackray ... Chromate of lead.

11th June, 1891.

9923. Allison, H. J. ..... Treating zinc ores (*Burnstine*).
9943. Imray, O. ..... Blue colouring matter (*Farbwerke vormals Meister, Lucius & Brüning*).
9947. Hall, A. T. ..... Treatment of waste liquors to obtain sulphurous or sulphuric acid and zinc.
9948. Hall, A. T. ..... Treatment of waste liquors to obtain sulphurous or sulphuric acid and oxide of iron.

MISCELLANEOUS.

8th June, 1891.

9659. Hollings, J. C. ..... Drawing squares to scale by one operation.
9688. Smith, A. H. ..... Non-conducting mats for covering boilers.
9697. Lingner & Kraft ..... Flexible rulers.
9702. Whowell, F. ..... Finishing, glazing, and pressing cotton.
9714. Brezzo, C. ..... Refrigerator.

9th June, 1891.

9716. Allen, J. F. ..... Manufacture of illuminating gas.
9738. Mann, J. J. ..... Knives for cutting the pile of fustians.
9748. Bernard, H. ..... Indicator for railway carriages.
9757. Heathfield, R. ..... Process of coating or cleaning metals.
9759. Miller & Carlile ..... Refrigerators.
9784. Noad, Minns, & Stevens Recovering metals from their ores.
9785. Walker, W. ..... Obtaining silicates.
9789. Lomas & Pether ..... Washer for steam, hydraulic, and other joints.
9796 Lake, H. H. ..... Compound for treating fuel (*The Standard Coal and Fuel Company*).

10th June, 1891.

9809. Hardy, J. J. ..... Preventing the corrosion of propeller shafts.
9818. Banovits, C. ..... Lock nut for bolts.
9871. Garzia, F. P. ..... Starting tramway vehicles.

11th June, 1891.

9917. Livingstone, J. ..... Railway chair keys.
9919. Douglas & Nicholls ... Packing for flange and other joints.
9932. Hayne, W. C. ..... Fireproof paint.

12th June, 1891.

10035. Smyth, H. F. ..... Projectiles for fire-arms.

13th June, 1891.

10075. Gay & Hammond ..... Fluid-tight joint.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1890.

7816. London.
8967. Blandy.
9133. Mackenzie.
9246. Ronczewski.
9288. Becker.
9401. Lowe. (4th December, 1889.)
9604. Smith.
9753. Thomas.
9827. Bate.
10001. Cookson.
10296. Watson & Watson.
10462. Rylands & Stoner.
10591. Imray (*Grinnell*).
10731. Boult (*Spiro*).
10808. Mills (*Hurlbut*).
11140. Adair.
11310. Bayly (*Barry*).
11317. Bayly (*Lancaster*).
11375. Renard.
11484. Hayhurst.
11630. Reichow.
11714. Rylands & Morant.
11960. Rockliffe.
11985. Tichborne & Heuston.
12038. Lewty.
12069. Calder.
12100. Guignet & Letteron.
12133. Jackson.
12176. Grll & Grll.
12200. Beatson.
12252. Imray (*Bourry*).
12269. Crawford & Crawford.
12358. Sanderson.
12360. The Midland Iron Company, Ld., & Davy.
12376. Saunders.
12388. McDougall, McDougall, & Sugden.
12399. Middleton.
12407. Neilson.
12425. Richmond.
12457. Reid.
12473. Stubbs & Stubbs.
12494. Bayly (*Powell*).
12506. Webster, Sen., & Webster, Jun.
12539. Chubb, Chalk, & Ball.
12584. Hawkyard & Braddock.
12592. Hendry & Hendry.
12612. Redman.
12617. Worms & Zwierzchowski.
12625. Clark (*Deeves, Gauthreaux, Brousseau, Byrd, Maspero, Hyde, Thompson, Barkley, & Capedevielle*).
12661. Dempster & Dempster.
12662. Lodge & Littlewood.
12668. Salomon.
12672. Thomas.
12690. McGhee & Burt.
12698. Bayly (*Ziegler*).
12714. Adams.
12763. Buffet.
12898. Kiddier, Kiddier, & Kiddier.
13000. Shinn.
13255. Grbig & Evershed.
13685. Carr.
13721. Goad.
14567. Billing & Parker.
15950. Walker.
16459. Livesey.
16820. Crosthwaite.
17348. Gallacher.
17521. Hall.
18930. Gregory & Harris.
19277. Howell.
20178. Farrow.
20640. Budenberg.
21069. Kluge.
8762. Boult (*Sharpe*).
9038. Bayly (*Rickie*).
9212. Statter & Brunton.
9259. Krause.
9351. Britten.
9507. Brooks.
9518. Foster.
9671. Woolnough.
9775. Hart.
9945. Walker.
10213. Hodgson.
10394. Dunlop.
10518. De Normanville.
10591A. Imray (*Grinnell*). (8th July, 1890.)
10976. Davis & Davis.
11210. Priestman.
11814. Bayly (*Davie*).
11822. Matthews.
11407. Budd.
11519. Bayly (*Wintherlick & Gilbert*).
11764. C. Mackintosh & Co., Ld., & Dempsey.
12022. Bayly (*Dorr*).
12043. Sutherland & Esdaile.
12116. Bradbury.
12141. McCarthy.
12185. Ross.
12219. Helliwell & Helliwell.
12281. Malpass.
12339. Lavin.
12359. Kellett & Springfield Mill Company.
12362. Chambers.
12383. Shepard.
12389. McDonald.
12398. Topp.
12406. Shettle.
12412. Barbour.
12453. Groombridge & South
12458. Cockburn.
12481. Darling.
12504. Allam.
12511. Dumaresq.
12522. Fielding & Fielding.
12545. Edwards (*André*).
12586. Harrington.
12608. Sawyer.
12614. The Positive Nut-Lock Washer Company, Ld., & Spear.
12626. Mond.
12640. Von Ainback.
12643. Hornsby & Roe.
12649. Grosvenor & Bedford.
12658. Sandie (*The Sawyer Crystal Blue Company*).
12666. Brazell.
12676. Maxsted & Bell.
12695. Bayly (*Williams*).
12712. Leoni.
12731. Tudsbury.
12783. Lake (*De Montauzan*).
12924. Wood.
12953. Engert.
13218. Greenwood.
13370. Sage.
13687. Linnell.
14299. Morrison.
14920. Church.
16413. Böhm.
16810. Morton & Gee.
17153. Hirsch & Reinisch.
17441. Eades & Waring.
18138. Johnson (*Roberts*).
19250. Winterflood.
19867. North.
20631. Aubertin.
20901. Holthaus.
21304. Fayod.

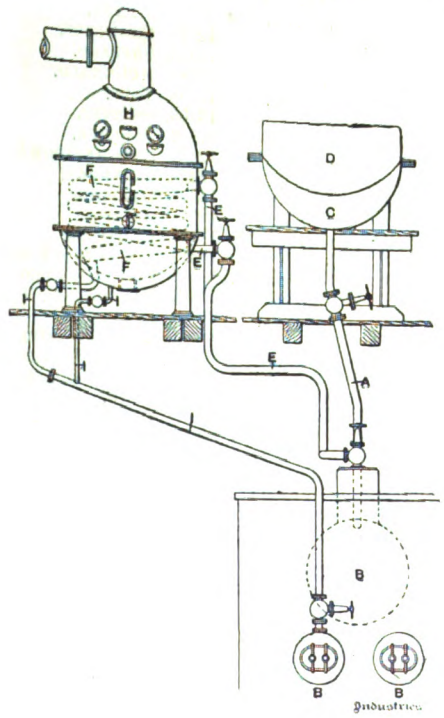
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5067. Weyer.
5067. Rockhill.
5268. Lassen.
5360. Fales.
5519. Leigh (*Markwick*).
Bevilikgy, Everett, & Collins.
5856. Grenier.
5969. Jenkins.
6015. Robinson & Badger.
6501. Rasmussen & Mar-cotty.
6622. Soulerin.
6904. Van Workum.
6935. Gill.
7199. Wretschereк.
7317. Lake (*Godley*).
7346. Matson.
7400. Rizzoni.
7549. Camille.
7716. Welch & Berr.
7752. Egge.
7764. Newton (*Fox*).
7792. Lloyd.
7842. Dark.
7860. Legge.
7903. Stockburn, Stock-burn, & Stockburn.
7938. Keith.
7970. Wahlström.
7972. Sommer.
8026. Seitz.
8069. Capitaine.
8125. Rogers.
8128. Richards.
8136. Christiansen.
8146. Boult (*Ries*).
8163. Dewey.
8165. Baron.
8167. Gates.
8184. Markell.
665. Deeming.
1372. Bellerstein.
2608. Smith.
3099. Russell.
3605. Calder.
4099. Akester.
4816. Eberhardt. (13th September, 1890.)
5274. Standiford & Hyers.
5382. Harris.
5579. Evans.
5719. Boult (*Grote*).
5926. Doull.
5981. Webber.
6322. Stevens. (22nd September, 1890.)
6586. Keble.
6896. Scheid.
6905. Woolnough.
6974. Fitzgerald.
7255. Southwell.
7337. Thompson (*Christians*).
7356. Lindemuth.
7492. Walleiser.
7638. Eyre & Graham.
7739. Cocker.
7754. Peck.
7777. Thompson (*Clamer*).
7797. Beveridge.
7859. Fitzpatrick (*Hentschel*).
7908. Bousfield (*Schultz*).
7936. Humber.
7946. Allison (*Ronan*).
7971. De Soldenhoff.
8012. Dittmer.
8034. Shepard.
8079. Johnson (*Weidknecht*).
8127. Richards.
8129. Richards.
8142. Boult (*De Bausset*).
8147. Thompson (*Crittenden*).
8164. Lake (*Hill*).
8166. Lake (*Mitchell*).
8172. Clegg.
8186. Heys (*McDonald*).
8233. Bischoff.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

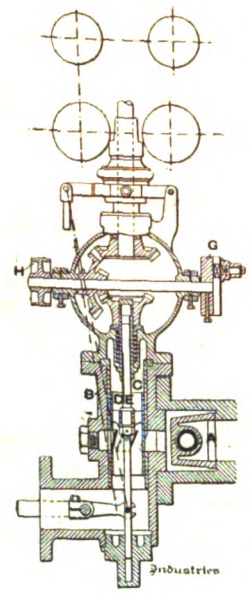
ENGINEERING.

Boiler Feeding Device.—*W. P. Thompson, Liverpool.* (*A. Kriener, Summi, Russia*).—This invention embraces a device for conveying the steam and condensation water from steam heated apparatus, direct back to the boiler producing the steam, without any other mechanical aids. In carrying out the invention as shown in the accompanying illustration, a pipe A is provided, which conducts the steam from the boiler B



into a steam chamber C, situated in the double bottom of the boiling down or steam heated apparatus D, where it condenses as it yields up its heat and trickles back through the said pipe A. By another arrangement the steam is conducted by means of pipes E out of the boiler B into a pipe coil or worm F, and between the double bottom on the apparatus H, and the condensed water returns to the boiler by means of exhaust pipes I. In the first arrangement it is, of course, necessary to have, in the boiler B and steam chamber C, an approximately equal pressure, and an approximately equal temperature must prevail the other apparatus, on the contrary, renders it possible for a lower pressure and temperature to exist in the pipe coil F and in the steam chamber G than in the boiler. The difference of pressure is, in fact, compensated for by means of the weight of the condensed water collected in the exhaust pipe I. The difference of pressure existing in the boiler B, and in the steam pipe F, or chamber G, will, in every case, equal the height of the column of condensed water in the exhaust pipes I (measured from the water level in the boiler). The result is that, in case a great difference of pressure is to be reached, the apparatus H and the boiler must be so arranged that a considerable fall exists between them. Claims: The devices herein described and shown for conveying condensed water from the steam heated apparatus back to the boiler generating the steam, whereby the condensed water may be returned to the boiler by the action of gravity alone.—No. 2966. February 18th, 1891. 6*d.*

Expansion Valves.—*W. P. Thompson, Liverpool.* (*G. Jalsoviczky, Budapest, Hungary.*)—The adjustable double-valve gear of steam engines, which are mostly regulated by the governor, enable variable quantities of steam to be used. Considerable friction, however, results between the two valves, which has the effect of impairing the exactness of adjustment and of reducing the sensitiveness of the governor. The governor expansion valve constructed according to this invention is designed to remove this disadvantage and effect the automatic distribution of the steam without offering excessive resistance to the governor. The accompanying illustration shows this invention, it being a

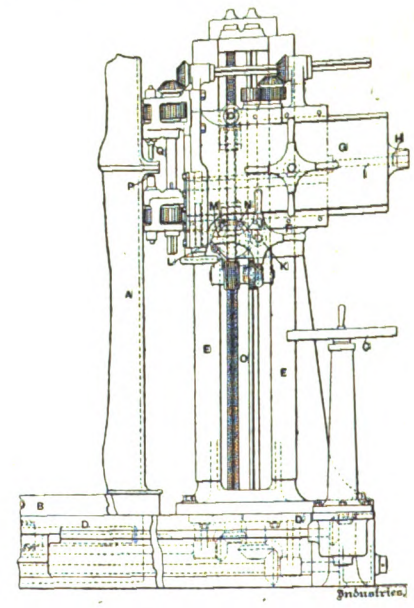


section of the apparatus:—A is the distribution valve, and on its valve-box a cast-iron cylinder B is secured, which has inserted in it a metal cylinder C, in which moves a cylindrical valve D, having four three-cornered openings in it, and corresponding with similar openings in the metallic cylinder C. The cylindrical valve is seated on the rod E in such a way that it not only revolves with it, but can also move longitudinally in the cylinder C by the action of the governor, and by suitable means provided. The distribution takes place by the revolution of the cylindrical valve, steam being admitted to the passage outside the metallic cylinder C, and through the holes in the valve D, as they correspond with the holes in the cylinder C, into its inside. In the example shown, as there are four openings, steam will be admitted four times for each revolution of the valve D, which corresponds to two double strokes of the piston. Accordingly the engine will make two revolutions to one of the cylindrical valve. The revolution of the crank of the engine is transmitted by means of bevel gear in the cast-iron case to the governor in such a way that this makes half as many revolutions as the crank. Motion is also transmitted from the distributing valve to a crank G, and to overcome the dead points of the crank a belt pulley H is provided. Claims: Improved apparatus for controlling the distribution of steam in steam engines, consisting of a distributing valve and a cylindrical valve, in which latter are openings to correspond with openings in a cylinder, in combination with the governor gearing as described.—No. 6097. April 9th, 1891. 6*d.*

Gun Mountings.—*T. English, Dartford, Kent.*—Carriages and mountings for quick-firing guns, which are arranged to be transportable on wheels, to be capable of being pivoted in position, and to be aimed and fired from the shoulder, are described in this specification. The trunnions of the gun are held in blocks that can slide parallel to the axis of the gun on a cradle, which also is trunnioned, and is mounted by a pivot or perch pin on the upper part of the carriage, and which is provided in front with a pair of hydraulic recoil cylinders, one on each side of the gun, and in the rear with a pair of springs of sufficient strength to advance the gun after recoil to the firing position. The carriage has a trail and a pair of wheels, so that the gun can be readily moved from place to place. When it is desired to use the gun in position it is run onwards until the axletree of the carriage comes vertically over a fixed base provided to receive a pivot in its centre. This pivot, by means of a lever, is slid down from the body of the carriage into the hole of the fixed base, and a ring that can revolve round the upper part of the base is shackled to the carriage, which can then be traversed round the base so as to point the gun in any direction. The gunner, having his shoulder against a shoulder-piece projecting from the rear of the gun, can traverse the latter through a limited arc on the upper pivot in a horizontal plane, and can swing the gun on the trunnions in a vertical plane. To relieve the shoulder-piece from downward strain when the gun recoils, a friction strap applied to the cradle (which strap is usually kept loose by a spring, but which becomes tightened as the gun recoils) is applied to a drum forming part of the top carriage, concentric with the cradle, and acts as a brake to impede the descent of the preponderating rear of the carriage. Claims: In combination with the transporting carriage of a quick-firing gun, a fixed base with racer for the carriage wheels, and with a pivot and ring, to which the carriage is shackled for working the gun; in combination with the recoil cradle of a quick-firing gun a brake strap attached thereto, and embracing a fixed brake drum on the mounting.—No. 6488. April 28th, 1890. 6*d.*

Rotary Pump.—*A. J. Boult, London.* (*A. Lambert, Lyon, France.*)—The object of this invention is to construct an improved rotary pump with movable rollers, which consists of a cylindrical main casing in which revolves a disc or plunger. This plunger is of smaller diameter than the body of the pump, whilst its width is greater than the internal width of the body, which, with the cover, are suitably recessed in parts to receive the plunger, which is arranged eccentrically to the body of the pump so that it comes into contact with the circumference thereof at a part situated between the inlet and the outlet, which part may be curved to fit a small arc of the plunger's surface. The plunger receives rotation from the exterior, and is provided with recesses arranged symmetrically around its periphery and intended for the reception of cylindrical rollers; these recesses extend only partly across the periphery of the disc, their length being equal to the interior width of the main body of the pump. The sides or cheeks of these recesses may be integral with the pump plunger, or may be formed of circular plates secured to the ends thereof, and the body and cover of the pump should be bored to such a depth as will allow the cheeks to fit into them exactly, for they then render tight the side joints between plunger and pump body, and increase the power of the pump. Claims: A rotary pump and intype described, in which the recessed plunger has side cheeks, and fits into circular depressions in the pump body, the rollers being of the same length as the general width of the pump body, whereby the suction and discharge orifices are separated by the combined action of the weight of the rollers, the pressure of the liquid, and centrifugal force.—No. 10502. July 7th, 1890. 8*d.*

Drilling Machine.—*G. Booth & G. Pickersgill, both of Halifax.*—The inventors describe a special construction of machine for drilling the holes in the flanges of boiler flue sections, when two of such are in position with the annular metal ring or washer between them. The holes are thus drilled with accuracy, and are also countersunk in the manner to be described. A half-front elevation of a machine is given, with two sections of boiler tube in position in readiness to be operated upon. The flues A whilst being drilled are fixed on a circular table B, fitted with a series of ordinary jaw chucks, which are moved simultaneously. The table is rotated by a hand-wheel C, the said table resting upon a suitable bed D. At each end of this bed is a vertical standard E, and upon each standard is an adjustable vertical slide or saddle F, which carries an adjustable horizontal slide G for adjusting the drills in position for drilling. An adjustable stop nut H is placed upon a screwed rod I attached to the slide F in order to lock it after adjustment. The slide F is adjustable by the handle J, operating the gearing K L, which in turn operates a bevel-wheel M, such bevel-wheel operating a bevel-wheel N which slides upon the grooved vertical screw O. The lower counter-sinking drills P are operated simultaneously, and the slides G on each of the vertical standards are operated in unison, being geared together by the horizontal shafting shown in the illustration by dotted lines. The rose bits for countersinking top and bottom edges of the holes are indicated at P and Q. Self-acting feed me-



chanism is fitted as shown, and each saddle is provided with a balance weight and chain, not shown. Claims: A drilling machine for drilling the flanges and washers of boiler flues in position and countersinking the holes at one operation; constructing the drill holders, slides, and bearings, in the manner described; operating the pair of drills and headstocks independently or simultaneously.—No. 4035. March 6th, 1891. 6*d.*

Square Hole Drilling Machines.—*H. Ainley, London.*—This invention has for its object various improvements on previous patents granted conjointly to the inventor and A. Oakes, in which a revolving cutter is controlled by a pair of templates or their equivalent, and so made to cut a hole of a form corresponding with that of the templates. In the present improvements the inventor, instead of giving a lateral movement to the cutter spindle while in rotation and controlled by the templates, suspends the cutter spindle from a fixed point, and while it is rotating gives it an oscillating motion by means of a template, whereby the cutter will describe a figure corresponding to the form of the template. Claims: The arrangement of machinery

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as described, in which an oscillating rotating cutter spindle is used, controlled by a rotating slide, and a fixed template for cutting square or approximately square holes.—No. 10956. July 14th, 1890. 8*d*.

TWIST DRILLS.—*C. Van Haagen, Chester, Delaware, U.S.A.*—The invention has for its object the manufacture of twist or straight drills or reamers by forging, and is carried out by having two gripping and forging dies having a movement to and from each other, their internal surfaces being adapted to forge the outer circumference of the drill with the groove. The invention

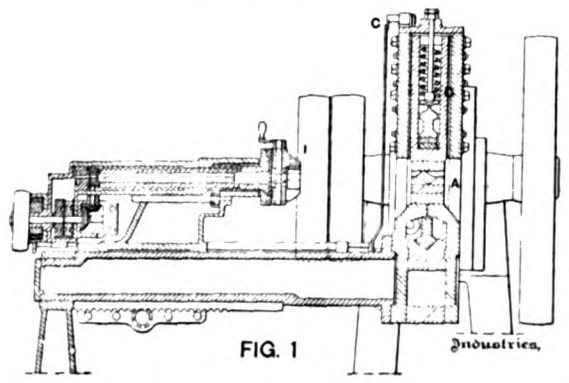


FIG. 1

also includes mechanism for reciprocating the dies and an automatic feed. This method, according to the inventor, leaves the tool with its outer skin almost untouched, and produces a tool of the greatest possible strength and durability. In the accompanying illustrations, which show the invention, Fig. 1 is a longitudinal section, Fig. 2 a front elevation with the feeding mechanism removed, and Fig. 3 a transverse section on the line Z Z (Fig. 2). A B shows the forging and gripping dies, the lower of which B is held in the main frame of the machine and the upper A is secured to a vertically reciprocating frame C operated by eccentrics and cams. D is the main shaft of the machine, and has two eccentrics E E secured upon it, which work two frames F F simultaneously in opposite directions, the frames being guided in the main frame of the machine, and holding two oppositely reciprocating hammer dies G G. One of the frames F has a cam engaging with a similar cam plate on the vertically reciprocating frame C, so that the reciprocations of the frame F cause the frame C to be projected downwards at each stroke. The frame C is returned by a spring H. A chuck I for holding the drill to be forged is carried by a frame which slides upon the main frame of the machine, and has arrangements to effect an automatic feed, so that at every one of the reciprocations of the

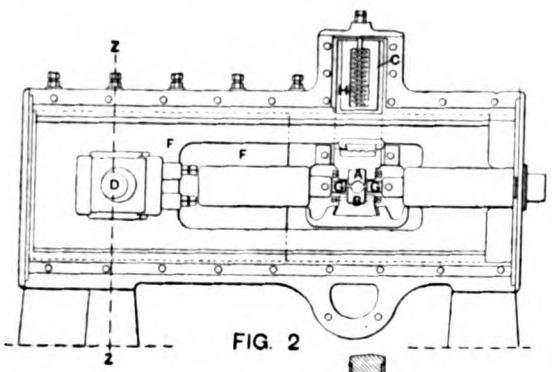


FIG. 2

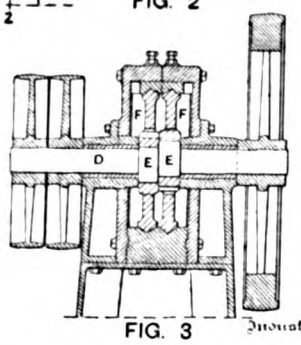
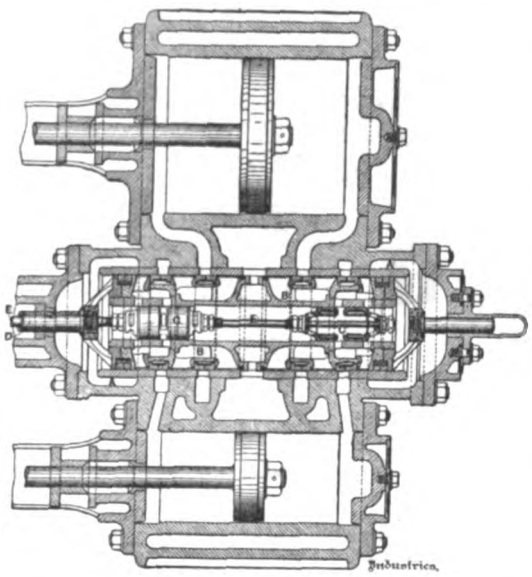


FIG. 3

frame C and its die there will be feeding movements communicated to the drill rod. There are sixteen claims to this specification, which claim the following main idea and its developments: In a machine for forging drills, the combination of reciprocating forging dies with a chuck to be moved to or from said dies, and mechanism whereby the movements of the dies or other operating parts control the movement of the chuck; in an automatic feeding apparatus as described, a brake to intermittently arrest the movement of the feeding device.—No. 15906. October 7th, 1890. 8*d*.

ANNEALING COPPER.—*T. W. Johnson, London.*—This invention relates to improvements in the method and apparatus for annealing copper wire and sheets, and has for its object to dispense with the tedious and expensive operation known as "pickling," which has had heretofore to be practised, in order to obtain a clean product after the annealing of the wire. This operation was necessary owing to imperfections attached to the annealing stage of the process. The process and apparatus for the treatment of copper wire are described; the same description would apply to the treatment of copper sheets except that the pot of particular form employed would be long, instead of circular. The copper wire having first been drawn to the required size, is first soaked in water to render it more pliable for winding purposes, and is afterwards drained and placed in layers, coils, or otherwise, in a specially arranged pot. This pot consists of three concentric pots, fitting closely one within the other, and the first or outer one of which is preferably of iron, while the other two are preferably of copper. Each pot has its own lid or cover, the last two lids having an upturned edge, whilst the first has a bent-down rim. The three pots, commencing with the outermost, are successively shorter. The wire is placed in the inner pot until it is filled, and the lid is placed thereon and luted around its outer periphery against the inner periphery of the intermediate pot. The luting is mixed white lead and putty, coated with red lead and oil. The intermediate pot is filled up with fine burnt wood dust, and its lid is placed on, a further quantity of the same filling going between this lid and the last or outer lid. The whole is heated and maintained at a red heat for about an hour. Claims: The process and apparatus described, and any mere modification thereof.—No. 4132. March 7th, 1891. 6*d*.

SLIDE VALVES.—*J. Marshall & R. Wigram, both of Leeds.*—The inventors have for their object the arrangement of slide valve and cylinder ports in such a manner as to control the supply to and discharge from a pair of cylinders arranged side by side and working either as compound or as twin cylinders. The accompanying illustration shows in longitudinal section a pair of cylinders constructed according to this invention. The metal between the two cylinders is bored out to receive a liner A, and has formed in it recesses communicating with ports leading to the ends of the two cylinders, and a larger recess in the middle for the exhaust. This liner A has a number of round holes drilled in it, facing the recesses previously described. Within the liner A is fitted the main slide valve B, which is tubular, and so shaped as to constitute a number of pistons, each being provided with spring packing; and within this slide valve B is a tubular expansion valve C. The slide rod D attached to the slide valve B is tubular, and has within it the slide rod E of the expansion valve C; these slide rods D and E may be worked by any suitable means, such, for example, as eccentrics or cams. The steam pipe being connected with either end of the steam



chest, charges with steam the two end parts of the chest and the middle part of the expansion valve C, from whence it will be admitted by ports in the expansion valve, and similar ones in the main slide valve, and the drilled openings in the liner into the respective ends of the cylinders, as will be readily understood on reference to the illustration. Claims: In combination with a pair of parallel cylinders and their ports, a cylindrical tubular slide valve, with packed piston parts governing passages to the said ports; the combination with the valve described of a tubular expansion valve arranged within the tubular slide valve.—No. 9300. June 16th, 1890. 6*d*.

CHANGE WHEELS.—*A. Eli, London.* (*L. Whiton, New London, Connecticut.*)—This invention has for its object the improvement of "back-gearing," such as is commonly used in lathes and like machines for increasing power. This "back-gear" has generally consisted of a shaft located in the rear of the cone spindle, and having gears that may be thrown into and out of mesh with the fixed and loose gears on said spindle. According to this invention the several elementary parts of such gearing are concealed within a cone which has the driving belt upon it. The specification describes two forms of this apparatus. The first, in which the change from fast to slow, or *vice versâ*, is effected quickly, and by one movement, while the machine is stopped; and in the second the change is effected while the apparatus is in motion. According to the first modification the headstock of the lathe has journaled in it a spindle, upon which a cone pulley is mounted, which, under certain conditions, may be connected to or disconnected from the spindle. To the spindle is secured a gear wheel, and to the journal is fixed by means of a thimble a smaller gear wheel. A spindle is secured within the cone, and has eccentrically mounted upon it connected gear wheels to gear with the two before-mentioned gear wheels, and also a locking device engaging with teeth on the spindle; so that if the engaging portions are turned into gear the pulley and spindle rotate as a whole, but when disengaged the motion is imparted through the gear wheels and so produces the increased speed. There are four claims, including the combination of a suitably journaled spindle, a pulley loosely fitted thereon, and a fixed gear with concentrically arranged fixed gear wheels journaled eccentrically upon an adjacent shaft, such gear wheels being arranged to be thrown in and out of mesh by the partial rotation of the eccentric journal.—No. 15058. September 23rd, 1890. 8*d*.

CUT-OFF GEAR.—*J. Lumb, Elland, York.*—From a reciprocating steady motion obtained by any suitable means, such, for example, as an eccentric, the inventor obtains two reciprocating motions timed alternately, and having a quick and free return for cutting off the steam. Attached to the valve rods are two sliding bars mounted in juxtaposition and free to move longitudinally. A space is left between the said bars, and on their adjacent faces a notch is formed having an inclined edge and a toothed or undercut edge. In the space between the two bars, two spring members of a trigger piece are caused to reciprocate longitudinally by the steady motion obtained from the engine as before mentioned. At the outer ends of the spring pieces are provided teeth to engage with the notches of the sliding bars. The operation is as follows:—At about the end of the outward stroke of the trigger piece, the tooth piece at the end of one of the spring pieces will engage with the notch on one of the sliding bars, and draw it back and open the valve. A suitable catch falls into position and retains the bar in that position, and the spring piece is disengaged from the notch. This causes the other spring piece to engage with the notch on the other sliding bar, pushing it forward, and so opening the other valve. This second bar is retained by another catch in its open position. Upon the second outward movement of the trigger piece the tooth of the first spring piece will again engage with the first-mentioned bar, which has in the meantime returned into its "closed" position by means of springs or the like. This invention is especially applicable to cut-off valves of the "Rider" class, and by means of a modification is equally applicable to such valves as the "Corliss," "stamper," "grid," "crown," "plug," and others. Claims: Connecting to the valve rods, sliding bars having notches, which notches engage with spring members, moving longitudinally with a trigger piece, for the purposes shown and described.—No. 11279. July 3rd, 1890. 8*d*.

VALVE GEAR.—*H. F. G. Meltzer, Charlottenburg, Germany.*—This is an apparatus for actuating the valves of steam engines which differs from other valve gear, in which it is claimed that the cut-off can be varied at pleasure within the widest limits, and without a reaction on the governor taking place, and all the periods of taking steam can be varied independently of each other. The accompanying illustrations show in Fig. 1 a side

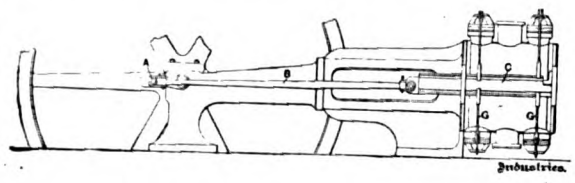


FIG. I.

elevation of an engine fitted with this valve gear, and Fig. 2 a large section taken through the cylinder. The crank shaft of the engine has a crank pin A connected by a rod B with a slide C, which is free to travel in guides, and is so arranged as to be situated at the dead centre at the same time as the engine piston. This slide C is made to actuate the supply and exhaust valves, and the operation is as follows:—The slide C has two inclined surfaces (see Fig. 2), each provided with two grooves D and E, D being deeper than E. Into the one or other of these grooves a stud F, attached to the end of a rod G, engages. The slide C is prevented from shifting in a longitudinal direction to the cylinder by suitable guides, but is free to move in a direction transverse to the cylinder. A spring H bears on the end of the rod G, and forces the stud F into one or other of the grooves, and according to whether the stud F be in the upper or lower will depend whether the exhaust valves are open or closed. Inclines, not shown in the figures, are provided, which act on

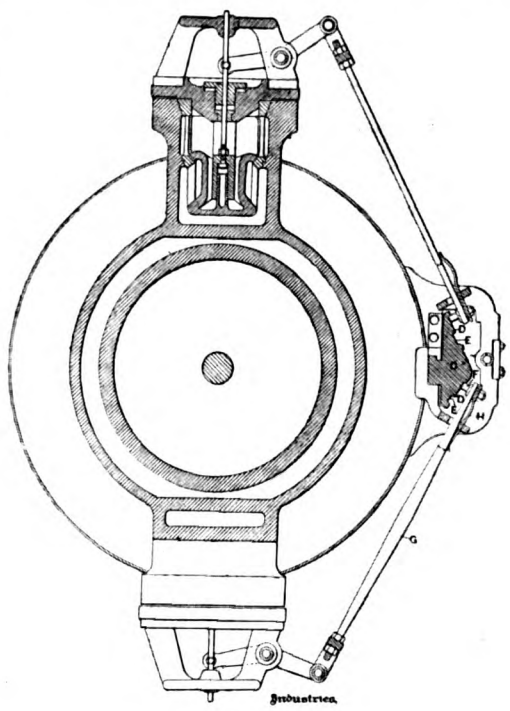


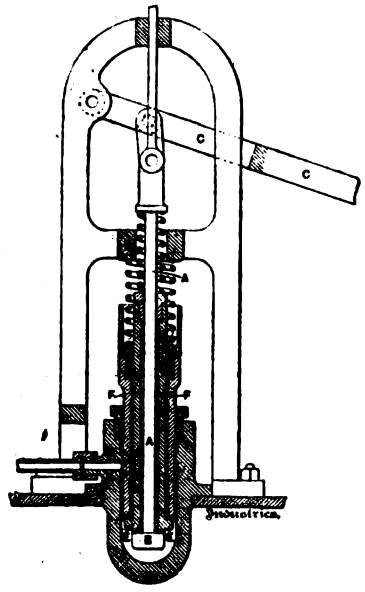
FIG. 2.

the stud F and force it up or down, and these are made adjustable. The adjustable inclined pieces are each attached to a rack, which racks are moved simultaneously in opposite directions by suitable gearing, or they may be automatically adjusted from the governor. Claims: Valve gear for steam engines, wherein rods that actuate the devices controlling the admission and discharge of the fluid pressure are provided, with studs which alternately gear with one or other of two grooves formed in a slide, which

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travels longitudinally synchronously with the engine piston; the said studs being made to pass from one groove to the other by inclines brought into contact by the alternating motion of the slide, and so move the valve rods and alternately open and close the valves.—No. 8415. May 30th, 1890. 8*d.*

PUMPS.—*C. Kingsford, Erith, Kent.*—This invention is stated to be particularly applicable to pumps where the resistance increases as the work proceeds, as, for example, when raising the ram of a hydraulic press. The inventor employs several plungers, arranged concentrically and controlled by springs, so that, as the work increases, the effective area of the pump plunger is automatically diminished. The accompanying figure shows in vertical section a pressure pump constructed according to this in-



vention. A is the central plunger having a head or flange B and worked by means of the lever C. A second plunger D surrounds the plunger A, and also has a head or flange E. A third plunger F surrounds the plunger D. The plunger F is arranged to slide upon D, and the plunger D upon the central plunger A, and suitable packing is arranged between them. Two helical springs bear upon the tops of the plungers F and D. The action is as follows:—When the lever C is worked the three plungers A, D, and F begin to descend together. As the resistance of the pump increases the plunger F will be held back by the pressure, and the effective area will be only that of the flanges of the two plungers A and D. As the resistance increases still more, D will be held back by the pressure, and the plunger A will act alone. Any number of concentric plungers may be employed, and the inventor describes numerous modifications for carrying this invention into effect. Claims: The application of springs to give motion to plungers of large area while the pressure is comparatively low, which plungers cease to act when the pressure equals the resistance of the springs, a plunger of less area continuing the operation; the various modifications and appliances described are also claimed.—No. 7667. May 16th, 1890. 8*d.*

ELECTRICITY.

ELECTRIC RAILWAYS.—*J. Bayly, London.* (*T. Evans, San Francisco.*)—This invention relates to that class of electric railways which have a current collector attached to the motor car, making electrical connection with an insulated underground conductor. The improvements relate to the underground tube and to the construction of the current collector. The underground tube has a slot along the top, through which the shank or carrying bar of the collector is passed; on the top or roof of the underground tube and at one side of the slot the conductor is secured, and between the slot and conductor, and extending along the tube, a depending apron or partition is fixed. This apron, when carried down a suitable distance, protects the conductor from mud, water, and dust. The current collector is mounted on a suitably shaped trolly or support to enable it to pass over the apron, and consists of a grooved or double-flanged wheel or wheels, mounted in, but insulated from, the end of the support, with suitable binding posts provided by means of which wires enclosed within the support can connect the contact wheels with the motor. Claim: The combination with the stationary conductor of a trolly, having wheels mounted in insulated boxes, and binding posts, with electrical connection to the contact wheels.—No. 10252. July 2nd, 1890. 8*d.*

OVERHEAD CONDUCTORS.—*Siemens Bros. & Co., London.* (*Siemens & Halske, Berlin.*)—In overhead conductors for tramcars, &c., difficulty has been found in maintaining good electrical contact, owing to the vertical oscillation of the vehicle or varying height of the conductor. This invention has for its object the removal of these difficulties. This is carried into effect as follows:—Instead of supporting the arms carrying the sliding contacts on the vehicle body, a longitudinal horizontal bearer is mounted on but insulated from the axle boxes on one or both sides of the vehicle, and has attached to it the upright conducting arms carrying the sliding contacts. As the conducting arms project above the vehicle, they may be connected at the top by a rod or otherwise suitably braced together. The inventors prefer that the sliding contacts should be made to extend across the vehicle so as to be supported on each side by the conducting arms. Another arrangement described consists of making the supports, whether they be attached to the car body or axle boxes, as before described, with a yielding or spring action so that they automatically adjust themselves to the vertical vibrations of the carriage or to variations in the height of the conductor. This is preferably carried out by making the contacts with a hinge joint at any convenient point, and having a spring or counterweight to tend to bring the upper portion into a vertical position. Where several arms are used they may be so connected by horizontal arms that they will be deflected together in parallelogrammatic form. Claims: Mounting the contacts of electric railways working with overhead conductors upon supports carried by, but insulated from, the axle boxes of the vehicle, so that the contacts are independent of the vertical oscillations of the vehicle body; constructing the supports of contacts with hinged joints, and acting thereon with springs or the like tending to bring them always into a vertical position.—No. 10743. July 10th, 1890. 8*d.*

ARMATURES.—*B. D. Southard, Chicago, U.S.A.*—This invention relates more particularly to that class of armatures for dynamos and motors known as the "Gramme" or cylinder armatures, in which wire is wound longitudinally upon the outer surface of a cylindrical core, returning through the interior of the latter, until the entire surface of the armature is covered with wire. A series of wires from the commutator are connected to the coil in various parts, so as to divide the latter into several coils in series. Should one of these coils burn or otherwise break down, it is a matter of great difficulty to unwind the coil from the cylinder, and replace the injured coil, and this invention is designed to remove this objection by so modifying the structure of the armature that the destructible portions being of uniform size, and therefore interchangeable, may be in the event of a breakdown quickly applied even by unskilled persons. Referring to the accompanying illus-

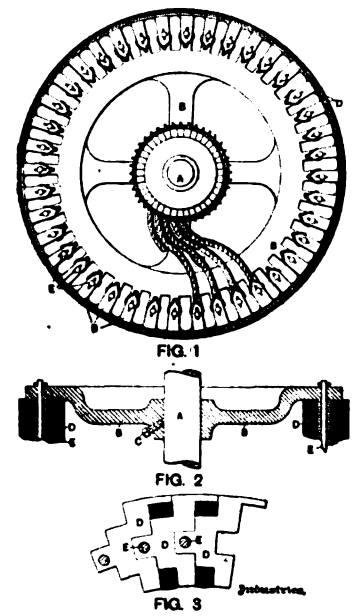


FIG. 1

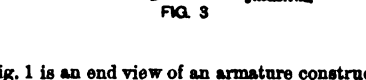


FIG. 2

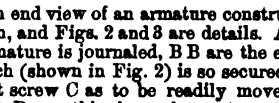


FIG. 3

trations, Fig. 1 is an end view of an armature constructed according to this invention, and Figs. 2 and 3 are details. A is the shaft upon which the armature is journaled, B B are the end plates or spiders, one of which (shown in Fig. 2) is so secured or clamped to the shaft by a set screw C as to be readily moved longitudinally if required; D D are thin iron plates stamped out in the form shown in Fig. 3, and secured together by rods E E, which pass also through the spiders B B at each end. By the plates D D being of the form shown, with projecting pieces fitting into corresponding recesses, they form when placed together a continuous cylindrical armature, of which any portion with its coil may be readily removed, by unscrewing the nuts on the rods E, and moving the spider along the spindle. Certain modifications in the form of the plates D are described, as well as the application of this invention to disc armatures. Claims: In armatures of the class described, the combination of a series of independently removable sections, suitably connected together in the form of a cylindrical core, divided longitudinally by joints between the sections for the purpose described.—No. 5135. March 23rd, 1891. 8*d.*

CHEMISTRY.

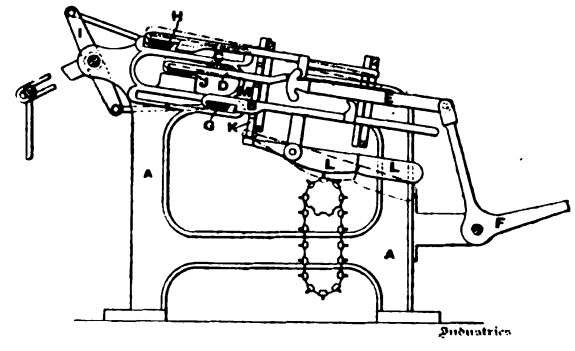
CHLORINE.—*W. P. Thompson, London.* (*F. Marx, Berlin.*)—This invention has for its object the electro-chemical formation of chlorine and chlorine compounds, especially producing protochloride of iron and perchloride of iron in the cheapest way possible. By this invention metals, alkalies, and lyes are produced as direct bye-products, and caustic lime, chloride of lime, and salts as indirect bye-products. Chlorine is obtained, in accordance with this invention, by electrolysis of metallic chlorides, which can be of two kinds: (1) Electrolitic decomposition of watery solutions of the metallic chlorides. The main product of this is chlorine, and the bye-products are the hydrated oxides of alkaline earths, and other earths, and from the remaining metallic chlorides the metals as such. (2) Electrolytic decomposition of melted metallic chlorides, or mixtures thereof, or double combinations of the same. The main product is chlorine, and the bye-products are metals or metallic alloys. Negative carbon electrodes should be used in the decomposition of alkaline chloride combinations in watery solution, and negative metallic electrodes in the decomposition of melted metallic chlorides; and, when possible, they should be of the metal which is obtained as a bye-product of the decomposition. The apparatus consists of decomposing cells under which a heating apparatus is placed, and having tight-closing covers, each with a pipe for conveying the chlorine away, and means for electrical connection. Claims: The process described for the manufacture of iron protochloride, iron perchloride, and chloride of lime, in which chlorine gas produced by means of electrolytes formed of metallic chloride compounds, or of a mixture of the same, are employed for the dissolving of iron and for the saturation of hydrate of lime; in the process described, the obtaining of metals, lyes, and alkalies as bye-products.—No. 19942A. December 6th, 1890. 8*d.*

MISCELLANEOUS.

LOCK NUTS.—*H. E. Newton, London.* (*A. Gross, Sydney.*)—Ordinary bolts may be adapted to this method of locking a nut thereon. This is done by making a groove or key-way longitudinally in the screwed part of the bolt, and of sufficient depth to allow of a locking appliance or key to repose in it without interfering with the passage of the nut. The groove has an enlarged cavity at its end, which should be beyond the screwed part, and into this cavity the bulbous end of the locking appliance fits. After the nut has been screwed down the projecting portion of the locking piece is turned over the nut. Claim: The device for locking nuts on bolts, consisting of a key formed with an enlarged or bulbous end in combination with a corresponding groove formed in the bolt, the key being of sufficient length to enable it to be turned over the nut.—No. 6486. April 15th, 1891. 6*d.*

WATER HEATER.—*W. Matthews & J. & W. Yates, all of Manchester.*—This invention has for its object the heating of water by means of steam, and the apparatus consists of a calorifier or closed vessel, into which steam is admitted, the steam, or preferably the water, being within a coil, so that there is no actual contact between the steam and the water. From the calorifier the heated water passes into a circulating cylinder, which is also a closed vessel, and from thence into the reserve tank or cistern. The hot water may be withdrawn from the pipes leading from the calorifier to the circulating chamber, and the water resulting from condensation of the steam in the calorifier by gravity, or when this is impracticable by means of a steam trap. Claims: The apparatus for heating water, constructed and arranged substantially as described in the specification.—No. 10851. July 12th, 1890. 6*d.*

LOOMS.—*J. Thomis & M. & J. Priestley, all of Bradford.*—This invention has for its object the construction of a machine for operating the healds and warp threads in looms, in such a manner that when healds or warp threads have been raised, and the pattern surface requires the same to remain up for one or more picks of the shuttle, they are held in the raised position until liberated by mechanism connected with the pattern surface. The accompanying illustration represents in side elevation a heald operating machine suitable to the present combination of draw bars, one side of the machine being removed for the sake of clearness. On the frame A of the machine are mounted a series of draw bars equal to the number of healds required by the pattern; each set of draw bars is composed of three bars, two of which, B and C, are for operating the centre bar D, which is hinged to bar E, the said bar E being connected to the healds by a bell crank lever F. The reciprocating draw knives G H are operated by a rocking lever I and connecting rods, and an additional bar J is provided for holding the centre bars D and the healds in an elevated position. The draw bars B, C, and D are operated by three projections on the needles K, which in turn are operated by



a lever L and a rotating lag cylinder M. When the healds are down forming the bottom of the "shed" the bars C, D, and E are back towards the centre of the machine, and if the healds are to remain down, no peg on the lag cylinder M will present itself to the respective lever L, which will then be in the position shown in dotted lines, and the needle or needles K will be lifted so that the draw bars are clear of draw knives G H, and by this means the healds remain at the bottom of the "shed." When the pattern requires a change in the position of the healds, a peg on the lag cylinder will raise the respective lever L, allowing a corresponding needle K to descend, and one of the draw bars B or C to engage with a draw knife G or H, by which the draw bar and the centre bar D will be operated in such direction that the healds connected therewith are raised, the centre bar D engaging with stationary bar J; and if the healds are to remain up the centre bar D will remain engaged with the bar J for so many picks of the shuttle as there are pegs in the lag cylinder, keeping the lever L in the position shown in full lines. Claims: The combination of draw bars B and C with a retaining bar D, and operating needles K, arranged in the manner described.—No. 10980. July 14th, 1890. 8*d.*

Copies of the British specifications may be obtained on application to SIR HENRY READER LACK, *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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